

# Megaplex-2100/2104

Modular Integrated Access Multiplexers

Version 12.9





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Installation and Operation Manual

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For further information contact RAD at the address below or contact your local distributor.

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RAD warrants to DISTRIBUTOR that the hardware in the Megaplex-2100/2104 to be delivered hereunder shall be free of defects in material and workmanship under normal use and service for a period of twelve (12) months following the date of shipment to DISTRIBUTOR.

If, during the warranty period, any component part of the equipment becomes defective by reason of material or workmanship, and DISTRIBUTOR immediately notifies RAD of such defect, RAD shall have the option to choose the appropriate corrective action: a) supply a replacement part, or b) request return of equipment to its plant for repair, or c) perform necessary repair at the equipment's location. In the event that RAD requests the return of equipment, each party shall pay one-way shipping costs.

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This Agreement shall be construed and governed in accordance with the laws of the State of Israel.

## Product Disposal



To facilitate the reuse, recycling and other forms of recovery of waste equipment in protecting the environment, the owner of this RAD product is required to refrain from disposing of this product as unsorted municipal waste at the end of its life cycle. Upon termination of the unit's use, customers should provide for its collection for reuse, recycling or other form of environmentally conscientious disposal.

## General Safety Instructions

The following instructions serve as a general guide for the safe installation and operation of telecommunications products. Additional instructions, if applicable, are included inside the manual.

### Safety Symbols



**Warning**

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This symbol may appear on the equipment or in the text. It indicates potential safety hazards regarding product operation or maintenance to operator or service personnel.

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Danger of electric shock! Avoid any contact with the marked surface while the product is energized or connected to outdoor telecommunication lines.

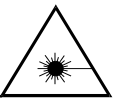
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Protective ground: the marked lug or terminal should be connected to the building protective ground bus.

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**Warning**

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Some products may be equipped with a laser diode. In such cases, a label with the laser class and other warnings as applicable will be attached near the optical transmitter. The laser warning symbol may be also attached.

Please observe the following precautions:

- Before turning on the equipment, make sure that the fiber optic cable is intact and is connected to the transmitter.
- Do not attempt to adjust the laser drive current.
- Do not use broken or unterminated fiber-optic cables/connectors or look straight at the laser beam.
- The use of optical devices with the equipment will increase eye hazard.
- Use of controls, adjustments or performing procedures other than those specified herein, may result in hazardous radiation exposure.

**ATTENTION:** The laser beam may be invisible!

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In some cases, the users may insert their own SFP laser transceivers into the product. Users are alerted that RAD cannot be held responsible for any damage that may result if non-compliant transceivers are used. In particular, users are warned to use only agency approved products that comply with the local laser safety regulations for Class 1 laser products.

Always observe standard safety precautions during installation, operation and maintenance of this product. Only qualified and authorized service personnel should carry out adjustment, maintenance or repairs to this product. No installation, adjustment, maintenance or repairs should be performed by either the operator or the user.

# Handling Energized Products

## General Safety Practices

Do not touch or tamper with the power supply when the power cord is connected. Line voltages may be present inside certain products even when the power switch (if installed) is in the OFF position or a fuse is blown. For DC-powered products, although the voltages levels are usually not hazardous, energy hazards may still exist.

Before working on equipment connected to power lines or telecommunication lines, remove jewelry or any other metallic object that may come into contact with energized parts.

Unless otherwise specified, all products are intended to be grounded during normal use. Grounding is provided by connecting the mains plug to a wall socket with a protective ground terminal. If a ground lug is provided on the product, it should be connected to the protective ground at all times, by a wire with a diameter of 18 AWG or wider. Rack-mounted equipment should be mounted only in grounded racks and cabinets.

Always make the ground connection first and disconnect it last. Do not connect telecommunication cables to ungrounded equipment. Make sure that all other cables are disconnected before disconnecting the ground.

Some products may have panels secured by thumbscrews with a slotted head. These panels may cover hazardous circuits or parts, such as power supplies. These thumbscrews should therefore always be tightened securely with a screwdriver after both initial installation and subsequent access to the panels.

## Connecting AC Mains

Make sure that the electrical installation complies with local codes.

Always connect the AC plug to a wall socket with a protective ground.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Always connect the power cord first to the equipment and then to the wall socket. If a power switch is provided in the equipment, set it to the OFF position. If the power cord cannot be readily disconnected in case of emergency, make sure that a readily accessible circuit breaker or emergency switch is installed in the building installation.

In cases when the power distribution system is IT type, the switch must disconnect both poles simultaneously.

## Connecting DC Power

Unless otherwise specified in the manual, the DC input to the equipment is floating in reference to the ground. Any single pole can be externally grounded.

Due to the high current capability of DC power systems, care should be taken when connecting the DC supply to avoid short-circuits and fire hazards.

Make sure that the DC power supply is electrically isolated from any AC source and that the installation complies with the local codes.

The maximum permissible current capability of the branch distribution circuit that supplies power to the product is 16A (20A for USA and Canada). The circuit breaker in the building installation should have high breaking capacity and must operate at short-circuit current exceeding 35A (40A for USA and Canada).

Before connecting the DC supply wires, ensure that power is removed from the DC circuit. Locate the circuit breaker of the panel board that services the equipment and switch it to the OFF position. When connecting the DC supply wires, first connect the ground wire to the corresponding terminal, then the positive pole and last the negative pole. Switch the circuit breaker back to the ON position.

A readily accessible disconnect device that is suitably rated and approved should be incorporated in the building installation.

If the DC power supply is floating, the switch must disconnect both poles simultaneously.

## Connecting Data and Telecommunications Cables

Data and telecommunication interfaces are classified according to their safety status.

The following table lists the status of several standard interfaces. If the status of a given port differs from the standard one, a notice will be given in the manual.

Ports	Safety Status
V.11, V.28, V.35, V.36, RS-530, X.21, 10 BaseT, 100 BaseT, Unbalanced E1, E2, E3, STM, DS-2, DS-3, S-Interface ISDN, Analog voice E&M	SELV Safety Extra Low Voltage: Ports which do not present a safety hazard. Usually up to 30 VAC or 60 VDC.
xDSL (without feeding voltage), Balanced E1, T1, Sub E1/T1	TNV-1 Telecommunication Network Voltage-1: Ports whose normal operating voltage is within the limits of SELV, on which overvoltages from telecommunications networks are possible.
FXS (Foreign Exchange Subscriber)	TNV-2 Telecommunication Network Voltage-2: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are not possible. These ports are not permitted to be directly connected to external telephone and data lines.
FXO (Foreign Exchange Office), xDSL (with feeding voltage), U-Interface ISDN	TNV-3 Telecommunication Network Voltage-3: Ports whose normal operating voltage exceeds the limits of SELV (usually up to 120 VDC or telephone ringing voltages), on which overvoltages from telecommunication networks are possible.

**Always connect a given port to a port of the same safety status. If in doubt, seek the assistance of a qualified safety engineer.**

Always make sure that the equipment is grounded before connecting telecommunication cables. Do not disconnect the ground connection before disconnecting all telecommunications cables.

Some SELV and non-SELV circuits use the same connectors. Use caution when connecting cables. Extra caution should be exercised during thunderstorms.

When using shielded or coaxial cables, verify that there is a good ground connection at both ends. The grounding and bonding of the ground connections should comply with the local codes.

The telecommunication wiring in the building may be damaged or present a fire hazard in case of contact between exposed external wires and the AC power lines. In order to reduce the risk, there are restrictions on the diameter of wires in the telecom cables, between the equipment and the mating connectors.

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**Caution**

To reduce the risk of fire, use only No. 26 AWG or larger telecommunication line cords.

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**Attention**

Pour réduire les risques s'incendie, utiliser seulement des conducteurs de télécommunications 26 AWG ou de section supérieure.

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Some ports are suitable for connection to intra-building or non-exposed wiring or cabling only. In such cases, a notice will be given in the installation instructions.

Do not attempt to tamper with any carrier-provided equipment or connection hardware.

## Electromagnetic Compatibility (EMC)

The equipment is designed and approved to comply with the electromagnetic regulations of major regulatory bodies. The following instructions may enhance the performance of the equipment and will provide better protection against excessive emission and better immunity against disturbances.

A good ground connection is essential. When installing the equipment in a rack, make sure to remove all traces of paint from the mounting points. Use suitable lock-washers and torque. If an external grounding lug is provided, connect it to the ground bus using braided wire as short as possible.

The equipment is designed to comply with EMC requirements when connecting it with unshielded twisted pair (UTP) cables. However, the use of shielded wires is always recommended, especially for high-rate data. In some cases, when unshielded wires are used, ferrite cores should be installed on certain cables. In such cases, special instructions are provided in the manual.

Disconnect all wires which are not in permanent use, such as cables used for one-time configuration.

The compliance of the equipment with the regulations for conducted emission on the data lines is dependent on the cable quality. The emission is tested for UTP with 80 dB longitudinal conversion loss (LCL).

Unless otherwise specified or described in the manual, TNV-1 and TNV-3 ports provide secondary protection against surges on the data lines. Primary protectors should be provided in the building installation.

The equipment is designed to provide adequate protection against electro-static discharge (ESD). However, it is good working practice to use caution when connecting cables terminated with plastic connectors (without a grounded metal hood, such as flat cables) to sensitive data lines. Before connecting such cables, discharge yourself by touching ground or wear an ESD preventive wrist strap.



## FCC-15 User Information

This equipment has been tested and found to comply with the limits of the Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the Installation and Operation manual, may cause harmful interference to the radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

## Canadian Emission Requirements

This Class A digital apparatus meets all the requirements of the Canadian Interference-Causing Equipment Regulation.

Cet appareil numérique de la classe A respecte toutes les exigences du Règlement sur le matériel brouilleur du Canada.

## Warning per EN 55022 (CISPR-22)

**Warning**

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This is a class A product. In a domestic environment, this product may cause radio interference, in which case the user will be required to take adequate measures.

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**Avertissement**

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Cet appareil est un appareil de Classe A. Dans un environnement résidentiel, cet appareil peut provoquer des brouillages radioélectriques. Dans ces cas, il peut être demandé à l'utilisateur de prendre les mesures appropriées.

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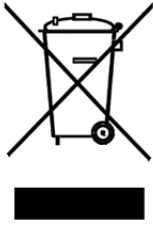
**Achtung**

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Das vorliegende Gerät fällt unter die Funkstörgrenzwertklasse A. In Wohngebieten können beim Betrieb dieses Gerätes Rundfunkstörungen auftreten, für deren Behebung der Benutzer verantwortlich ist.

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## Mise au rebut du produit



Afin de faciliter la réutilisation, le recyclage ainsi que d'autres formes de récupération d'équipement mis au rebut dans le cadre de la protection de l'environnement, il est demandé au propriétaire de ce produit RAD de ne pas mettre ce dernier au rebut en tant que déchet municipal non trié, une fois que le produit est arrivé en fin de cycle de vie. Le client devrait proposer des solutions de réutilisation, de recyclage ou toute autre forme de mise au rebut de cette unité dans un esprit de protection de l'environnement, lorsqu'il aura fini de l'utiliser.

## Instructions générales de sécurité

Les instructions suivantes servent de guide général d'installation et d'opération sécurisées des produits de télécommunications. Des instructions supplémentaires sont éventuellement indiquées dans le manuel.

## Symboles de sécurité



**Avertissement**

Ce symbole peut apparaître sur l'équipement ou dans le texte. Il indique des risques potentiels de sécurité pour l'opérateur ou le personnel de service, quant à l'opération du produit ou à sa maintenance.



Danger de choc électrique ! Evitez tout contact avec la surface marquée tant que le produit est sous tension ou connecté à des lignes externes de télécommunications.



Mise à la terre de protection : la cosse ou la borne marquée devrait être connectée à la prise de terre de protection du bâtiment.



Certains produits peuvent être équipés d'une diode laser. Dans de tels cas, une étiquette indiquant la classe laser ainsi que d'autres avertissements, le cas échéant, sera jointe près du transmetteur optique. Le symbole d'avertissement laser peut aussi être joint.

Veillez observer les précautions suivantes :

- Avant la mise en marche de l'équipement, assurez-vous que le câble de fibre optique est intact et qu'il est connecté au transmetteur.
- Ne tentez pas d'ajuster le courant de la commande laser.
- N'utilisez pas des câbles ou connecteurs de fibre optique cassés ou sans terminaison et n'observez pas directement un rayon laser.
- L'usage de périphériques optiques avec l'équipement augmentera le risque pour les yeux.
- L'usage de contrôles, ajustages ou procédures autres que celles spécifiées ici pourrait résulter en une dangereuse exposition aux radiations.

**ATTENTION : Le rayon laser peut être invisible !**

Les utilisateurs pourront, dans certains cas, insérer leurs propres émetteurs-récepteurs Laser SFP dans le produit. Les utilisateurs sont avertis que RAD ne pourra pas être tenue responsable de tout dommage pouvant résulter de l'utilisation d'émetteurs-récepteurs non conformes. Plus particulièrement, les utilisateurs sont avertis de n'utiliser que des produits approuvés par l'agence et conformes à la réglementation locale de sécurité laser pour les produits laser de classe 1.

Respectez toujours les précautions standards de sécurité durant l'installation, l'opération et la maintenance de ce produit. Seul le personnel de service qualifié et autorisé devrait effectuer l'ajustage, la maintenance ou les réparations de ce produit. Aucune opération d'installation, d'ajustage, de maintenance ou de réparation ne devrait être effectuée par l'opérateur ou l'utilisateur.

## Manipuler des produits sous tension

### Règles générales de sécurité

Ne pas toucher ou altérer l'alimentation en courant lorsque le câble d'alimentation est branché. Des tensions de lignes peuvent être présentes dans certains produits, même lorsque le commutateur (s'il est installé) est en position OFF ou si le fusible est rompu. Pour les produits alimentés par CC, les niveaux de tension ne sont généralement pas dangereux mais des risques de courant peuvent toujours exister.

Avant de travailler sur un équipement connecté aux lignes de tension ou de télécommunications, retirez vos bijoux ou tout autre objet métallique pouvant venir en contact avec les pièces sous tension.

Sauf s'il en est autrement indiqué, tous les produits sont destinés à être mis à la terre durant l'usage normal. La mise à la terre est fournie par la connexion de la fiche principale à une prise murale équipée d'une borne protectrice de mise à la terre. Si une cosse de mise à la terre est fournie avec le produit, elle devrait être connectée à tout moment à une mise à la terre de protection par un conducteur de diamètre 18 AWG ou plus. L'équipement monté en châssis ne devrait être monté que sur des châssis et dans des armoires mises à la terre.

Branchez toujours la mise à la terre en premier et débranchez-la en dernier. Ne branchez pas des câbles de télécommunications à un équipement qui n'est pas mis à la terre. Assurez-vous que tous les autres câbles sont débranchés avant de déconnecter la mise à la terre.

## Connexion au courant du secteur

Assurez-vous que l'installation électrique est conforme à la réglementation locale.

Branchez toujours la fiche de secteur à une prise murale équipée d'une borne protectrice de mise à la terre.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Branchez toujours le câble d'alimentation en premier à l'équipement puis à la prise murale. Si un commutateur est fourni avec l'équipement, fixez-le en position OFF. Si le câble d'alimentation ne peut pas être facilement débranché en cas d'urgence, assurez-vous qu'un coupe-circuit ou un disjoncteur d'urgence facilement accessible est installé dans l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si le système de distribution de courant est de type IT.

## Connexion d'alimentation CC

Sauf s'il en est autrement spécifié dans le manuel, l'entrée CC de l'équipement est flottante par rapport à la mise à la terre. Tout pôle doit être mis à la terre en externe.

A cause de la capacité de courant des systèmes à alimentation CC, des précautions devraient être prises lors de la connexion de l'alimentation CC pour éviter des courts-circuits et des risques d'incendie.

Assurez-vous que l'alimentation CC est isolée de toute source de courant CA (secteur) et que l'installation est conforme à la réglementation locale.

La capacité maximale permissible en courant du circuit de distribution de la connexion alimentant le produit est de 16A (20A aux Etats-Unis et Canada). Le coupe-circuit dans l'installation du bâtiment devrait avoir une capacité élevée de rupture et devrait fonctionner sur courant de court-circuit dépassant 35A (40A aux Etats-Unis et Canada).

Avant la connexion des câbles d'alimentation en courant CC, assurez-vous que le circuit CC n'est pas sous tension. Localisez le coupe-circuit dans le tableau desservant l'équipement et fixez-le en position OFF. Lors de la connexion de câbles d'alimentation CC, connectez d'abord le conducteur de mise à la terre à la borne correspondante, puis le pôle positif et en dernier, le pôle négatif. Remettez le coupe-circuit en position ON.

Un disjoncteur facilement accessible, adapté et approuvé devrait être intégré à l'installation du bâtiment.

Le disjoncteur devrait déconnecter simultanément les deux pôles si l'alimentation en courant CC est flottante.

## Glossary

<b>Address</b>	A coded representation of the origin or destination of data.
<b>Agent</b>	In SNMP, this refers to the managed system.
<b>Alternate Routing</b>	In switching, alternate routing is the choice of the next-best path when the best path is blocked.
<b>Analog</b>	A continuous wave or signal (such as human voice).
<b>ANSI</b>	American National Standards Institute.
<b>Attenuation</b>	Signal power loss through equipment, lines or other transmission devices. Measured in decibels.
<b>AWG</b>	The American Wire Gauge System, which specifies wire width.
<b>Balanced</b>	A transmission line in which voltages on the two conductors are equal in magnitude, but opposite in polarity, with respect to ground.
<b>Bandwidth</b>	The range of frequencies passing through a given circuit. The greater the bandwidth, the more information can be sent through the circuit in a given amount of time.
<b>Baud</b>	Unit of signaling speed equivalent to the number of discrete conditions or events per second. If each signal event represents only one bit condition, baud rate equals bps (bits per second).
<b>Bipolar</b>	Signaling method in E1/T1 representing a binary "1" by alternating positive and negative pulses, and a binary "0" by absence of pulses.
<b>Bit</b>	The smallest unit of information in a binary system. Represents either a one or zero ("1" or "0").
<b>Bridge</b>	A device interconnecting local area networks at the OSI data link layer, filtering and forwarding frames according to media access control (MAC) addresses.
<b>Buffer</b>	A storage device. Commonly used to compensate for differences in data rates or event timing when transmitting from one device to another. Also used to remove jitter.
<b>Bus</b>	A transmission path or channel. A bus is typically an electrical connection with one or more conductors, where all attached devices receive all transmissions at the same time.
<b>Byte</b>	A group of bits (normally 8 bits in length).
<b>Carrier</b>	A continuous signal at a fixed frequency that is capable of being modulated with a second (information carrying) signal.
<b>Channel</b>	A path for electrical transmission between two or more points. Also called a link, line, circuit or facility.

<b>Channel Bank</b>	Equipment that connects multiple voice channels to high speed links by performing voice digitization and time division multiplexing. Voice is converted to a 64 kbps signal (24 channels into 1.544 Mbps in countries offering T1 services, such as the U.S.A.; 30 channels into 2.048 Mbps in countries offering E1 services, such as in Europe).
<b>Clock</b>	A term for the source(s) of timing signals used in synchronous transmission.
<b>Compression</b>	Any of several techniques that reduce the number of bits required to represent information in data transmission or storage, thereby conserving bandwidth and/or memory.
<b>Congestion</b>	A state in which the network is overloaded and starts to discard user data (frames, cells or packets).
<b>Control Signals</b>	Signals passing between one part of a communications system and another (such as RTS, DTR, or DCD), as part of a mechanism for controlling the system.
<b>Data</b>	Information represented in digital form, including voice, text, facsimile and video.
<b>dBm</b>	A measure of power in communications: the decibel in reference to one milliwatt (0 dBm = 1 milliwatt and -30 dBm = .001 milliwatt).
<b>Diagnostics</b>	The detection and isolation of a malfunction or mistake in a communications device, network or system.
<b>Digital</b>	The binary ("1" or "0") output of a computer or terminal. In data communications, an alternating, non-continuous (pulsating) signal.
<b>E1 Line</b>	A 2.048 Mbps line, common in Europe, that supports thirty-two 64 kbps channels, each of which can transmit and receive data or digitized voice. The line uses framing and signaling to achieve synchronous and reliable transmission. The most common configurations for E1 lines are E1 PRI, and unchanneled E1.
<b>E&amp;M Signaling</b>	Voice transmission system that uses separate paths for signaling and voice. The "M" lead (mouth) transmits signals to the remote end of the circuit while the "E" lead (ear) receives incoming signals.
<b>Encapsulation</b>	Encapsulating data is a technique used by layered protocols in which a low level protocol accepts a message from a higher level protocol, then places it in the data portion of the lower-level frame. The logistics of encapsulation require that packets traveling over a physical network contain a sequence of headers.
<b>Equalizer</b>	A device that compensates for distortion due to signal attenuation and propagation time with respect to frequency. It reduces the effects of amplitude, frequency and/or phase distortion.
<b>Ethernet</b>	A local area network (LAN) technology which has extended into the wide area networks. Ethernet operates at many speeds, including data rates of 10 Mbps (Ethernet), 100 Mbps (Fast Ethernet), 1,000 Mbps (Gigabit Ethernet), 10 Gbps, 40 Gbps, and 100 Gbps.
<b>Flow Control</b>	A congestion control mechanism that results in an ATM system implementing flow control.

<b>Frame</b>	A logical grouping of information sent as a link-layer unit over a transmission medium. The terms packet, datagram, segment, and message are also used to describe logical information groupings.
<b>Frame Relay</b>	An efficient packet switching technology providing high speed frame or packet transmission with minimum delay and efficient bandwidth utilization over virtual circuits. The link layer handles much of the network layer functionality. It has less protocol overhead than X.25.
<b>Framing</b>	At the physical and data link layers of the OSI model, bits are fit into units called frames. Frames contain source and destination information, flags to designate the start and end of the frame, plus information about the integrity of the frame. All other information, such as network protocols and the actual payload of data, is encapsulated in a packet, which is encapsulated in the frame.
<b>Full Duplex</b>	A circuit or device permitting transmission in two directions (sending and receiving) at the same time.
<b>G.703</b>	An ITU standard for the physical and electrical characteristics of various digital interfaces, including those at 64 kbps and 2.048 Mbps.
<b>Gateway</b>	Gateways are points of entrance and exit from a communications network. Viewed as a physical entity, a gateway is that node that translates between two otherwise incompatible networks or network segments. Gateways perform code and protocol conversion to facilitate traffic between data highways of differing architecture.
<b>Ground Start</b>	A signaling method in which the customer premises equipment (CPE) transmits an off-hook condition by creating a zero-voltage condition.
<b>IEEE C37.94</b>	A standard providing plug-and-play transparent communications between different manufacturer's Teleprotection and multiplexer devices using multimode optical fiber. The standard defines clock recovery, jitter tolerances, physical connection method, and the equipment-failure actions for all communications link failures.
<b>Impedance</b>	The combined effect of resistance, inductance and capacitance on a transmitted signal. Impedance varies at different frequencies.
<b>In-Band Signaling</b>	The transmission of signaling information over the same path as data and/or voice information. Another term for in-band signaling is robbed-bit signaling. Robbed-bit refers to the 8 kbps of each channel used for signaling.
<b>Interface</b>	A shared boundary, defined by common physical interconnection characteristics, signal characteristics, and meanings of exchanged signals.
<b>IP Address</b>	Also known as an Internet address. A unique string of numbers that identifies a computer or device on a TCP/IP network. The format of an IP address is a 32-bit numeric address written as four numbers from 0 to 255, separated by periods (for example, 1.0.255.123).
<b>Jitter</b>	The deviation of a transmission signal in time or phase. It can introduce errors and loss of synchronization in high speed synchronous communications.

<b>Laser</b>	A device that transmits an extremely narrow and coherent beam of electromagnetic energy in the visible light spectrum. Used as a light source for fiber optic transmission (generally more expensive, shorter lived, single mode only, for greater distances than LED).
<b>Latency</b>	The time between initiating a request for data and the beginning of the actual data transfer. Network latency is the delay introduced when a packet is momentarily stored, analyzed and then forwarded.
<b>Leased Line</b>	A permanent telephone connection between two points that is rented for exclusive use from a telecommunications common carrier. In contrast to a normal dial-up connection, a leased line is always active. Typically, the highest speed data connections require a leased line connection. For example, a T1 channel is a type of leased line that provides a maximum transmission speed of 1.544 Mbps.
<b>Line Driver</b>	A signal converter which conditions a digital signal to ensure reliable transmission over an extended distance.
<b>Loading</b>	The addition of inductance to a line in order to minimize amplitude distortion. Used commonly on public telephone lines to improve voice quality, it can make the lines impassable to high speed data, and baseband modems.
<b>Loopback</b>	A type of diagnostic test in which the transmitted signal is returned to the sending device after passing through all or part of a communications link or network.
<b>Manager</b>	An application that receives Simple Network Management Protocol (SNMP) information from an agent. An agent and manager share a database of information, called the Management Information Base (MIB). An agent can use a message called a traps-PDU to send unsolicited information to the manager. A manager that uses the RADview MIB can query the RAD device, set parameters, sound alarms when certain conditions appear, and perform other administrative tasks.
<b>Mark</b>	In telecommunications, this means the presence of a signal. A mark is equivalent to a binary 1. A mark is the opposite of a space (0).
<b>Master Clock</b>	The source of timing signals (or the signals themselves) that all network stations use for synchronization.
<b>Metering</b>	This feature is intended for support of payphones, and therefore includes dedicated circuits for the detection of polarity and of 16 kHz or 12 kHz metering pulses.
<b>Modular</b>	Modular interfaces enable field-changeable conversion.
<b>Multidrop</b>	A communications configuration in which multiple devices share a common transmission facility (or multipoint line), although generally only one may transmit at a time. Usually used with some kind of polling mechanism to address each connected terminal with a unique address code.
<b>Multimode Fiber</b>	A fiber with a large core diameter; 50-200 microns compared with the wavelength of light. It therefore propagates more than one mode. With multimode fiber, light traverses multiple paths, some longer than others. This leads to dispersion, which reduces optical range.




<b>Multiplexer</b>	At one end of a communications link, a device that combines several lower speed transmission channels into a single high speed channel. A multiplexer at the other end reverses the process. Sometimes called a mux.
<b>Network</b>	(1) An interconnected group of nodes. (2) A series of points, nodes, or stations connected by communications channels; the collection of equipment through which connections are made between data stations.
<b>Node</b>	A point of interconnection to a network.
<b>Off-Hook</b>	A state that results when you lift a telephone receiver, producing a busy signal.
<b>Omnibus</b>	Instant multi-party voice communications between distant operators in a non-service-intrusive fashion.
<b>On-Hook</b>	A state that results when the telephone receiver is in place. No loop current flows and the switch recognizes that the telephone is available for incoming calls.
<b>Packet</b>	An ordered group of data and control signals transmitted through a network, as a subset of a larger message.
<b>Packet Switching</b>	A data transmission technique, which divides user information into discrete data envelopes called packets, and sends the information packet by packet.
<b>Parameters</b>	Parameters are often called arguments, and the two words are used interchangeably. However, some computer languages such as C define argument to mean actual parameter (i.e., the value), and parameter to mean formal parameter. In RAD CLI, parameter means formal parameter, not value.
<b>Payload</b>	The 48-byte segment of the ATM cell containing user data. Any adaptation of user data via the AAL will take place within the payload.
<b>Polling</b>	See <b>Multidrop</b> .
<b>Port</b>	The physical interface to a computer or multiplexer, for connection of terminals and modems.
<b>prompt</b>	One or more characters in a command line interface to indicate that the computer is ready to accept typed input.
<b>Protocol</b>	A formal set of conventions governing the formatting and relative timing of message exchange between two communicating systems.
<b>Register</b>	A storage device capable of receiving and holding a number of digits.
<b>Reverse Polarity</b>	Signaling call answer and disconnect status is often a problem on analog voice circuits (FXO). When circuits supporting reverse polarity are available, the signaling problem can be solved by sensing reverse polarity and toggling the status of the signaling bits appropriately.

<b>Router</b>	An interconnection device that connects individual LANs. Unlike bridges, which logically connect at OSI Layer 2, routers provide logical paths at OSI Layer 3. Like bridges, remote sites can be connected using routers over dedicated or switched lines to create WANs.
<b>Routing</b>	The process of selecting the most efficient circuit path for a message.
<b>Satellite Link</b>	A microwave link that uses a satellite to receive and retransmit signals. Uses a geosynchronous orbit to keep a satellite above a fixed position on the equator.
<b>Sharing Device</b>	A device that enables sharing of a single resource (modem, mux or computer port) among several devices (terminals, controllers or modems).
<b>Space</b>	In telecommunications, the absence of a signal. Equivalent to a binary 0.
<b>Sub-Rate Multiplexing</b>	In the U.S. this refers generally to time division multiplexing at data rates less than 64 kbps.
<b>T1</b>	A digital transmission link with a capacity of 1.544 Mbps used in North America. Typically channelized into 24 DS0s, each capable of carrying a single voice conversation or data stream. Uses two pairs of twisted pair wires.
<b>Teleprotection</b>	Transmission of protection commands in high voltage grids of electricity. IEEE C37.94 is a standard for interfacing between Teleprotection equipment and communications devices.
<b>Telnet</b>	The virtual terminal protocol in the Internet suite of protocols. It lets users on one host access another host and work as terminal users of that remote host. Instead of dialing into the computer, the user connects to it over the Internet using Telnet. When issuing a Telnet session, it connects to the Telnet host and logs in. The connection enables the user to work with the remote machine as though a terminal was connected to it.
<b>TFTP (Trivial File Transfer Protocol)</b>	A simplified version of the File Transfer Protocol that transfers files but does not provide password protection or user-directory capability.
<b>Throughput</b>	The amount of information transferred through the network between two users in a given period, usually measured in the number of packets per second (pps).
<b>Timeslot</b>	A portion of a serial multiplex of timeslot information dedicated to a single channel. In E1 and T1, one timeslot typically represents one 64 kbps channel.
<b>Trunk</b>	A single circuit between two points, both of which are switching centers or individual distribution points. A trunk usually handles many channels simultaneously.

<b>Voice Compression</b>	Newer voice compression algorithms try to model 64 kpbs PCM (G.711) more efficiently using fewer bits to reduce the bandwidth required, while preserving the quality or audibility of the voice transmission. Vendors such as RAD support low bit rate voice compression algorithms such as ITU G.723.1 and G.729A to permit the greatest number of simultaneous multiple calls while maintaining high quality voice. In this way, compressed voice systems can offer greater bandwidth savings, reduced network congestion and high quality voice transmissions.
<b>Zero suppression</b>	Technique used to ensure a minimum density of marks.



## Declaration of Conformity

<b>Manufacturer's Name:</b>	RAD Data Communications Ltd.	
<b>Manufacturer's Address:</b>	24 Raoul Wallenberg St., Tel Aviv 69719, Israel	
	declares that the product:	
<b>Product Name:</b>	Megaplex-2100	
<b>Product Options:</b>	All	
	conforms to the following standard(s) or other normative document(s):	
<b>EMC</b>	EN 55022:2010	Information technology equipment; Radio disturbance characteristics; Limits and methods of measurement.
	EN 55024:2010	Information technology equipment; Immunity characteristics; Limits and methods of measurement.
	EN 61000-3-2:2006	Electromagnetic compatibility (EMC); Section 3-2: Limits for harmonic current emissions (equipment input current 16A per phase)
	EN 61000-3-3:2008	Electromagnetic compatibility (EMC); Section 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16A$ per phase and not subject to conditional connection.
<b>Safety</b>	EN 60950-1:2006 + A11:2009, A1:2010 + A12:2011	Information technology equipment; Safety - Part 1: General requirements.
<b>Supplementary Information:</b>	The product herewith complies with the requirements of the EMC Directive 2004/108/EC, the Low Voltage Directive 2006/95/EC, the R&TTE Directive 99/5/EC for wired equipment and the ROHS Directive 2011/65/EU. The product was tested in a typical configuration.	
	Tel Aviv, 1 January 2013	
	 Nathaniel Shomroni Homologation Team Leader	
<b>European Contact:</b>	RAD Data Communications GmbH Otto-Hahn-Str. 28-30, D-85521 Ottobrunn-Riemerling, Germany	



## Declaration of Conformity

<b>Manufacturer's Name:</b>	RAD Data Communications Ltd.	
<b>Manufacturer's Address:</b>	24 Raoul Wallenberg St., Tel Aviv 69719, Israel	
	declares that the product:	
<b>Product Name:</b>	Megaplex-2104	
<b>Product Options:</b>	All	
	conforms to the following standard(s) or other normative document(s):	
<b>EMC</b>	EN 55022:2010	Information technology equipment; Radio disturbance characteristics; Limits and methods of measurement.
	EN 55024:2010	Information technology equipment; Immunity characteristics; Limits and methods of measurement.
	EN 61000-3-2:2006	Electromagnetic compatibility (EMC); Section 3-2: Limits for harmonic current emissions (equipment input current 16A per phase)
	EN 61000-3-3:2008	Electromagnetic compatibility (EMC); Section 3-3: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current $\leq 16A$ per phase and not subject to conditional connection.
<b>Safety</b>	EN 60950-1:2006 + A11:2009, A1:2010 + A12:2011	Information technology equipment; Safety - Part 1: General requirements.
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	Tel Aviv, 1 January 2013	
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# Quick Start Guide

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If you are familiar with the Megaplex, use this guide to prepare it for operation.

## Preliminary Preparations

1. Before turning the Megaplex on, set section 1 of the switch located on the front panels of the CL modules to ON. Set all the other sections to OFF.
2. Connect the Megaplex to power, and turn it on.
3. Connect the communication port of a PC running a terminal emulation program to the CONTROL-DCE connector of the CL module (use a straight cable). Configure the PC for 9600 bps, eight data bits, no parity, and one stop bit.
4. Press the **<Enter>** key several times in sequence: you should see the Megaplex prompt. If you see **PASSWORD>**, press **<Enter>** to obtain the prompt.

## General Configuration Procedure

Perform the following actions in the order given below.

Step	Action	Use the Command
1	Reset the database to the default parameters	<b>DB INIT</b>
2	Define terminal control codes	<b>DEF TERM</b>
3	Define control port characteristics	<b>DEF SP</b> <b>DEF SP CON2</b>
4	Set Megaplex system time and date	<b>TIME</b> <b>DATE</b>
5	Define system characteristics. Make sure to select <b>V5.2 APP = NONE</b> .	<b>DEF SYS</b>
6	Define the signaling profiles	<b>DEF PROFILE</b>
7	Configure each module and channel, starting with main link ports	<b>DEF CH</b>
8	If necessary, configure static routes for HS-ETH/SW and ML-IP modules	<b>ADD ROUTE</b>

Step	Action	Use the Command
9	Define the TDMoIP configuration parameters (only for MP-2100/2104 with ML-IP modules). <ul style="list-style-type: none"> <li>Configure ML-IP external (LAN) port parameters</li> <li>Configure ML-IP internal TDM port parameters</li> <li>Configure timeslot bundles</li> </ul>	<b>DEF CH CC:EX[1 or 2 or 3]</b> <b>DEF CH CC:IN[1 or 2]</b> <b>ADD BND</b>
10	Configure the timeslot routing (including split timeslot utilization) for each channel, including routing to bundles defined on ML-IP modules	<b>DEF TS</b> <b>DEF SPLIT TS</b>
11	Define the general system parameters	<b>DEF AGENT</b> <b>DEF MMI</b> <b>DEF PWD</b>
12	Define the list of SNMP management stations to receive traps from this Megaplex unit	<b>ADD MANAGER LIST</b>
13	Define the list of other management agents for which routes will be learned using the RIP2 protocol	<b>ADD RIP2 AGENT</b>
14	Define IP filtering parameters (for SNMP and Telnet management)	<b>ADD NET ENTRY</b>
15	Define the flip data database parameters: <ul style="list-style-type: none"> <li>Enable flip broadcasting</li> <li>Define the flip activation delay</li> <li>Define flip events (up to 10): <ul style="list-style-type: none"> <li>Time events</li> <li>Failure events</li> </ul> </li> <li>Define flip entries (up to 10)</li> <li>Select the default configuration database</li> <li>Save and activate the new flip database</li> </ul> <p><b>Notes:</b></p> <ol style="list-style-type: none"> <li>To update all the Megaplex units in the network, use on each Megaplex the FLIP NET UPD command.</li> <li>To activate the updated flip database, use on each Megaplex the FLIP NET GO command</li> </ol>	<b>DEF FLIP BROADCAST</b> <b>DEF NET DELAY</b>  <b>DEF AGENDA</b> <b>ADD FLIP EVENT</b> <b>ADD FLIP ENTRY</b> <b>DEF DEFAULT DB</b> <b>FLIP UPD</b>
16	Define alarm handling parameters: <ul style="list-style-type: none"> <li>Alarm reporting policy</li> <li>Alarm filtering</li> <li>Alarm processing</li> </ul>	<b>DEF AP</b> <b>DEF AR</b>  <b>DEF AW</b> <b>DEF AF</b>  <b>ADD AI</b> <b>ADD AM</b> <b>ADD PERMANENT AM</b>
17	Save the configuration database	<b>DB UPD D</b> <b>DB NET UPD D</b> (where D is the desired database number, in the range of 1 to 10)

The Megaplex is now ready for operation. Refer to the installation plan and connect the required cables to the various module ports.



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**Appendix A. Pinouts**

**Appendix B. Operation Environment**



# Chapter 1

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## Introduction

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### 1.1 Overview

Megaplex-2100/2104 is a family of high-capacity user-configurable modular E1/T1 Integrating Access Devices with SNMP management.

Megaplex-2100/2104 multiplexers provide an efficient and cost-effective method for integrating data, voice, fax, ISDN access, etc., for transmission over TDM networks, and are well adapted for use in corporate networks.

Megaplex-2100/2104 equipment also supports the TDMoIP (TDM over IP) protocol and therefore can be integrated in corporate IP networks using IP-based backbones.

*Figure 1-2* illustrates the systems application flexibility conferred by Megaplex-2100/2104 equipment.

### Product Options

Megaplex-2100 systems are available in two chassis sizes:

- **Megaplex-2100** – 4U-high chassis for desktop and rack installation, can accommodate up to 12 I/O and/or main link modules and supports plug-in power supply modules and an optional ringer module. Redundancy is available for all the critical subsystems.
- **Megaplex-2104** – compact 2U-high chassis with integral power supply (and optional integral ringer) for desktop and rack installation, can accommodate up to 5 I/O and/or main link modules. It is a cost-effective alternative for branch office applications.

A general view of the two chassis types appears in *Figure 1-1*. Both chassis versions have system status indicators on their front panels and on the module panels. The cable connections are made directly to the module panels.

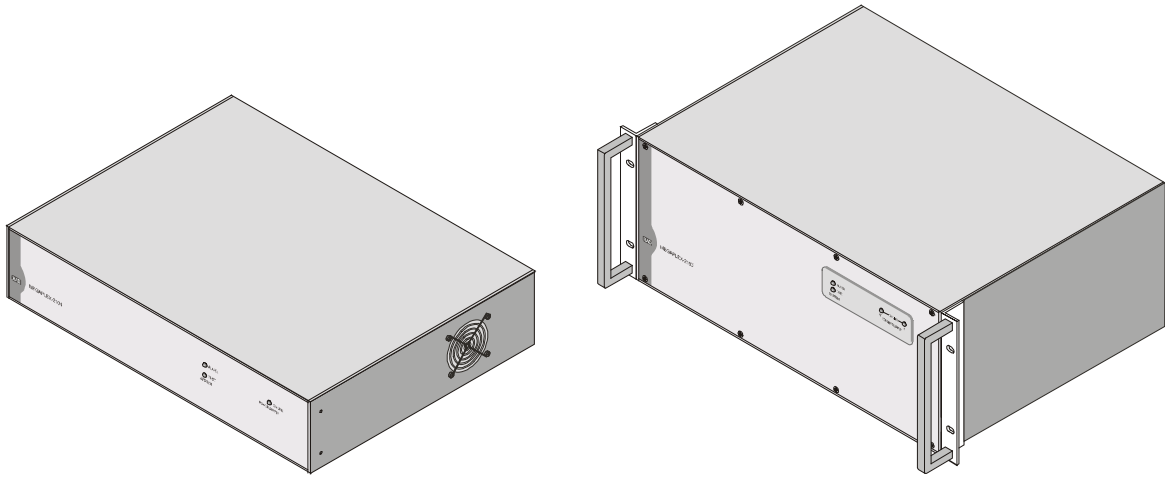


Figure 1-1. Megaplex-2100 Chassis Types

RAD offers the following rack mounting kits:

- RM-MP-MX-23/19: for installing the Megaplex-2100 in both 19" and 23" racks
- MP2104/RM: for installing the Megaplex-2104 in 19" racks.

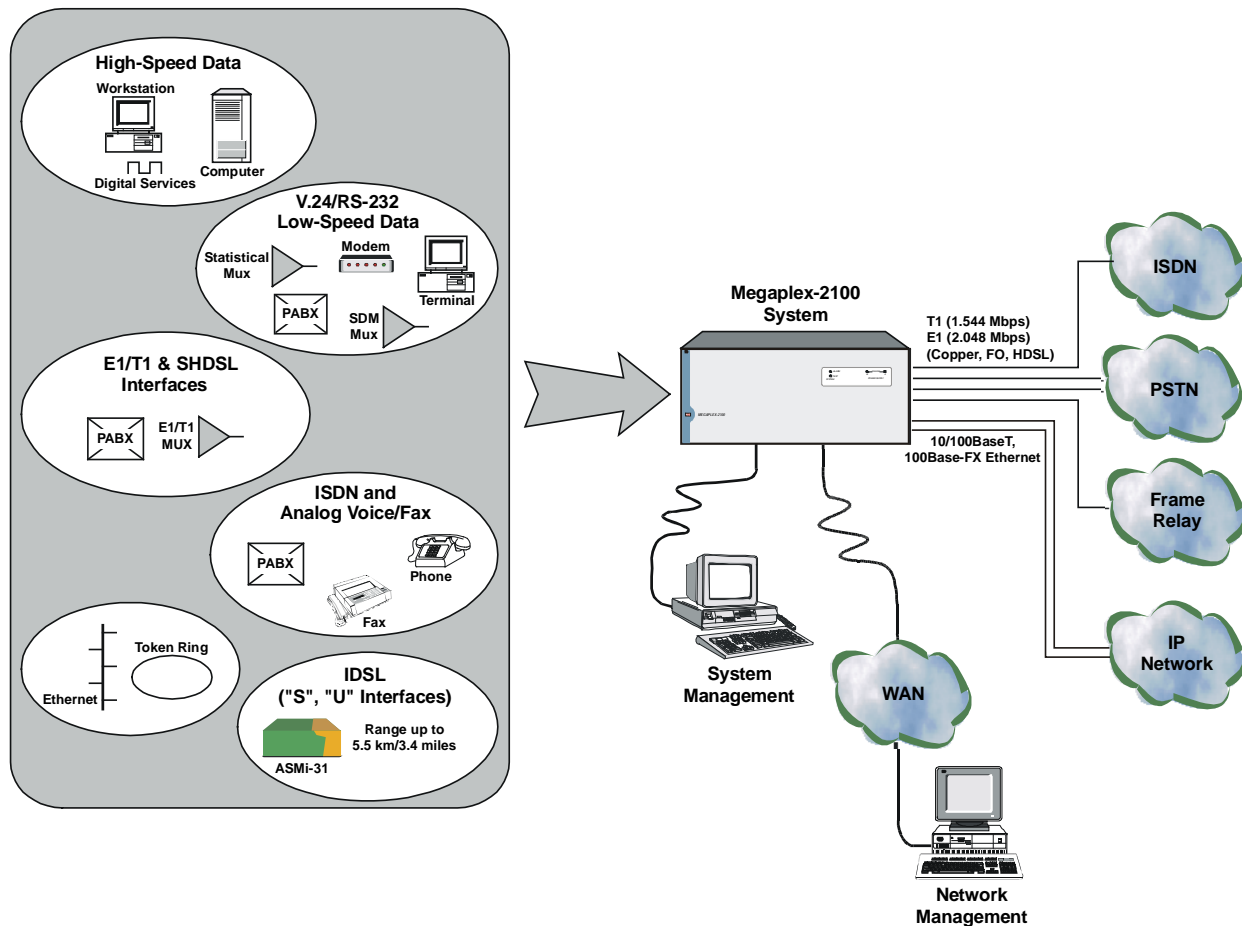
Rack-mount brackets can be attached in two ways, so modules can face either toward the front, or the rear of the rack.

**Note**

*In this manual, the generic term **Megaplex** is used when the information is applicable to both equipment versions. The complete equipment designation is used only for information applicable to specific equipment versions.*

## Applications

*Figure 1-2* illustrates the systems application flexibility conferred by Megaplex-2100/2104 equipment.



*Figure 1-2. Megaplex-2100/2104 System Applications*

Megaplex-2100/2104 is a flexible modular multiplexer, supporting up to 248 64-kbps channels that can be used to provide various types of services. Megaplex-2100/2104 systems enable the integration of multiple dedicated voice, ISDN, Ethernet and LAN channels onto several E1 or T1 trunks, as well as over Ethernet interfaces to IP networks. Megaplex-2100/2104 systems split the voice and data channels and redirect the traffic to separate trunks, maximizing efficiency by directly connecting each trunk to the appropriate service (PSTN, ISDN, Frame Relay, IP networks, etc.).

Megaplex-2100/2104 is especially suitable for use as an economical, compact remote access multiplexer. It is ideal for small communities, providing mixed services for both business and residential customers.

Megaplex-2100/2104 systems can be deployed both at the exchange in the point-of-presence, or at the remote distribution node location (such as in an apartment building's basement or telecommunication closet).

## Main System Features

Megaplex-2100/2104 systems are ideally suited to implementing custom system designs according to specific applications, and can be used to build cost-effective private corporate networks, as well as networks using public TDM carriers and IP transmission services.

The Megaplex-2100/2104 systems are compatible with the Megaplex-4 next generation Multiservice nodes, also offered by RAD. When equipped with IP main link modules, Megaplex-2100/2104 systems are fully compatible with the IPmux family of TDMoIP gateways offered by RAD, and therefore permit the Megaplex equipment to become part of an integrated corporate IP network. Moreover, Megaplex-2100/2104 systems comply with the applicable standards, and therefore are fully interoperable with TDM and TDMoIP equipment from other vendors and can be efficiently integrated in access networks.

The Megaplex-2100/2104 systems are available in two chassis versions, which can be equipped with various types of main link and input/output (I/O) modules to provide the required user and system interfacing. Several power supply options are also available.

The flexible modular construction and the advanced management capabilities of the Megaplex-2100/2104 family enable the using organization to easily configure individual systems for specific requirements and operating modes, and change rapidly system configurations.

Moreover, the operating software can be remotely downloaded, therefore improvements and new features can be easily added across the whole network. The range of modules and options available for the Megaplex-2100/2104 family is continuously expanding. The I/O modules currently available include:

- High-speed multichannel synchronous data I/O modules, operating at multiples of 56 kbps and 64 kbps.
- Sub-multiplexer modules for low-speed synchronous and asynchronous data transmission.
- Multichannel ISDN basic rate access modules, including support for data rate adaptation per ITU-T Rec. I.460.
- Voice/fax sub-multiplexer modules with 2-wire and 4-wire interfaces and various signaling capabilities, that can directly connect to PBX and PSTN lines, as well as to fax and telephone sets. The voice modules are available in several versions, that support toll-quality PCM and ADPCM coding, or high-quality low-bit rate compression.
- Ethernet LAN connectivity modules with internal Ethernet switch supporting port-based VLANs and VLAN tag-based switching or bridge, bridge/router, and IP router.
- Multiport T1 (DS1) and E1 I/O and main link modules, which support applications such as fractional T1 and E1, direct connection to digital PBX and allow cascading of Megaplex-2100/2104 units.

The current main link options support two families of interfaces:

- Interfaces to TDM networks: T1 (1.544 Mbps), E1 (CEPT, 2.048 Mbps), as well as fractional T1 and fractional E1 data services. A wide range of electrical, optical and HDSL interfaces are available.

- Interfaces to IP networks using 10/100BASE-T or 100BASE-FX Ethernet interfaces.
- Interfaces to high-speed digital data services networks running at sub-E1 rates ( $n \times 64$  kbps in the range of 128 to 2048 kbps).

Megaplex equipped with 8-port main link modules in conjunction with the 12-port high speed module features a traffic payload capacity of up to 248 DS0 timeslots. This capacity can be carried by 8 E1 links or 10 T1 links, or any equivalent combination of E1 and T1 links. The main link modules of version 11 and lower still support up to 124 DS0 timeslots (8 Mbps). This capacity can be carried by 4 E1 links or 5 T1 links, or any equivalent combination of T1 and E1 links.

Main link utilization is user-programmable at the individual timeslot level, with full timeslot cross-connect capabilities. Timeslot utilization is user-programmable down to the bit level (minimum bandwidth allocation unit of two bits, i.e., 16 kbps).

Megaplex-2100/2104 equipment can be powered by AC and DC power sources. To enhance system availability, Megaplex-2100/2104 supports main link redundancy, as well as common logic redundancy. When necessary, two power supply modules can be installed to provide redundancy.

The Megaplex-2100/2104 equipment supports Telnet and SNMP management, both inband through the main links, and out-of-band through Ethernet or RS-232 supervisory ports. SNMP enables fully graphical, user-friendly management using the RADview network management stations offered by RAD, as well as management by any other SNMP-based management systems.

In addition, a supervision terminal that provides full configuration and management capabilities can be connected to the RS-232 supervisory ports, either directly or through modem links.

---

---

## 1.2 Physical Description

### System Structure

All the Megaplex-2100/2104 multiplexers use a modular chassis, which can be installed, by means of rack-mount brackets in 19" or 23" racks. The chassis has physical slots in which modules are installed by the user to obtain the desired multiplexer configuration.

Any multiplexer configuration includes the following subsystems:

- Multiplexing and network interface subsystem, can include several main link (ML) modules.
- Control subsystem, can include one or two common logic (CL) modules.
- Power supply subsystem, can include one or two power supply (PS) modules.
- User interfacing and processing subsystem. The number of user interfacing modules that can be installed in a chassis depends on the chassis type, the maximum number being up to 11.

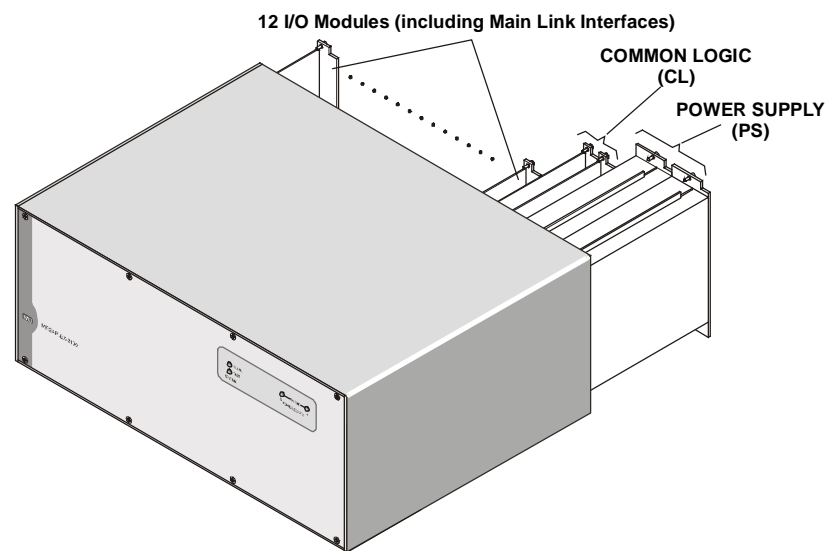
The common logic and power supply modules are always installed in their dedicated chassis slots, whereas the main link and user interfacing modules can be installed in any of the other chassis slots (called *I/O slots*).

Any system must include at least one main link module, one common logic module, and one power supply module. These modules are thus referred to as *system modules*. User interfacing modules, called *I/O modules*, are added to this basic configuration.

Where necessary, additional system modules may also be added, to obtain configurations with extended capabilities: for example, to provide main link redundancy capabilities, additional main link modules can be installed.

## Description of Megaplex-2100 Enclosure

*Figure 1-3* shows a general view of the Megaplex-2100 enclosure.



*Figure 1-3. MP-2100 Enclosure, General View*

The enclosure has 16 module slots. Two of them are reserved for PS modules, and two – for CL modules. The other 12 slots are intended for main link and I/O modules. Each I/O slot can accept any type of I/O or main link module. Ringer-2100R modules (which occupy two adjacent I/O slots), can also be installed in any pair of I/O slots. The modules are inserted from the rear side.

The MP-2100 enclosure can be ordered with brackets for installation in racks. The brackets are attached to the sides of the enclosure, near the front or rear panel.

*Figure 1-4* shows a typical rear view of the MP-2100 enclosure and identifies the slots and their use. Note the labels which designate the type of module that can be installed in each slot; in addition, each slot is keyed, therefore it is not possible to install the wrong module type.

---

### **Caution**

To prevent physical damage to the electronic components assembled on the two sides of the module printed circuit boards (PCB) while it is inserted into its chassis slot, support the module while sliding it into position and make sure that its components do not touch the chassis structure, nor other modules.

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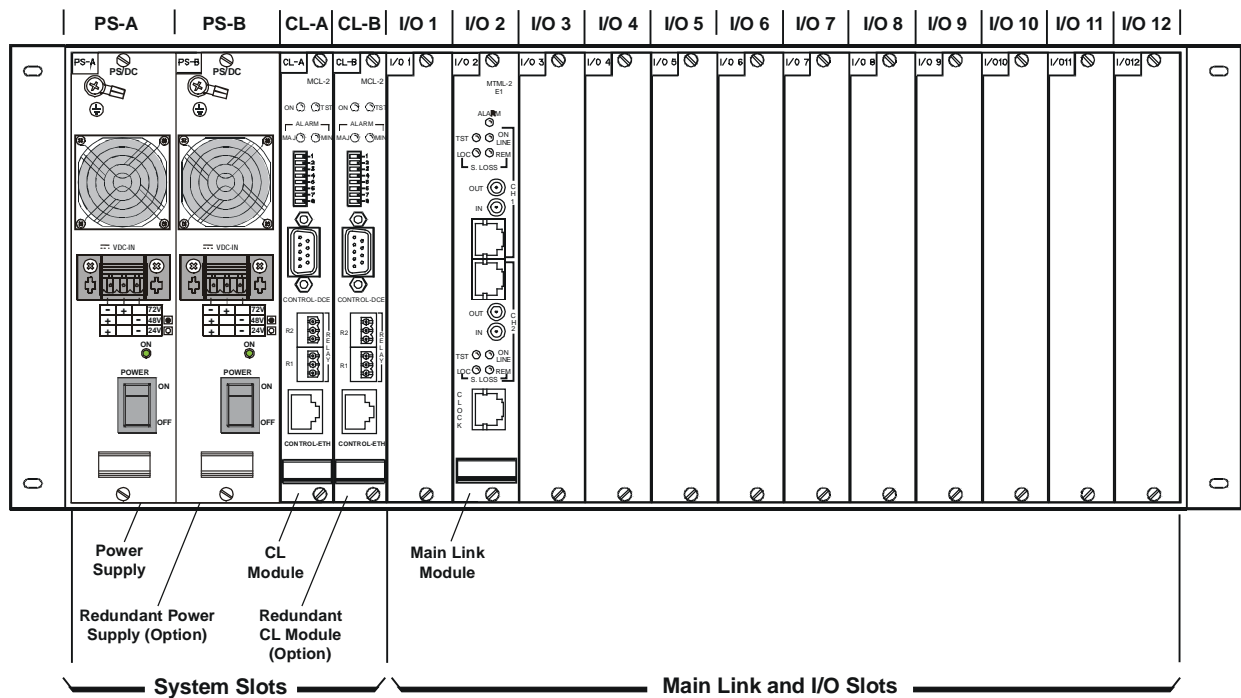


Figure 1-4. MP-2100 Enclosure, Typical Rear View

The front panel of the MP-2100 enclosure includes labels for the system status indicators.

Figure 1-5 identifies the front panel indicators. Their functions are described in Chapter 3.

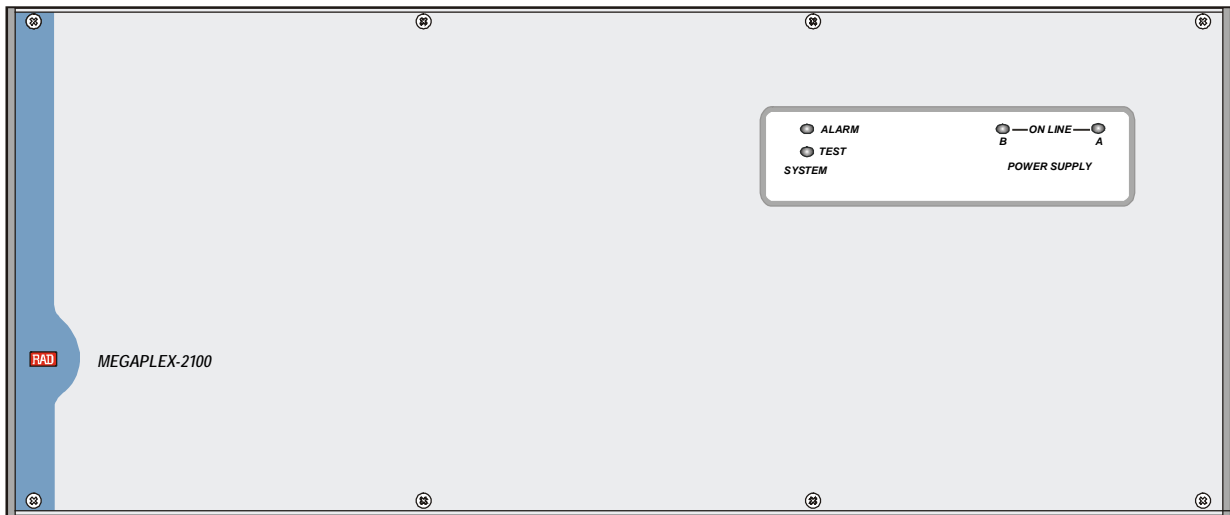
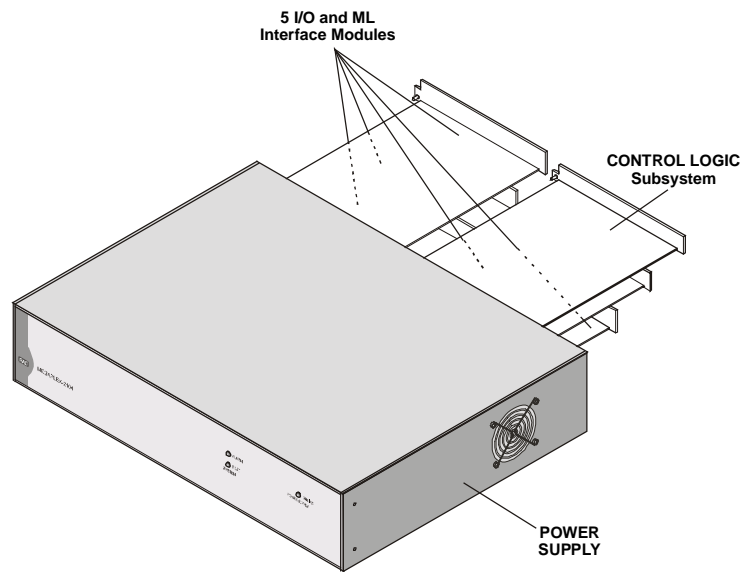


Figure 1-5. MP-2100 Enclosure, Front Panel

## Description of MP-2104 Enclosure

Figure 1-6 shows a general view of the MP-2104 enclosure. Note that new versions have a miniature cooling fan on the power supply side.

Figure 1-6. MP-2104 Enclosure, General View



The enclosure has 6 module slots. One of them is reserved for the CL.2 module. The other 5 slots are intended for main link and I/O modules. Each I/O slot can accept any type of I/O or main link module. The modules are inserted from the rear side. The enclosure has an internal power supply.

The MP-2104 enclosure can be ordered with brackets for installation in racks. The brackets are attached to the sides of the enclosure, as explained below.

Figure 1-7 shows a typical rear view of the MP-2104 enclosure equipped with an CL.2 module, and identifies the slots and their use.

Note the labels which designate the type of module that can be installed in each slot; in addition, each slot is keyed, therefore it is not possible to install the wrong module type.

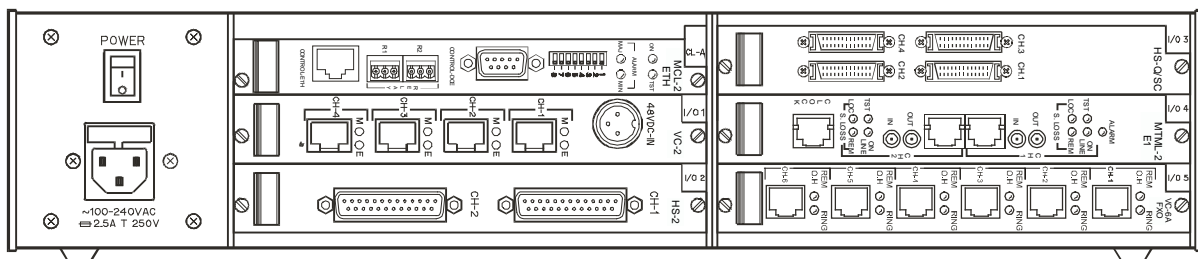


Figure 1-7. MP-2104, Rear View

Figure 1-8 identifies the front panel indicators. Their functions are described in Chapter 3.



Figure 1-8. MP-2104, Front View



## Redundancy

The operation of a Megaplex system depends on three critical modules: the power supply, the main link module, and the CL module. Main link redundancy is available in both Megaplex-2100 and Megaplex-2104 chassis. In addition, MP-2100 features CL and PS module redundancy.

The minimum MP-2100 system configuration requires only one PS module, one main link module, and one CL module. For critical applications, an additional redundant module of each type can be installed in the enclosure. The MP-2100 system automatically puts a redundant module in service in case the corresponding module fails, thereby ensuring continuous system operation in the event of any single module failure. The redundant CL modules must have identical HW & SW versions.

Redundant modules may be inserted or removed even while the system operates, without disrupting the traffic or degrading the system performance (hot swapping capability). Megaplex-2100 supports hot swap with redundancy on CL, PS and I/O modules, while Megaplex-2104 supports hot swap with redundancy on I/O modules.

## I/O Modules

Any I/O module can be freely installed in any of the I/O slots of a Megaplex chassis. I/O module channels can be connected to any desired main link port.

Module location does not affect the assignment of timeslots on main links and the routing of the module data streams, which are defined by the operator in accordance with system requirements.

The I/O modules used by Megaplex systems are listed in [Table 1-1](#). Some of the modules can also be used in the Megaplex-4 New Generation Multiservice Access Platform (see [Megaplex-4 Installation and Operation Manual](#)).

### Note

*In Table 1-1, an asterisk \* means that the module can utilize 4 buses (each having a capacity of 32 timeslots, for a chassis capacity of 124 timeslots) using any main link; other I/O modules can utilize up to 62 timeslots. See also special notes for HS-6N, HS-12N and VC family modules.*

Table 1-1. I/O Module Types

Function	Designation	Description
Low Speed Data Modules	LS-12	Data sub-multiplexer module with BERT support, provides twelve synchronous or asynchronous data channels with ITU-T Rec. V.24/EIA RS-232 interfaces, each having independently selectable data rate in the range of 2.4 to 64 kbps. Supports end-to-end transmission of control signal per channel. Channels can be bundled into two groups, each independently routed to a different main link port.  LS-12 modules support the bidirectional broadcast mode.
	LS-6N	Data sub-multiplexer module similar to LS-12 except that it can bundle channels in only one group.

Function	Designation	Description
	HS-RN ★	Four-channel low-speed data module, provides four synchronous or asynchronous data channels with ITU-T Rec. V.24/EIA RS-232 interfaces, each having independently selectable data rate in the range of 0.6 kbps up to 38.4 kbps in the asynchronous mode, and up to 64 kbps in the synchronous mode. HDLC-based end-to-end signaling is also supported. HS-RN modules support the bidirectional broadcast mode.
High Speed Data Modules	HS-2	High-speed data interface module, provides two high-speed V.35 or RS-530/V.11 data channels. Channel data rates are user-selectable in the range of $n \times 56$ kbps or $n \times 64$ kbps, where $n$ is up to 31 for E1 operation, and up to 24 for T1 operation. HS-2 modules support the bidirectional broadcast mode.
	HS-Q/N	High-speed data interface module, provides four high-speed V.35 or RS-530/V.11 data channels and supports the BERT function. Channel data rates are user-selectable in the range of $n \times 56$ kbps or $n \times 64$ kbps, where $n$ is up to 24 for T1 operation, and up to 31 for E1 operation (maximum 1884 kbps). HS-Q modules support the bidirectional broadcast mode.
	HS-6N, HS-12N ★	Similar to HS-Q/N, but with 6 or 12 high speed synchronous data channels, operating at data rates of $n \times 56$ or $n \times 64$ kbps, up to 1984 kbps. Supports enhanced clock modes and BERT. Any channel can be directed to any main link module. HS-6N and HS-12N modules support the bidirectional broadcast mode. <b>Note:</b> In conjunction with 8-port main link modules, HS-6N and HS-12N modules utilize the full TDM capacity of the Megaplex chassis (8 buses, each having a capacity of 32 timeslots, for a total chassis capacity of 248 timeslots).
	HS-703	High-speed data subchannel interface module, provides four 64 kbps codirectional ITU-T Rec. G.703 data channels.
	HS-S	ISDN basic rate access interface module with four type "S" interfaces. This module is intended for extension of ISDN lines over Megaplex links, and can provide phantom feed to user's equipment. Performs submultiplexing and data rate adaptation on B-channels in accordance with ITU-T Rec. I.460.
	HS-U-6, HS-U-12 ★	ISDN basic rate access interface module with 6, respectively 12, type "U" interfaces. Performs submultiplexing and data rate adaptation on B channels per ITU-T Rec. I.460. The module supports two operation modes: <ul style="list-style-type: none"> <li>/I: intended for extension of ISDN lines, can provide phantom feed to user's equipment. Supports 2B + D channels, and the channel data rates are user-selectable (16, 32, and 64 kbps for each B channel, and 16 kbps for the D channel).</li> </ul> /I: intended for use over leased lines, and can be used as dedicated line termination units for the ASM-31 and ASMi-31 short-range modem offered by RAD. Supports user channel data rates of 4.8, 9.6, 19.2, 48, 56, and 64 kbps over each B channel, and 128 kbps by combining the two B channels.

Function	Designation	Description
	HSF-1, HSF-2 ★	One- or two-port Teleprotection interface modules, complying with IEEE C37.94 requirements, with 850 nm multimode fiber interface for connection to teleprotection equipment. Link capacity for each port is selectable in the range of 1 to 10 timeslots (64 to 640 kbps)
Internetworking Modules	HS-ETH	1/2/4-channel Ethernet bridge/router module supporting n x 56/64 kbps data rates (up to 1.984 Mbps payload) per channel. Suitable for LAN to LAN extension applications. Provides up to four high performance, remote, self-learning 10BASET Ethernet bridge or IP router channels. Each channel terminates in a separate RJ-45 connector. Supports VLANs. Version with 10/100BASET Fast Ethernet bridge module also available.
	HS-ETH/SW ★	Four-channel Ethernet I/O module with 10BASET/100BASETX interfaces. Has an internal Layer 2 Ethernet switch with VLAN support, including double-tagging. Supports static routing, IP subnet switching over PPP, and the STP and RSTP protocols.  WAN side supports data transfer rates of 64 to 1536 kbps for T1 links, and 64 to 1984 kbps for E1 links. Total WAN capacity is up to 4096 kbps.
Voice/Fax Modules		Voice interface module, provides six PCM-encoded toll-quality voice channels. The VC-6 module is available in three models: <ul style="list-style-type: none"> <li>VC-6/E&amp;M: 4-wire or 2-wire interfaces with E&amp;M signaling per RS-464 Types I, II, III and V, and BT SSSDC5.</li> <li>VC-6/FXS: 2-wire interfaces for direct connection to telephone sets.</li> <li>VC-6/FXO: 2-wire interfaces for direct connection to PBX extension lines.</li> </ul> VC-6 modules, except for the /FXO version, support the bidirectional broadcast mode.
	VC-6/LB	Voice interface modules, provide six PCM-encoded toll-quality voice channels with 2-wire local-battery (LB) interface for military field telephones.
	VC-6A	Voice interface module, has characteristics similar to those of the VC-6 module described above, and in addition supports 32 kbps ADPCM coding. The VC-6A module is available in five models: <ul style="list-style-type: none"> <li>VC-6A/E&amp;M: 4-wire or 2-wire interfaces with E&amp;M signaling per RS-464 Types I, II, III and V, and BT SSSDC5.</li> <li>VC-6A/FXS: 2-wire interfaces for direct connection to telephone sets, supports metering pulses and reverse-polarity signaling (wink start).</li> <li>VC-6AG/FXS: 2-wire interfaces for direct connection to telephone sets, supports ground start.</li> <li>VC-6A/FXO: 2-wire interfaces for direct connection to PBX extension lines, supports metering pulses and reverse-polarity signaling (wink start).</li> <li>VC-6AG/FXO: 2-wire interfaces for direct connection to PBX extension lines, supports ground start.</li> </ul> VC-6A modules, except for the /FXO version, support the bidirectional broadcast mode.

Function	Designation	Description
	VC-4, VC-8, VC-16	<p>Voice interface modules, provide four, eight, or sixteen PCM-encoded toll-quality voice channels. Suitable for various loop-start applications, PSTN applications, and public payphone applications (support wink-start signaling and pulse-metering). VC-16 enables a single Megaplex-2100 unit to support up to 120 PCM voice channels (or up to 60 channels with Megaplex-2104).</p> <p>The modules are available in three models:</p> <ul style="list-style-type: none"> <li>• E&amp;M: 4-wire or 2-wire interfaces with E&amp;M signaling per RS-464 Types I, II, III and V, and BT SSDC5.</li> <li>• FXS: 2-wire interfaces for direct connection to telephone sets.</li> <li>• FXO: 2-wire interfaces for direct connection to PBX extension lines.</li> </ul> <p><b>Note:</b> These modules have access to 4 buses but can use simultaneously only 3 buses (A, B, C or B, C, D).</p>
	VC-4A, VC-8A	<p>Voice interface modules, provide four or eight PCM- or ADPCM-encoded toll-quality voice channels. Suitable for various loop-start applications, PSTN applications, and public payphone applications (support wink-start signaling and pulse-metering).</p> <p>The modules are available in three models:</p> <ul style="list-style-type: none"> <li>• E&amp;M: 4-wire or 2-wire interfaces with E&amp;M signaling per RS-464 Types I, II, III and V, and BT SSDC5.</li> <li>• FXS: 2-wire interfaces for direct connection to telephone sets.</li> <li>• FXO: 2-wire interfaces for direct connection to PBX extension lines.</li> </ul> <p>Note: These modules have access to 4 buses but can use simultaneously only 3 buses (A, B, C or B, C, D).</p>
	VC-16A ★	<p>16-channel voice interface module with user-selectable voice encoding method (PCM at 64 kbps, linear PCM at 128 kbps or ADPCM at 32 kbps). Has selectable 4-wire or 2-wire interface.</p> <p>VC-16A transmits voice without any channel signaling, thus it is intended primarily for basic point-to-point applications which do not require signaling, or use only in-band signaling (such as DTMF).</p>
	VC-4/OMNI ★	<p>A special "omnibus" E&amp;M interface module provides 4 toll-quality voice channels to support applications where a master site needs to communicate with multiple remote stations simultaneously (such as to broadcast an important message).</p>

Function	Designation	Description
Voice/Fax Modules ( <i>Cont.</i> )	VFS-24	<p>Family of voice/fax signal compression server modules supporting low-rate compressed voice. Four module versions are offered:</p> <ul style="list-style-type: none"> <li>VFS-24: module with T1 interface, can compress up to 24 voice channels</li> <li>VFS-48: module with two T1 interfaces, can compress up to 48 voice channels</li> <li>VFS-30: module with E1 interface, can compress up to 30 voice channels</li> <li>VFS-60: module with two E1 interfaces, can compress up to 60 voice channels</li> </ul> <p>The modules can be configured to use MPMLQ voice compression per ITU-T Rec. G.723.1 at a channel data rate of 5.3 or 6.4 kbps, or CS-ACELP per Annex A of ITU-T Rec. G.729A at a channel data rate of 8 kbps. Advanced DSP techniques provide high-quality compressed voice while also supporting transmission of Group III facsimile at user-selected rates, up to 14.4 kbps. In addition, any timeslot can be transparently transferred to a desired Megaplex main link port, instead of being processed by the digital signal processing circuits.</p> <p>The main application for these modules is to increase bandwidth utilization efficiency when digital PBXs are connected over T1 or E1 trunks. They can also act as voice compression servers for voice modules.</p>
	VFS-48	
	VFS-30	
	VFS-60	
	*	

## Main Link (ML) Modules

The main functions of the main link modules are as follows:

- Interfacing between the chassis TDM buses and the external communication links. Each main link module can serve all the four TDM buses in a Megaplex chassis, and supports the full bandwidth of TDM buses (31 timeslots per bus).
- Generation of chassis timing reference, used to provide the clock and timing signals used by all the modules installed in the same chassis. The chassis timing reference can be generated by an internal clock or locked to various external sources. The chassis timing reference is used in common by all the four TDM buses.

### Note

*IP main link modules can also lock the chassis timing to the clock signal recovered from the payload rate carried by a user-selected bundle.*

- Test internal and external signal paths, using an internal test subsystem that can measure BER, inject test tones and perform loopbacks.

*Table 1-2* lists the main link modules available for Megaplex systems.

*Table 1-2. Main Link Modules*

Designation	Description
-------------	-------------

Designation	Description
ML-IP	<p>IP main link module, includes all the functions needed to support the transfer of TDM traffic over IP networks, including IP routing functions. Provides standard 10/100 Mbps Ethernet connectivity for Megaplex, complying with all relevant IEEE Ethernet LAN standards. Uses RAD TDMoIP<sup>®</sup> technology to convert the Megaplex TDM bit stream into IP packets for transmission over IP networks. Features two Ethernet uplinks with choice of 10/100BASET (UTP) or 100BASEF (fiber) interface and additional 10/100BASET Ethernet user port. Features Resilient Fast Ethernet Ring (RFER) technology to build Fast Ethernet networks with 50 msec self-healing link protection.</p> <p>The ML-IP module has a non-blocking full cross-connect matrix that handles user-configurable bundles for independent routing through the IP network. Supports free routing of timeslots from any I/O module or other module ports to any bundle, as well as direct bypassing of timeslots between bundles, without requiring bandwidth on the internal chassis buses. For voice channels, the module can convert signaling formats, and perform near-end echo cancelling. The module also supports the R2 signaling protocol.</p> <p>ML-IP has three Ethernet ports, interconnected through an internal Ethernet switch: two ports serve as uplink ports and the third enables other user's equipment to connect to the uplink without requiring additional external equipment. The uplinks provide a total payload capacity of 16 kbps to 4 Mbps. The user port has a 10/100BASET interface; the other two ports can be ordered with 10/100BASET interfaces, or with 100BASE-FX optical interfaces. The optical interfaces operate at 1310 nm and can be ordered with LC, FC/PC or ST connectors, for use with multimode or single-mode fibers.</p>
ML-8E1	<p>8-port copper E1 interface modules. Feature full cross-connect, bypass, and diagnostics. Equipped with integral user-enabled LTU. Station clock interface provided. Can display signaling bit state of any timeslot carrying voice. Support self-healing ring redundancy topology.</p>
ML-8T1	<p>8-port copper T1 interface modules. Feature full cross-connect, bypass (including multiframe synchronization), and diagnostics. Equipped with integral user-enabled CSU. Station clock interface provided. Can display signaling bit state of any timeslot carrying voice. Support self-healing ring redundancy topology.</p>
ML-2E1, ML-1E1	<p>Dual E1 TDM main link module with standard ITU-T Rec. G.703 interfaces, has user-selectable DSU or LTU interface. Each link can be independently configured to use the CAS protocol. Station clock interface also included.</p> <p>Includes a non-blocking full cross-connect matrix that supports direct bypassing of timeslots between the two E1 links (without requiring bandwidth on the internal chassis buses for bypassing slot), as well as enabling free routing of timeslots from any I/O channel or other module ports to any E1 timeslot. Can perform signaling format conversions, and in the CAS mode also support the R2 signaling protocol.</p> <p>Has enhanced diagnostics with BERTs (dual-port modules only), loopbacks, and tone injection per timeslot. Can display signaling bit state of any timeslot carrying voice. Support self-healing ring redundancy topology.</p> <p>The module is also available in a single-link version, ML-1E1. This version does not include a test subsystem for BER measurement and test tone injection</p>

Designation	Description
ML-2T1, ML-1T1	<p>Dual T1 TDM main link module with standard ANSI T1.403 interfaces, has user-selectable DSU or CSU interface. Includes a non-blocking full cross-connect matrix that supports direct bypassing of timeslots between the two T1 links, without requiring bandwidth on the internal chassis buses, as well as enabling free routing of timeslots from any I/O channel or other module ports to any T1 timeslot. Can perform signaling format conversions.</p> <p>Has enhanced diagnostics with BERTs (dual-port modules only), loopbacks, and tone injection per timeslot. Can display signaling bit state of any timeslot carrying voice. Support self-healing ring redundancy topology.</p> <p>The module is also available in a single-link version, ML-1T1. This version does not include a test subsystem for BER measurement and test tone injection</p>
MLF-2E1, MLF-1E1	<p>Dual fiber-optic E1 TDM main link module. The links are available with a wide range of optical interfaces. Each link simulates a standard ITU-T Rec. G.703 interface. Each link can be independently configured to use the CAS.</p> <p>Includes a non-blocking full cross-connect matrix that supports direct bypassing of timeslots between the two E1 links, without requiring bandwidth on the internal chassis buses, as well as enabling free routing of timeslots from any I/O channel or other module ports to any E1 timeslot. Can perform signaling format conversions, and in the CAS mode also provides support for the R2 signaling protocol.</p> <p>The module is also available in a single-link version, MLF-1E1. This version does not include a test subsystem for BER measurement and test tone injection</p>
MLF-2T1, MLF-1T1	<p>Dual fiber-optic T1 TDM main link module. The links are available with a wide range of optical interfaces. Each link simulates a standard ANSI T1.403 interface.</p> <p>Includes a non-blocking full cross-connect matrix that supports direct bypassing of timeslots between the two T1 links, without requiring bandwidth on the internal chassis buses, as well as enabling free routing of timeslots from any I/O channel or other module ports to any T1 timeslot. Can also perform signaling format conversions.</p> <p>The module is also available in a single-link version, MLF-1T1. This version does not include a test subsystem for BER measurement and test tone injection</p>
ML-20N/2, ML-20N/1	<p><math>n \times 64</math> kbps main link module, provides <math>n \times 64</math> kbps synchronous links for direct connection to high-speed data services networks running at sub-E1 rates (128 to 2048 kbps). In addition, the module can provide backup links for E1 main links over high-speed digital data lines. The module is available in two versions:</p> <ul style="list-style-type: none"> <li>• ML-20N/2 dual link version</li> <li>• ML-20N/1 single link version</li> </ul>

## General Configuration Rules for Main Link Modules

Main link modules (E1, T1 or IP) can be installed in any I/O slot.

The number of main link modules that can be installed in a Megaplex chassis depends on the desired system configuration. The following general rules always apply:

- At least one main link module must be installed in each Megaplex chassis.
- The number of main link modules actually installed in a Megaplex can be selected in accordance with the type (IP and TDM) and number of links required by the specific user's application. The only restrictions are:

- Any timeslot can be routed to only one main link or bundle, except for timeslots assigned to unidirectional and bidirectional applications.
- The equipment connected to the remote ends of each link uses a compatible timing mode, for example, loopback timing (that is, timing locked to the Megaplex nodal timing) or adaptive timing (timing locked to the clock recovered from a selected bundle).

## Main Link Redundancy Options

Full redundancy is available for links to the network. The supported redundancy modes depend on the main link module type:

- For ports of TDM main link modules, three types of redundancy are available:
  - Dual parallel transmit redundancy. To use this type of redundancy, an additional main link port with the same type of interface (E1 or T1) is configured to serve as a redundant port for each main link port to be protected. The two ports transmit the same information in parallel.

With respect to the receive function, at any time only one port, called the active (master) port, is connected to the internal TDM buses, and the other serves as a hot-standby (slave). This equipment configuration protects against transmission path failure.

When the two ports are located on the same module, the redundancy switching time is short (maximum 50 msec), thereby minimizing traffic disruption.
  - Y-cable redundancy (only for copper interfaces). To protect only against hardware failure, two ports with the same type of interface but located on different modules are configured to serve as a redundancy pair. Redundancy between the two module ports is obtained by connecting an Y-cable in parallel to the two ports defined as redundancy pair. At any time, only one port (the active port) transmits to the link, and the other is disconnected from the link. When a failure is detected in the active port, it stops transmitting to the link and the other port becomes active.
  - Ring redundancy. TDM main link modules also support ring redundancy, a RAD proprietary topology that provides higher availability for critical applications. This topology requires the use of dual-port main link modules, for example, ML-2E1, ML-2T1, etc.

In this redundancy mode, two transmission paths are used to create a dual-ring topology, that is, one path propagates data “clockwise” and the other “counterclockwise”. Therefore, each Megaplex can receive data through two different paths. Normally, one of the rings carries the data, and the other is idle.

In case of failure, the failed segment is bypassed by transferring data through the second ring.
- For IP main link modules, redundancy is always available at the bundle level, i.e., two bundles (defined on the same ML-IP module or on different ML-IP modules) can operate as a redundant pair. To use this capability for traffic protection, the same timeslot (or group of timeslots) are simultaneously transmitted on two different bundles. The receive function uses only the data received through one of these bundles.



This provides functionality similar to the dual parallel transmit redundancy described above for TDM main link modules: if the active bundle stream fails, Megaplex will start using the other bundle stream.

In addition, redundancy can be provided at additional levels:

- Redundancy at the external port level (and the cable connected to the external port): this can be achieved by routing the same bundle to different external ports.
- Full redundancy at the transmission path level. For this purpose, the bundle is routed through different ML-IP modules and network routing is designed to ensure that the packets travel through the network via different paths.
- Ring redundancy, implemented by means of the RAD-proprietary RFER (resilient fast Ethernet ring) protocol, provides higher protection for the transmission path, and is especially suited for LAN/WAN applications. In this redundancy mode, the topology is similar to that of a ring, and therefore it can propagate data either "clockwise" or "counterclockwise".

Because of the Ethernet protocol characteristics, the ring is not actually closed: a pair of adjacent nodes on the ring keep the ring open by disconnecting an arbitrary ring segment, thereby preventing frames from making a full round trip. If a segment breaks (fails), the RFER protocol automatically moves the blocking nodes to the ends of the failed segment and reconnects the previously disconnected segment. Therefore, full connectivity is restored for any single point of failure.

For TDMoIP traffic, this change takes effect within 50 msec; for other Ethernet traffic, it takes longer (approximately 20 seconds).

## Common Logic Modules

The CL module has the following main functions:

- Interfacing with the network management stations or supervision terminal.
- Control of Megaplex system operation.
- Storage of application software, which determines the capabilities and features provided by the Megaplex, in flash memory. This software can be remotely downloaded and updated through the management link without taking the equipment off-line.
- Storage of configuration databases. This information is stored in non-volatile memory. The configuration databases can also be uploaded and downloaded through the management link.
- Collection of operational history (alarms, performance statistics, etc.). This information can be read by maintenance personnel using a Telnet host or a terminal connected to the CL module, or by the management station, through the management link.
- Reporting of Megaplex chassis status for display on bay alarm panels or operator's monitoring consoles. This is achieved by two dry-contact alarm relays with user-configurable functionality.

Only one CL module is necessary per Megaplex chassis, however the chassis has two slots dedicated to this type of module. The second slot can be used to install a redundant CL module, thereby providing a hot-standby capability for the Megaplex system control functions.

When a second CL module is installed, the two modules operate as a master/slave pair: one module is the active (master) module, and the other serves as a hot standby (slave).

Only the master module communicates with the management station/terminal and actively manages the Megaplex system. The slave module communicates only with the master module. Moreover, its transmit line in the serial port connectors is disabled, to enable physical connection in parallel (e.g., by means of a Y cable) to a management facility.

The slave module is automatically updated by the master module with all the configuration and status data, therefore it can take over at any time without disrupting system operation.

## Power Supply (PS) Modules

This section describes the PS modules available for the Megaplex-2100 and Megaplex-2104.

### PS Modules for Megaplex-2100

The MP-2100 chassis has two PS slots, thereby enabling the installation of two PS modules. Normally, a single PS module per unit is sufficient. However, a second PS module may be added. With a redundant PS module, both modules are connected to power and share the load when the system is operating. In case of failure or loss of input power, the remaining module continues to supply the power alone. Switch-over is thus automatic and does not disturb normal operation.

The MP-2100/MP-2104 chassis can use both AC and DC power supply modules. The current PS module versions are listed below:

- DC-powered modules: PS/48 and PS/24. The modules operate on -48 VDC and 24 VDC, respectively (nominal voltage is marked on the module panel), and can provide line feed voltages (-48 or 24 VDC) to the I/O modules installed in the chassis, through an internal bus.

These voltages are sufficient for most voice modules, however when a higher voltage is required (for example, for ISDN modules), it must be provided by an external source.

- AC-powered modules: PS/110 and PS/230, operate on 110 VAC and 230 VAC, respectively (nominal voltage is marked on the module panel). For these modules, when line feeding is needed it is necessary to use an external voltage source.

### Feed and Ring Voltage Sources

MP-2100 PS modules can be connected to an external feed and ring generation voltage source, for example, the Ringer-2200N standalone unit offered by RAD. The connection is made as follows:

- AC-powered PS modules have a separate connector for -48 VDC

- DC-powered modules derive the -48 VDC or 24 VDC feed voltage from the DC input voltage.

RAD offers the following options for providing the required feed and ring generation voltages:

- Ringer-2100R module, a 4U-high double-width auxiliary module that can be installed in any pair of adjacent I/O slots of the Megaplex-2100. This module generates the required voltages and distributes them to the modules installed in the chassis through an internal bus.

In addition, the same voltages are available on a front-panel output connector, for connection to other units or direct connection to the DC feed and ring input connectors located on various types of modules. The Ringer-2000R can be ordered for operation on AC or DC.

- Standalone Ringer-2000 unit, intended for installation in 19" racks. Provides 10 outputs that can be connected by means of cables to the power supply interface modules, or directly to the connectors located on modules that require external ring and feed voltages. Supports up to 60 active channels.
- Standalone Ringer-2200N unit, intended for installation in 19" racks. Supports up to 120 active channels.

### PS Modules for Megaplex-2104

The Megaplex-2104 chassis includes an internal power supply. The AC-powered power supply module can operate on AC input voltages in the range of 100 through 240 VAC, and the DC-powered module operates on either -48 VDC or 24 VDC (according to order).

As an option, the Megaplex-2104 can also be ordered with an internal ringer (the RI option), to provide battery (line feed) and ring voltages for the modules installed in the chassis.

## Auxiliary Modules

In addition to the Ringer-2100R module described above, RAD offers the ACM alarm control module.

The ACM module provides two main functions:

- **Input ports** – enable the Megaplex management system to read inbound indications from external sources. The ACM module has eight inbound ports, which can be used to sense conditions external to the Megaplex unit (e.g., read the state of external sets of relay contacts, and environmental sensors), and report them to the management station, using user-configurable alarm strings.
- **Output ports** – provide outbound indications and control signals by means of dry relay contacts controlled by the Megaplex management system. The ACM module has four outbound ports equipped with change-over dry relay contacts. The relay contacts can be used to report internal system alarms to outside indicators, e.g., lights, buzzers, bells, etc., located on a bay alarm or remote monitoring panel, and to control external devices or applications (fans, dialers, backup power sources, etc).

For additional details, refer to the *ACM Installation and Operation Manual*.

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## 1.3 Functional Description

This section provides a functional description of the Megaplex system and describes its main features.

For background information on the operating environment of Megaplex systems, refer to [Appendix B](#).

### System Structure

Each Megaplex chassis version has physical slots in which modules are installed by the user to obtain the desired multiplexer configuration. The number of slots is 16 for the MP-2100 version, and 6 for the MP-2104. Any multiplexer configuration includes the following subsystems:

- Control subsystem, can include one or two common logic (CL) modules.
- Power supply subsystem, can include one or two power supply (PS) modules.
- Multiplexing and network interface subsystem, can include several main link (ML) modules.
- User interfacing and processing subsystem. The number of user interfacing modules that can be installed in a chassis is up to 11 for the MP-2100 version, and up to 4 for the MP-2104 version.
- Chassis. The main function of the chassis is to provide interconnections between various modules, and in particular to connect between the user interfacing (I/O) modules, and the main link modules that provide the connections to the network.

The common logic and power supply modules are always installed in their dedicated chassis slots, whereas the main link and user interfacing modules can be installed in any of the other chassis slots (called *I/O slots*).

Any Megaplex system must include at least one main link module, one common logic module, and one power supply module. These modules are thus referred to as *system modules*. User interfacing modules, called I/O modules, are added to this basic configuration.

Where necessary, additional system modules may also be added, to obtain configurations with extended capabilities, for example, redundancy.

### Megaplex Functional Block Diagram

[Figure 1-10](#) shows the functional block diagram of the Megaplex system.

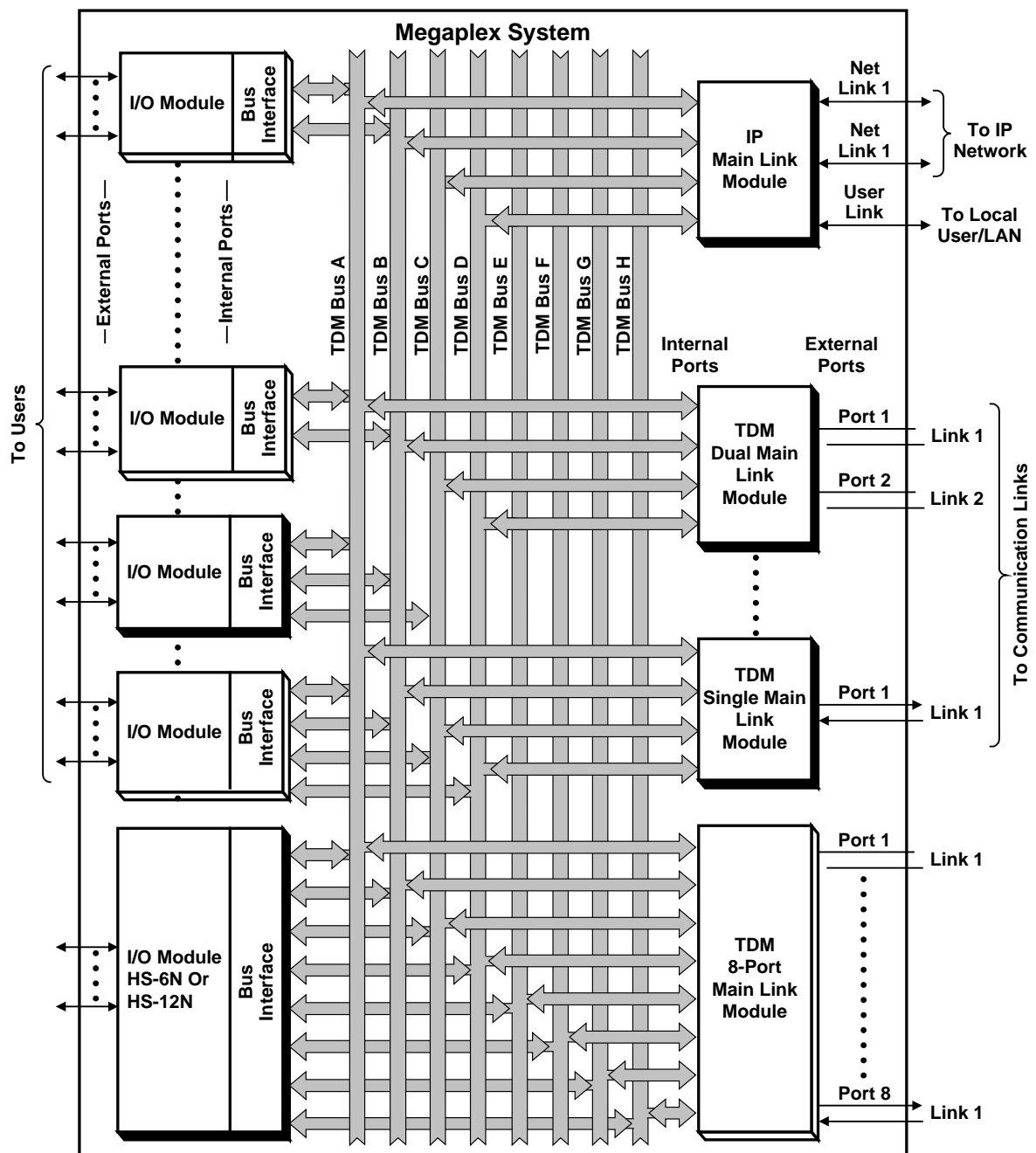


Figure 1-9. Megaplex System Organization

The Megaplex system performs the multiplexing function by controlling the flow of data among the main link and I/O modules installed in the Megaplex chassis in accordance with customer's requirements.

The flow of data is performed through a set of TDM buses, as shown in [Figure 1-10](#):

- An I/O module has external ports that connect to the local user's equipment, and bus interfaces which connect to the TDM buses of the chassis. Internal ports connect the module circuits to the bus interfaces.

- A main link module has external ports (called *network* or *main link interfaces*) that connect to communication links, and bus interfaces which connect the module to the TDM buses of the chassis.

## TDM Bus Functions

The TDM buses serve as a highway through which all the information processed by the Megaplex flows. Any module deposits information received through its external ports on one to eight TDM buses, and simultaneously collects the information to be sent through its external ports from the desired buses. The information is deposited and collected in discrete time intervals, called timeslots. A timeslot supports a data rate of 64 kbps.

The main function of the common logic subsystem with respect to the TDM buses is to configure the reading and writing of data by each module in accordance with the user requirements. Therefore, considerable flexibility is available with respect to routing, because each module has access to all the information, and can be instructed to read and write the desired information in the desired timeslots of the TDM buses.

Note that this operating mode requires that all the modules access the bus at accurately controlled instants, because even small deviations may cause errors. Therefore, to ensure correct system operation, the timing of all the TDM buses, main link ports and I/O modules must be locked to a common nodal clock.

### ***TDM Bus Bandwidth***

Each Megaplex TDM bus carries data at a rate of 2.048 MHz. The bus data is structured as frames having a repetition rate of 8 kHz; each frame comprises 32 timeslots, where each timeslot includes 8 bits (one byte).

#### **Note**

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*For some modules, one of the timeslots must be reserved for overhead, leaving only 31 timeslots available to carry user's payload. Modules that can use the full bus bandwidth (32 timeslots) are identified in Table 1-1.*

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Since each timeslot contains eight bits, the Megaplex system enables the user to improve bandwidth utilization, by providing the capability to perform routing at the individual bit level (that is, in units of 16 kbps, or pairs of bits). This capability, called split timeslot assignment, is used only for low-speed channels which do not require allocation of a whole timeslot (64 kbps).

### ***Number of Utilizable TDM Buses***

The number of TDM buses that is available in a Megaplex chassis operating with any previous software version is 2 (these TDM buses are designated A and B). Starting with software version 7.0X, the number of available TDM buses is 4. These additional 2 TDM buses are designated C and D. Starting with software version 12.0X, there are 4 additional TDM buses designated E, F, G, H. These buses are used by the 8-port main link modules working in conjunction with the HS-6N or HS-12N modules.

Only modules having the appropriate hardware can access the larger number of buses. Not all the modules available for the Megaplex system have this capacity.

*Table 1-3* lists the modules that can access more than two TDM buses: the other modules can use only the buses A and/or B.

*Table 1-3. Modules with Access to More than Two TDM Buses*

<b>Module Type</b>	<b>Number of Internal TDM Buses</b>
ML-IP	A,B,C,D buses
ML-20N/1, ML-20N/2	A,B,C,D buses
ML-2 with hardware revision 2	A,B,C,D buses
ML-8E1, ML-8T1	All 8 buses
HS-6N, HS-12N	All 8 buses
HS-RN	A,B,C,D buses
HS-U-6, HS-U-12	A,B,C,D buses
HSF-1, HSF-2	A,B,C,D buses
VC-4, VC-4A, VC-8, VC-8A, VC-16	3 buses (A, B, C or B, C, D)
VC-16A	A,B,C,D buses
HS-ETH	Buses A, B or C, D (in accordance with order)
HS-ETH/SW	A,B,C,D buses
VF-24, VF-30, VF-48, VF-60	A,B,C,D buses

## Main Link Module Functions

### *TDM Main Link Module Functional Block Diagram*

*Figure 1-11* shows the functional block diagram of a typical dual-link TDM main link module. An 8-port main link module block diagram is similar, differing only in the number of ports (8) and buses (8). The module includes TDM bus interfaces, a full-function cross-connect matrix, link interfaces and a test subsystem.

The TDM bus interfaces collect information intended for transmission by the main link module from the chassis TDM buses, and deposit the received information on these buses.

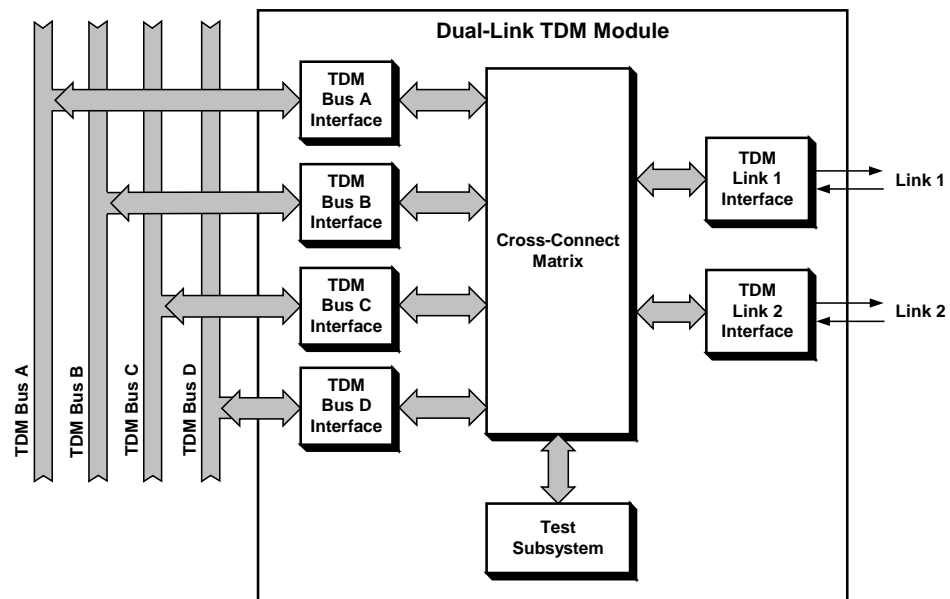


Figure 1-10. Typical Dual-Link Main Link Module, Functional Block Diagram

The cross-connect matrix performs the following functions:

- Controls the signal flow between the link interfaces and the four chassis TDM buses.

**Note**

*The matrix also controls the flow of inband management traffic between the CL module and the appropriate link interfaces. The management connection is not shown in the simplified diagram of Figure 1-11, because it uses a different communication channel and therefore does not occupy timeslots on the TDM buses.*

- Enables bypassing of timeslots between the two main link ports, without requiring bandwidth on the chassis TDM buses.
- Supports unidirectional routing of timeslots, and broadcasting from one timeslot to multiple destinations (these functions are described in [Chapter 7](#)).
- Provides full control over the routing of the signaling information associated with each timeslot (called **Channel-Associated Signaling** – CAS), as well as over the formatting of the signaling information (see [Handling the Channel-Associated Signaling Information](#) below).
- Routes signals from the test subsystem toward the local and remote sides, to support the following test and diagnostic functions:
  - Local and remote BERT on channels, ports, bundles, individual timeslots and individual bits in a timeslot.
  - Local and remote loopbacks on channels, ports, and timeslots.
  - Forward and remote tone injection in individual timeslots (voice channels only).

The TDM link interfaces prepare the payload data stream provided by the cross-connect matrix for transmission over the link in accordance with the link type (E1, T1, etc.), and also provide the physical interfaces to the external links.



### IP Main Link Module Functional Block Diagram

Figure 1-12 shows the functional block diagram of a typical IP main link module.

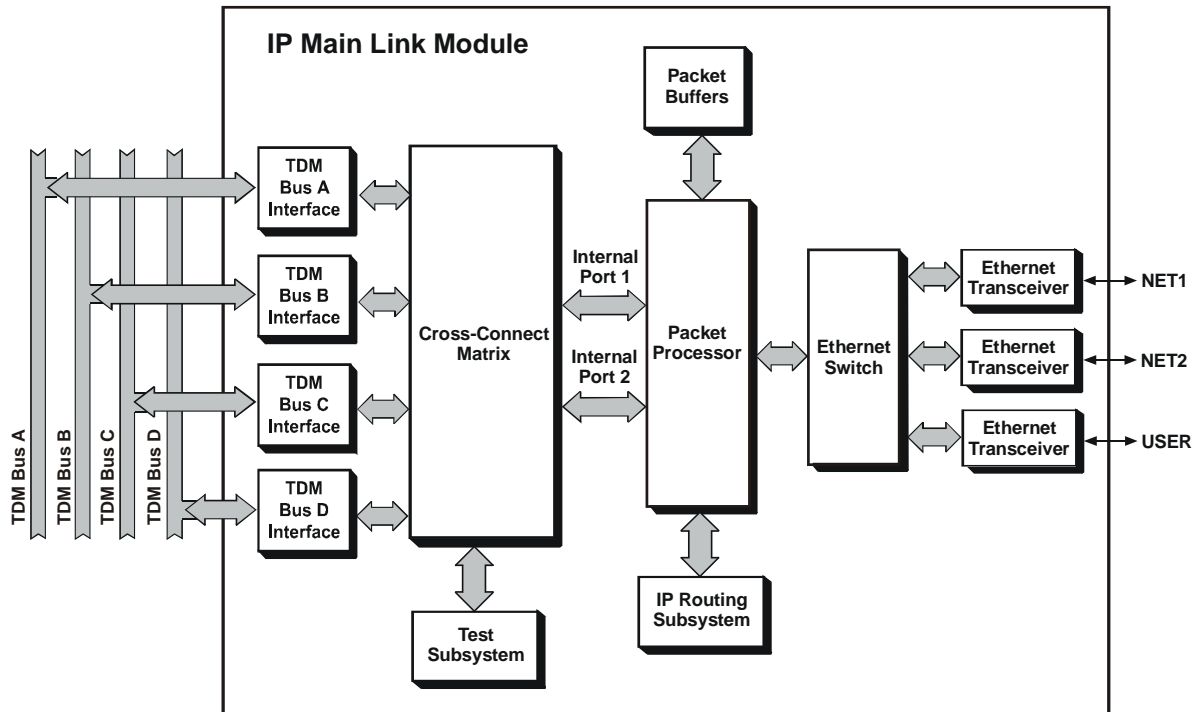


Figure 1-11. IP Main Link Module, Functional Block Diagram

The IP main link module includes TDM bus interfaces, a cross-connect matrix and a test subsystem similar to those of the TDM main link modules. The difference is in the hardware and software used to handle the traffic on the network side:

- **Cross-Connect Matrix.** The cross-connect matrix routes the payload to be transmitted to the network to the two internal TDM ports of the packet processor. Each of these internal ports has 31 payload timeslots.

#### Note

*When robbed-bit multiframe or channel-associated signaling must be transmitted for some of the channels carried through an internal TDM port, timeslot 16 of that port is reserved and only 30 of the port timeslots are available for payload.*

- **Creation of Timeslot Bundles.** The flow of information through the packet processor subsystem is controlled by defining timeslot bundles. A bundle is similar to a virtual internal port: it defines for the packet processor the payload (timeslots) to be routed to a certain user-selected destination in the IP network, and enables the user to specify the associated processing parameters. After associating I/O channels to a bundle, the other configuration activities needed to transport their payload are defined on the bundle. For example:
  - A voice channel will be “connected” to a bundle having one timeslot and CAS support will be enabled for that bundle
  - A 128 kbps data stream from a high-speed data channel will be routed to a 2-timeslot bundle without CAS support.

The bundle can have a minimum bandwidth of 2 bits (16 kbps), which is the minimum bandwidth that can be assigned by means of the cross-connect matrix to a low-speed data channel; the maximum bandwidth is 31 timeslots (1984 kbps).

- **Packet Processor.** The packet processor subsystem performs the functions needed to build packets for transmission over the IP network, and recover the payload carried by packets received from the IP network.

The packet processor has two internal TDM ports that connect to the internal TDM buses through the cross-connect matrix, and one packet port that connects to the network through the Ethernet switch (actually, the packet processor also has a port for CL management traffic directed to the IP network, whose utilization depends on the user's configuration). The network port of the packet processor is assigned a unique IP address. This address is therefore shared by the two associated internal TDM port and by the associated bundles.

The main functions performed by the packet processor are as follows:

- **In the transmit-to-network direction:**
  1. Separates the data received through each internal TDM port into separate bundles, as specified by the user.
  2. Fragments the continuous data stream of each bundle into slices having the size specified by the user ( $N \times 48$  bytes, where  $N$  is 1 to 8).
  3. Adds the overhead necessary to transmit each splice over the packet network and builds packets for transmission to the desired destination (see detailed description of process in [Appendix B](#)).

- **In the receive-from-network direction:**
  1. The packets retrieved from the received Ethernet frames are stored in packet buffers. Each bundle has its own buffer.

The function of the packet buffers is to enable the packet processor to read the bundle packets in the order and at the rate of the original data stream of each bundle. For each bundle, the received packets are loaded into the buffer immediately after being successfully received from the network, and are read out of the buffer and transferred to the packet processor at a fixed rate, which is equal to the original data payload rate of the bundle (see details below).

Therefore, these buffers are used to compensate for irregular variations (jitter) in the packet arrival time, caused by variations in the network transmission delay. The buffer size can be selected by the user in accordance with the expected jitter for each bundle (the size adjustment range is  $\pm 3$  to  $\pm 300$  msec).

Because of their function, these buffers are called *jitter buffers*.

2. The packet processor recovers the payload carried by the packets and restore the bundle data streams. The received bundle data streams are then sent through the internal TDM ports to the cross-connect matrix. The cross-connect matrix inserts the received data of each bundle into the prescribed timeslots of the appropriate TDM bus, to make it

available to the local I/O channels, or bypasses data to the other internal TDM port.

When an internal TDM port is configured to support channel-associated signaling, the packet processor will also handle the transmission of the signaling information associated with the payload carried by each bundle.

- **IP Routing Subsystem.** To enable IP communication, an IP routing subsystem is used to find, for each bundle, a route to its destination through the IP network (refer to *Appendix B* for a description of the IP routing process).

The IP addressing information that must be specified by the user includes two basic items:

- The source IP address, which is actually the IP address of the packet processor network port. Since the packet processor serves both internal TDM ports, both ports have the same IP address.
- The destination IP address. The user can specify separate IP addresses for each bundle.

When the destination address is not within the local IP subnet of the bundle source address, an additional item is needed – the next-hop IP address. The next-hop address is used to direct the bundle traffic to an IP entity (usually a port of an IP router) that can find a route to the desired destination.

When a new destination is added, the IP routing subsystem generates ARP requests to find the destination MAC address, and will also respond to ARP requests directed to the module (the ARP response will specify the MAC address of the relevant Ethernet port of the module).

Using the routing information entered by the user and the MAC addresses discovered by means of the ARP protocol, a route to the destination can be found. When the IP main link module and the destination are not in the same IP subnet, the route to the destination is automatically found by the IP routers which serve the IP network.

The route to the destination is therefore found in accordance with the standard IP routing processes, for example – using the standard RIP2 protocol. During this process, the routers in the IP network collect information discovered on the various available routes between the source and the destination. When more than one route can be used, the routing protocol determines the preferred route only in accordance with its built-in criteria, because the basic addressing information described above does not provide any control over the selection of a specific route.

To enable the user to influence the routing process, it is possible to provide additional routing information, by defining static (permanent) entries in a local IP routing table. Each of these entries includes the destination address and the corresponding next-hop address.

In addition, each static entry includes a user-specified metric, for the corresponding next-hop address. This metric specifies the maximum number of hops the transmitted packets can pass, before being discarded.

- **Ethernet Switch.** The flow of Ethernet traffic within the module is controlled by means of a multi-port Ethernet switch. Each switch port can handle 10 or 100 Mbps traffic, independently of the other ports, and it automatically adapts to the operating mode of the corresponding external port.

The Ethernet switch provides the following main traffic routes:

- Between the packet processor and the two external Ethernet ports serving as uplink ports (ports to the network). This permits the packet processor to send and receive frames through any of the uplink ports in accordance with user's configuration and the routing decisions made by the module routing subsystem.

When VLAN tagging is used, the user can specify, for each bundle, whether the frames will be routed to a specific external port, or let the external port be automatically selected in accordance with the VLAN ID.

- Between any pair of external Ethernet ports. This permits Ethernet traffic applied to any external port to appear at the other external ports. Since each port can operate at either 10 Mbps or 100 Mbps, the frame formats are automatically translated when ports operate in different modes.
- **Ethernet Ports.** The IP main link module has three independent Ethernet external ports, each having its own Ethernet transceiver, which handles all the tasks needed to access the physical transmission media. The NET 1 and NET 2 ports can be ordered with 10/100BaseT or 100Base-FX transceivers; the USER port has a 10/100BaseT transceiver. Each Ethernet port has its own unique MAC address.

10/100BaseT transceivers are capable of 10 Mbps and 100 Mbps operation, in either the half-duplex or full-duplex mode. The operating mode of any port can be configured manually by the user, or selected automatically determined by auto-negotiation.

## Internal Timeslot Assignment Algorithm

The assignment of timeslots on the internal TDM buses is performed by a special algorithm that takes care of all the internal operations needed to achieve the routing specified by the user while providing full cross-connect capability. The assignment is translated to actual routing of payload information by means of the cross-connect matrices located on each main link module.

The matrix can be used to perform the following functions:

- Connect an I/O channel to the destination specified by the user. This is performed by connecting the desired timeslots from the TDM buses to the desired internal ports:
  - For TDM main link modules, the destination is a port or timeslot specified by the user. This permits to route any I/O channel to any timeslot of any main link port installed in the chassis.
  - For IP main link modules, the equivalent operation is connection to timeslot bundles.
- Bypass timeslots between main link ports.

When the ports are located on the same module, bypassing permits to route any main link timeslot to any desired timeslot of another main link without occupying bandwidth on the chassis buses. For IP main link modules, the bypassing is performed between the two internal TDM ports of the module.

- Route management traffic to a designated main link port (or timeslot bundle).

When using channel-associated signaling, the timeslot assignment algorithm also routes the signaling information associated with each channel in parallel with the channel data.

### ***Full Cross-Connect Capability***

The timeslot assignment algorithm takes advantage of the full cross-connect matrix of main link modules. As a result, the internal routing is performed in two stages:

- The payload of an I/O channel is assigned the required number of timeslots on one or more of the internal TDM buses
- The cross-connect matrix of the main link module to which the channel is routed collects the assigned timeslots from the TDM buses and inserts them in the assigned timeslots of the frame generated by the destination port.

A similar process is used to bypass timeslots between main link ports and/or timeslot bundles:

- Timeslots bypassed between ports or bundles located on the same module are directly routed through the local cross-connect matrix of the module, and do not appear on the TDM buses
- Timeslots bypassed between ports or bundles located on different modules are assigned timeslots on the TDM buses, and the local cross-connect matrix of the each module routes the port/bundle timeslots to the assigned bus timeslots.

The algorithm operates automatically and is completely transparent to the user. Therefore, the user needs only to specify the destination (main link port or bundle and timeslots), and the algorithm finds the necessary number of free bus timeslots and performs all the required connections to route the channel to the specified destination.

### ***Support for 4 or 8 TDM Buses***

The timeslot assignment algorithm supports the 4 or 8 TDM buses available in the Megaplex chassis (depending on the modules installed), and permits using all the timeslots available on each chassis TDM bus.

Although the algorithm supports the maximum number TDM buses available, there are modules that do not support connection to all the available TDM buses (see the *Number of Utilizable TDM Buses* section on page 1-22). In this case, the system automatically routes the payload of any such module only to the TDM buses supported by it. If a problem occurs as a result of restrictions on the number of buses that can be used, the system will generate an alarm.

### ***Unidirectional Broadcast Function***

The unidirectional mode enables a user at a central location to send data or voice to multiple users connected to remote Megaplex units (simplex communication). In this mode, any message is simultaneously received by all the remote unidirectional users, but none of them can send back data to the originator.

This capability is achieved by separating the handling of the receive and transmit paths for the timeslots assigned for the unidirectional channels. As a result, the

user can specify the operating mode of each unidirectional channel either as unidirectional transmit, or unidirectional receive:

- **Unidirectional transmit:** the I/O channel transmits, but cannot receive (its receive path is disconnected). The information transmitted by the channel can be routed to any number of main link ports and/or bundles, for distribution to multiple remote Megaplex units, in accordance with user's configuration.

The number of internal TDM bus timeslots that must be assigned to the channel is equal to the number needed to support the channel data rate. No additional timeslots are required when the channel is routed to several main link ports, because each main link port or bundle extracts the payload from the same TDM bus timeslots.

The selection of the main link or bundle timeslots assigned to the channel is made during the configuration of timeslot utilization at each destination.

- **Unidirectional receive:** the I/O channel receives, but cannot transmit (its transmit path is disconnected). The user can select the main link port or bundle from which the channel receives, and the specific timeslot(s). When necessary, the same main link port or bundle can be connected to several channels operating in the unidirectional receive mode.

Main link or bundle timeslots connected to channels operating in the unidirectional receive mode can also be bypassed to other main link ports or bundles.

The number of chassis TDM bus timeslots that must be assigned to a main link port or bundle is equal to the number needed to support the channel data rate, irrespective of the number of channels connected to that port/bundle.

To simplify the routing activities performed during channel configuration, the user can select between two timeslot mapping modes:

- **User:** in this mode, the user selects the individual timeslots of the destination main link port/bundle.
- **Sequence:** in this mode, the user specifies only the starting timeslot of the destination main link port/bundle. The required number of timeslots (which depends on the channel data rate) is automatically assigned as one service bundle, i.e., consecutive main link timeslots are assigned to the channel, starting with the specified timeslot.

When using the unidirectional broadcast mode, it is necessary to instruct each main link port or bundle how to handle the traffic flow and signaling information. This is performed by defining the timeslot type.

For regular bidirectional channels, the timeslot types are **data**, **voice**, and **management** (see **DEF TS** command in Chapter 4). The additional selections available for the unidirectional broadcast mode are as follows:

- **Unidirectional broadcast – data:** the timeslot is handled as a data channel. This means that any signaling information associated with the channel is ignored.
- **Unidirectional broadcast – voice:** the timeslot is handled as a voice channel. This means that:

1. It is necessary to select a main link framing mode that supports channel associated signaling (e.g., G.704 multiframe (G.732S), SF (D4) or ESF).
2. The signaling information of the channel is routed (automatically) in parallel with the channel payload.

### ***Bidirectional Broadcast Function***

The bidirectional broadcast mode enables a user at a central location to communicate half-duplex with several users connected to remote Megaplex units. In this mode, any message sent by the user at a central location is simultaneously received by all the remote bidirectional broadcast users. In addition, at any time, one of these remote users can answer the originator by inserting a message in the appropriate timeslots.

As for the unidirectional broadcast capability, the bidirectional broadcast capability is also the result of separating the handling of the receive and transmit paths for the timeslots assigned to bidirectional channels.

To use the bidirectional broadcast mode, the user at the central location is configured to use the regular (bidirectional) mode, and therefore it can both transmit and receive. The other users are configured to use the bidirectional broadcast mode: this mode is similar to the unidirectional receive mode, except that at any time one of these users (and only one) can transmit to (and be received by) user A. This mode of operation is used in polled applications.

The additional timeslot types available for the bidirectional broadcast mode are as follows:

- **Bidirectional broadcast – data:** the timeslot is handled as a data channel. This means that any signaling information associated with the channel is ignored.
- **Bidirectional broadcast – voice:** the timeslot is handled as a voice channel. This means that:
  1. It is necessary to select a main link framing mode that supports channel associated signaling (e.g., G.704 multiframe (G.732S), SF (D4) or ESF).
  2. The signaling information of the channel is routed (automatically) in parallel with the channel payload.

### **Handling the Channel-Associated Signaling Information**

As explained in [Appendix B](#), when the CAS (legacy) method is used, the signaling information of each channel is carried by means of up to four bits (*signaling bits*), designated by the applicable standards as bits A, B, C, and D.

The number of bits actually available for carrying signaling information, and the data rate at which signaling information can be transferred depend on the main link type (E1 or T1) and the framing mode being used, which are determined by the applicable international standards.

#### **Note**

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*When configured to support CAS, IP main link modules transparently transfer the signaling information.*

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The information appearing in the signaling bits can be provided either by the voice interface modules installed in the Megaplex, or by digital PBXs or local exchange trunks connected by E1 or T1 trunks to one of the E1 or T1 ports of the Megaplex.

### ***Signaling Format Conversions***

Digital PBXs and local exchanges often use dedicated signaling protocols to exchange the signaling information through the E1 or T1 trunk bits assigned to CAS, and therefore interpret the state of CAS bits in proprietary ways.

The Megaplex systems can be configured to perform signaling protocol conversions, for example – to enable the termination of PBX timeslots by one of the Megaplex voice modules, to connect a PBX to PSTN lines, etc.

For this purpose, the format of the signaling information is defined by specifying a profile. The interpretation of the profile defines the information carried by each signaling bit transmitted by each port, and the signaling bit read by the receive path (normally, the bits at both ends of a link are used in a similar way, however the signaling mechanism of the Megaplex main link modules also provide flexibility in the selection of the received bit).

The Megaplex supports the definition of five different profiles, corresponding to various interoperability requirements.

The user can assign a separate profile to each TDM main link port, and to each internal TDM port of an IP main link module.

### ***Support of R2 Signaling Protocol***

The R2 signaling protocol is a type of channel-associated signaling protocol for E1 trunks that enables the setting up, metering and disconnection of phone calls using decadic pulse dialing.

The processing of the signaling information for transmission through the E1 trunk is performed by the main link module. Therefore, any type of voice channel is able to use the R2 protocol for setting up calls, simply by being routed to the desired timeslot of a main link port configured to use the R2 protocol.

The user can specify, for each timeslot of a main link port using the R2 protocol, the call setup permissions: incoming, outgoing or both. This determines whether the subscriber connected to the corresponding voice channel can use the line freely, or can only accept or only initiate calls.

The selection between regular (“legacy”) channel-associated signaling and the R2 protocol is also made by means of profiles. As a result, each main link port can be configured to use either legacy CAS (with or without signaling conversion) or the R2 protocol.

When defining a profile for the R2 protocol, the user can select the type of link, to enable the protocol to adapt its delay parameters to the link delay:

- Terrestrial link, with relatively low delay
- Satellite link, with high delays.

In addition to selecting the link type, the user can let the Megaplex to automatically select the appropriate default parameters, or can select manual configuration of R2 protocol parameters. Although the basic R2 protocol is defined in ITU-T recommendations, national PTT administrations often implement variations in accordance with their specific requirements.

To support these variations, the user can select among the following predefined R2 implementations:



- One of these implementations matches the ITU-T Rec. Q.421 implementation
- Five other implementations are selected in accordance with national standards: Argentina, Brazil (continuous and pulsed versions), India, Korea.

In addition to these predefined selections, additional sets of parameters are left for free user's selection.

### ***Compatibility with IPmux Signaling Protocols***

The default format of the signaling information inserted in the packets transmitted by Megaplex IP main link modules is different from the format used by the IPmux family of TDMoIP gateways offered by RAD.

To achieve compatibility when an IP main link module provides links to IPmux units, the user can adapt the signaling protocol by configuring the type of remote equipment, and the framing mode (ESF or SF (D4)) when the IPmux interface is T1.

### ***Support for National Protocols***

The national protocol is used to specify the following types of service parameters:

- Priority in case of collision between the local and far end call set up requests
- Configure the parameters that control the response to line fault conditions, detection of on-hook, off-hook and hook-flash states, etc.
- Define specific ring cadences. Up to 10 different ring cadences can be defined, where each cadence can include up to 4 pairs of distinct ringing/silence intervals.

## **System Timing Considerations**

One of the critical requirements of digital communications networks is timing accuracy. The basic requirement is to synchronize all the equipment in a network to the same timing source, that is, all the equipment in the network must operate at exactly the same clock rate, or at some sub-multiple thereof.

If this condition is not met, then from time to time bits transmitted between two equipment units that operate at even slightly different clock rates will either be lost, or the same bit may be read twice. Such occurrences, that lead to the loss of bit count integrity, are highly undesirable and may cause severe and periodic disruptions in network operation.

Many networks use very accurate timing sources, such as atomic clocks, to provide the primary timing signals to the main network nodes, e.g., telephone switching offices, digital switches, etc. From the nodes, the timing is disseminated via the communication links.

Since very accurate timing sources are often free-running, communication equipment usually includes "elastic" buffers that absorb small timing differences. An elastic buffer is a first-in, first-out (FIFO) memory with separate write (input) and read (output) clocks. For example, such buffers are used in the receive paths of the Megaplex main link modules.

## Overview of Megaplex System Timing Modes

The Megaplex system is designed to support reliable propagation of the timing information, even when the Megaplex units are interconnected only through an IP network. For this purpose, all the chassis clock signals are derived from a common clock signal, called the system or nodal clock, and flexible system timing options are available.

The following sections explain in detail the distribution of clock signals in Megaplex units, and in systems using Megaplex equipment.

### ***Main Link Receive Path Timing***

The receive path of a main link port always uses timing signals derived from the clock recovered from the receive signal of the same main link port.

This is also true for the Ethernet ports of the IP main link modules. However, for Ethernet ports, the receive clock is not of any real importance, because the receive signal consists of discrete frames, which are relatively short. Thus, large timing errors can be easily tolerated, because the errors are reset at the beginning of each frame and do not accumulate.

For TDM ports, the recovered clock is a clean and stable signal, which can be used as a reference for the nodal clock. However, the receive clocks used by the Ethernet transceivers of the IP main link modules cannot be used as nodal clock references, and therefore are used only within the module itself.

### ***Main Link Transmit Path Timing***

**Note**

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*The following discussion is relevant only for the transmit paths of TDM main link modules, because the transmit timing of the packet (for example, Ethernet) ports is not critical.*

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The source of the timing signals used by the transmit path of any TDM main link, starting with the read-out of transmit data from the chassis TDM buses and up to the transmit data rate of each TDM link interface, is always the nodal clock. This is also true for the transmit rate of each timeslot bundle carried by IP main link modules, but it is not relevant for the Ethernet ports transmit timing. The bundle rate is always a submultiple of the Megaplex nodal clock, in accordance with the number of timeslots in the bundle (or bits for split timeslot assignment).

The nodal clock can be locked to another clock signal (called timing source, or reference source), which can be selected in accordance with the communication system requirements.

The Megaplex uses an internal timing bus that can carry timing signals from several sources. The sources that can be used include each recovered main link receive clock, each transmit clock applied to a data channel that operates in the DTE timing mode, an external station clock, and an internal crystal oscillator. Moreover, the recovered clock signal of any bundle carried by an IP main link module can also be used as a reference for the nodal clock.

The desired source is selected in accordance with user's commands. The resulting transmit timing modes are:

- Internal timing, derived from the free-running clock signal generated by an internal crystal oscillator. When several main link modules are installed in the

chassis, the module that will provide the timing reference is automatically selected.

- Derived from one of the received clock signals, using one of the following methods:
  - Loopback timing: timing locked to the clock signal recovered from the receive signal of a selected main link.
  - External timing: timing locked to one of the high-speed data channels.
- Locked to an external clock signal (2048 kbps or 1544 kbps, in accordance with the module interface type, E1 or T1), supplied to the dedicated station clock connector of main link modules.
- Adaptive timing, locked to the recovered timing of a selected timeslot bundle. This mode is available only when IP main link modules are used in the chassis.

To ensure that a reliable timing source is used even when the selected master timing source fails, the Megaplex allows the selection of an additional fallback source.

The fallback source is automatically connected when the main source fails. If the fallback source also fails, the internal crystal oscillator is automatically selected.

### ***I/O Channel Timing Modes***

The digitizing data rate of voice channels is always locked to the nodal clock. The same is true for asynchronous data channels.

The timing modes available for synchronous data channels are also programmable, thereby permitting each channel to be configured as either DCE or DTE, with buffered retiming of the received data. Connection to the national network and to common-carrier data lines is also supported, with the external clock selectable as the source system timing.

For ISDN channels, the timing mode depends on the port operating mode, LT (TE) or NT.

The timing of internal data processing within modules with packet-switched interfaces, for example, those of Ethernet and token-ring bridge modules, is derived from the nodal timing, but the timing of the external interfaces is not locked to the internal timing.

### **System Timing Modes**

The main characteristics of each system timing mode are explained in the following sections.

#### ***Internal Timing***

The source for the internal timing signals is a crystal oscillator located in the main link module. The timing accuracy of the internal oscillator is  $\pm 32$  parts per million (ppm). This accuracy corresponds to a Stratum 4 clock.

*Figure 1-13* shows a basic network configuration that uses the internal timing mode in conjunction with loopback timing.

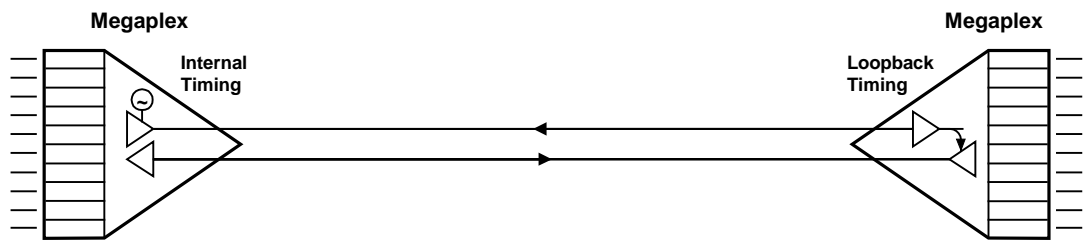


Figure 1-12. Network Using Internal Timing

The internal timing mode can be used in point-to-point links and in independent networks. In any system, only one unit may operate with internal timing: all the other units must use loopback timing to ensure synchronization. In this way, the unit that operates with internal timing is the clock source and determines the timing of the entire network.

### Loopback Timing

With loopback timing, the main link transmit clock is locked to the receive clock derived from the receive data of the same main link module. In effect, with loopback timing the Megaplex is sending back data at the rate data is being received. The loopback mode can be used as shown in [Figure 1-13](#), however there is an additional important application for the loopback mode, as shown in [Figure 1-14](#).

In the configuration of [Figure 1-14](#), two Megaplex units communicate through a link provided by a digital transmission network, e.g., the national network or a private carrier network.

Such networks usually incorporate very accurate timing sources, which are always preferable. Moreover, in many cases these networks will not accept data at a rate that differs from their own rate. Loopback timing then allows to lock the transmit timing of both Megaplex units to the accurate master clock provided by the network.

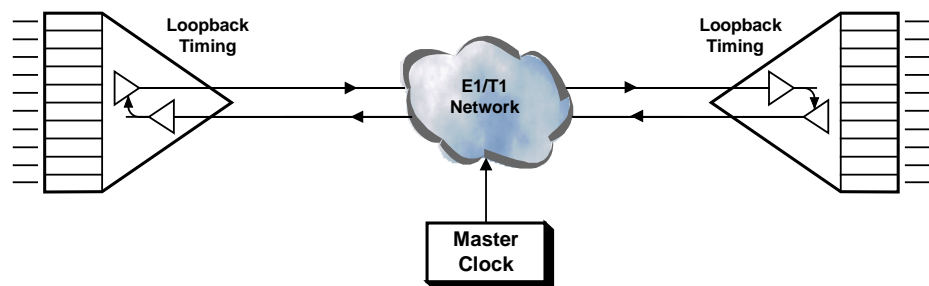


Figure 1-13. Typical Application of Loopback Timing

### External Timing

In the external timing mode, the Megaplex transmit timing is synchronized to the recovered receive signal of an ISDN module operating in the NT mode or to the transmit clock applied to a high speed data channel module that operates in the DTE timing mode. The desired channel is selected by the network management station or supervision terminal operator.

A typical configuration is shown in [Figure 1-15](#).

The external mode is very useful when one of the Megaplex channels, e.g., a high-speed data module, is connected to an AT&T DDS link, or to a similar data network. The DDS network can provide highly accurate timing and will accept only

data with similar accuracy, therefore it is necessary to lock the timing of the Megaplex link to the channel timing.

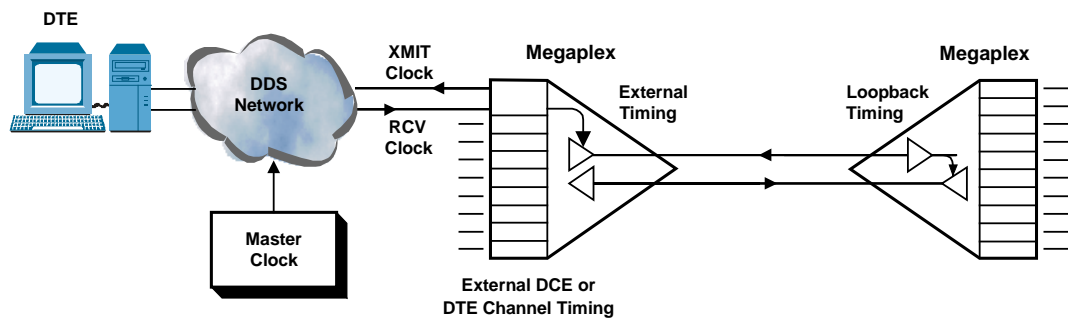


Figure 1-14. Typical External Timing Application

### Station Timing

In the station timing mode, the Megaplex transmit timing is synchronized to an external clock signal, supplied to the dedicated station clock interface, for example, a signal provided by a GPS-based timing source, the clock signals provided by an SDH add/drop multiplexer (ADM), or other suitable clock source.

The flow of timing signals in a basic station timing configuration is shown in [Figure 1-16](#).

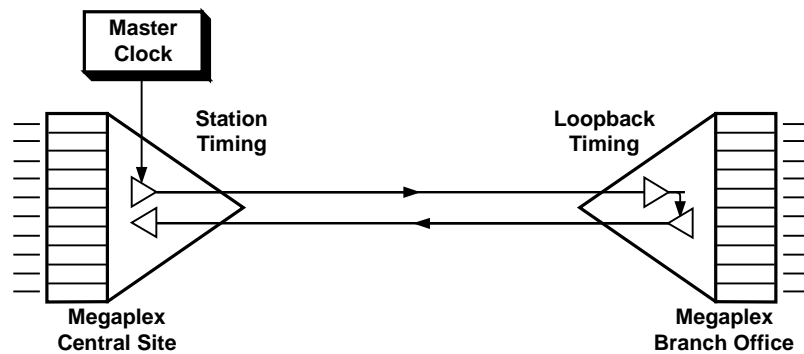


Figure 1-15. Basic Station Timing Application

In this application, the station clock timing, derived from the master clock located at the central site, is also made available to the Megaplex unit located at the remote site (the branch office), by using loopback timing at that site. The external clock signal (2048 kbps or 1544 kbps, in accordance with the interface type of the main link module, E1 or T1) is usually provided by a highly-accurate master clock source, which is often available in communication facilities.

The station clock interface can accept both ITU-T Rec. G.703 unframed “all-ones” signals, and RS-422 squarewave signals. The station clock interface also provides an output clock signal, thereby simplifying the connections required for the distribution of the clock signal to several equipment units installed in close proximity, e.g., in the same equipment rack (the clock interface connectors can be simply connected in a daisy-chain configuration).

The structure of the external clock interface provides a convenient way to distribute clock signals to several equipment units installed in close proximity, e.g., in the same equipment rack (the clock interface connectors can be simply connected in a daisy-chain configuration), as shown in [Figure 1-17](#).

In this application, the clock source is connected to the external clock input in the station clock interface, and serves as the nodal timing reference. The nodal clock signal, appearing at the external clock output, is connected to the external clock input of the next Megaplex, and so on.

To minimize waveform degradation, it is recommended to use the RS-422 squarewave interface, and use high-quality shielded cables, as short as practical.

Note that only the first Megaplex receives the reference signal: the other units receive the clock signal from the Megaplex nodal timing subsystem, which has Stratum 4E characteristics.

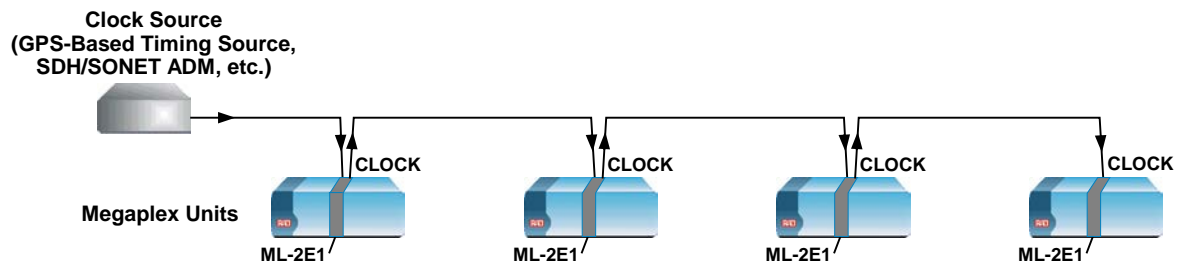


Figure 1-16. Clock Distribution Using ML Station Clock Interface

### Adaptive Timing

Adaptive timing, which is available only for IP main link modules, is a timing mode similar to the loopback timing mode described above, except that the timing reference is the payload receive rate of a selected bundle. Therefore, this mode enables locking the nodal timing of a Megaplex to that of a unit having a stable timing reference source, for example, a unit using station timing, even when the two units are connected only through a packet-switching network. The flow of timing signals between two Megaplex units in a typical adaptive timing configuration is shown in [Figure 1-18](#).

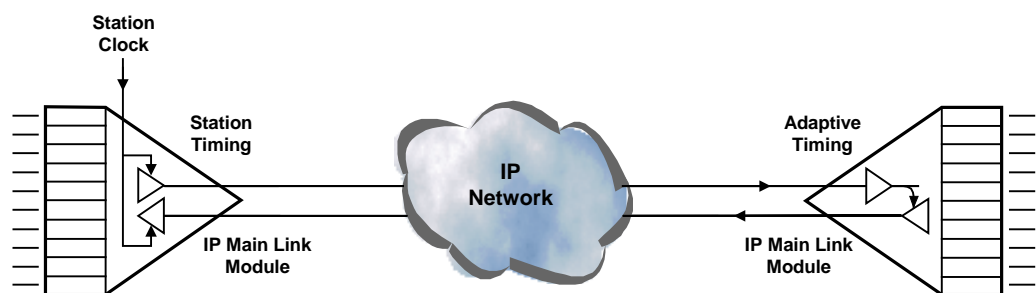


Figure 1-17. Typical Adaptive Timing Application

To support adaptive timing, the IP main link modules use a special adaptive clock recovery mechanism, which recovers the clock signal associated with the payload carried by a user-selected bundle. Actually, two bundles can be specified, one for deriving the main clock signal and another for the fallback clock.

The adaptive clock recovery mechanism operates on the assumption that the IP network does not lose data: in this case, the average rate at which payload arrives is equal to the rate at which payload is transmitted by the source. The original data rate can therefore be recovered by estimating the average rate of the payload data received in the frames arriving from the IP network.

Because of the transmission characteristics of packet switching networks, which use statistical multiplexing, the instantaneous receive rate can vary over a wide range. Therefore, the receive rate must be averaged over a sufficiently long interval. The optimal averaging interval is equal to the difference between the maximum and minimum transmission delays expected in the network, a parameter called delay variation.

IP main link modules use buffers to store packets for an interval equal to the maximum expected delay variation. Therefore, this buffer is also used by the adaptive clock recovery mechanism.

The method used to recover the payload clock of a bundle is based on monitoring the fill level of the bundle jitter buffer: the clock recovery mechanism monitors the buffer fill level, and generates a read-out clock signal with adjustable frequency. The frequency of this clock signal is adjusted so as to read frames out of the buffer at a rate that keeps the jitter buffer as near as possible to the half-full mark. This condition can be maintained only when the rate at which frames are loaded into the buffer is equal to the rate at which frames are removed. Therefore, this mechanism can recover the original payload transmit clock.

To further clean up the signal and obtain a stable signal at the internal chassis reference frequency, the recovered bundle payload clock signal is processed by the internal clock generator. The output signal of the clock generator is a stable signal at the internal chassis reference frequency.

## Data Channel Timing Modes

Data channels operating in the asynchronous mode always use the nodal clock as their rate generator clock.

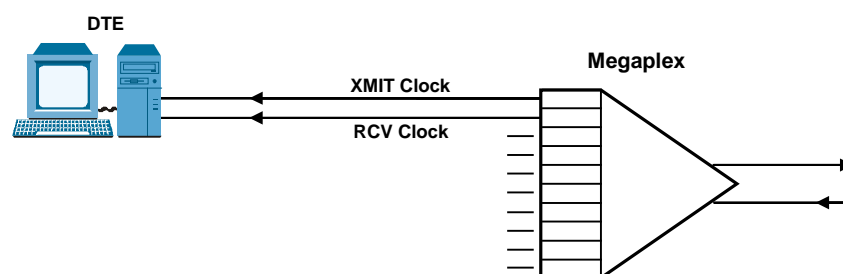
For data channels operating in the synchronous mode, the user can select the channel timing mode in accordance with the application requirements. The various channel timing modes are described below.

### *DCE Timing Mode*

In the DCE mode, the Megaplex data channel provides transmit and receive clocks for the equipment connected to the data channel, as shown in [Figure 1-19](#). The clock signals are derived from the nodal clock.

This mode is usually required for connection to DTE equipment.

Asynchronous data channels also use the DCE timing mode for their internal timing.



*Figure 1-18. DCE Channel Timing Mode*

### External DCE Timing Mode

In the external DCE mode, the Megaplex data channel sends data accompanied by a receive clock to the connected equipment, and accepts transmit data from the equipment according to the equipment clock. The flow of timing signals in the external DCE mode is shown in [Figure 1-20](#).

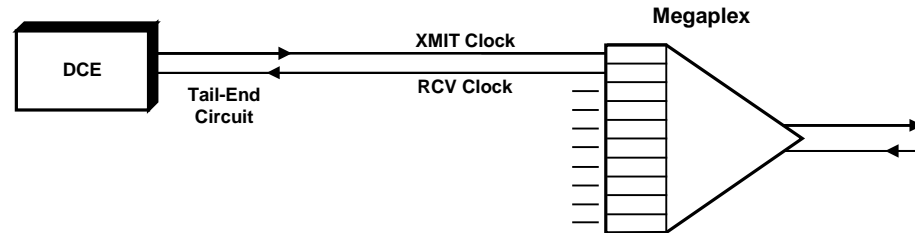


Figure 1-19. External DCE Timing Mode

The external DCE mode requires the equipment connected to the corresponding channel to use loopback timing, because its transmit timing must be locked to the Megaplex nodal timing.

The external DCE timing mode is often required for “tail end” connections, where a modem (DCE) is connected to a data channel. In this case, the remote terminal (DTE) connected to the remote end of the modem link must use loopback timing, thereby ensuring that the rate of data applied to the Megaplex channel transmit input is equal to the receive rate.

### DTE Timing Mode

In the DTE mode, the Megaplex data channel transmits and receives data according to the clock supplied by the connected equipment. To support this mode, the Megaplex unit must use external timing, with the channel operating in the DTE mode being selected as the timing reference source.

The flow of timing signals in a DTE timing application is shown in [Figure 1-21](#).

The DTE timing mode is required in applications such as data channels connected to a digital data switch or to a data carrier network: since the data switch provides the timing reference for the whole network, it must be able to provide clock signals for both the Megaplex and the equipment connected to it.

When operating channels in the DTE timing mode, one of the data channels can be selected as the external source for the entire system timing. To compensate for jitter and short-term instabilities, FIFO buffers are used at the input of each channel. FIFO length is user-selectable, provided the channel is not used as an external clock source.

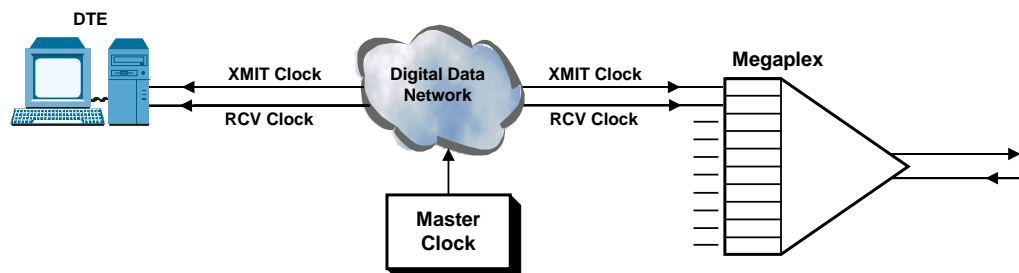


Figure 1-20. DTE Timing Mode



## ISDN Channel Timing Modes

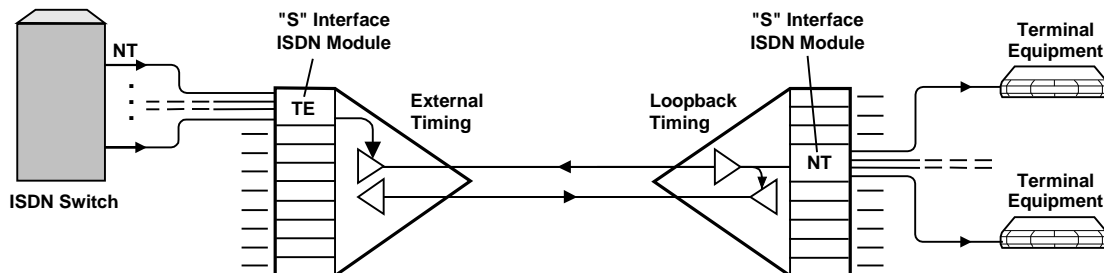
When a Megaplex link is used to connect remote ISDN equipment to the ISDN network, it is necessary to ensure that the timing of the remote equipment is locked to the network timing. Therefore, the operating mode of the Megaplex units must enable dissemination of the ISDN network timing through the Megaplex link. The various timing modes supported by ISDN channels are described below.

In all the modes described below, the receive timing of a port is derived from the incoming ISDN signal, and the transmit timing is derived from the Megaplex nodal clock.

### *Timing Modes for ISDN Channels with "S" Interface*

ISDN channels with "S" interfaces support two timing modes, TE and NT. The TE mode is used to connect an ISDN channel with "S" interface to the network, and the NT mode is used at the remote end.

*Figure 1-22* shows the flow of timing signals in a typical application, and the relationship between the two timing modes.



*Figure 1-21. Timing Modes for ISDN Channels with "S" Interface*

The characteristics of the two timing modes are described below:

- **TE Mode.** In the TE mode, the receive clock of one of the ISDN channels, which is recovered from the line signal received from the network termination unit to which the channel is connected, must be selected as reference for the Megaplex nodal timing.

As a result, the nodal timing is locked to the network timing, and can be distributed to the remote Megaplex unit. This also ensures that the channel transmit timing is also locked to the network timing.

- **NT Mode.** In the NT mode, the Megaplex nodal timing determines the timing of the data transmitted to the user's terminal equipment connected to the "S" interfaces. The receive timing is recovered from the line signal received from the user's terminal equipment. Therefore, to ensure that the same timing is used on the receive direction (from the user's terminal equipment to the "S" interface), the user's terminal equipment must operate with loopback timing.

#### **Note**

*When the ISDN network timing is available at the two Megaplex sites from other sources, for example, from clock distribution units, it is also possible to use the station clock mode at both ends of the link, instead of the timing modes described above.*

### Timing Modes for ISDN Channels with "U" Interface

In general, ISDN channels with "U" interfaces support two timing modes: LT and NT. When the channels are used to connect remote equipment to a network, the channels must operate in the /I mode (see description of this mode in the corresponding module Installation and Operation Manual). The NT-I mode is used to connect an ISDN channel to the network, and the LT mode is used at the remote end.

Figure 1-23 shows the flow of timing signals in a typical application of ISDN channels with "U" interfaces.

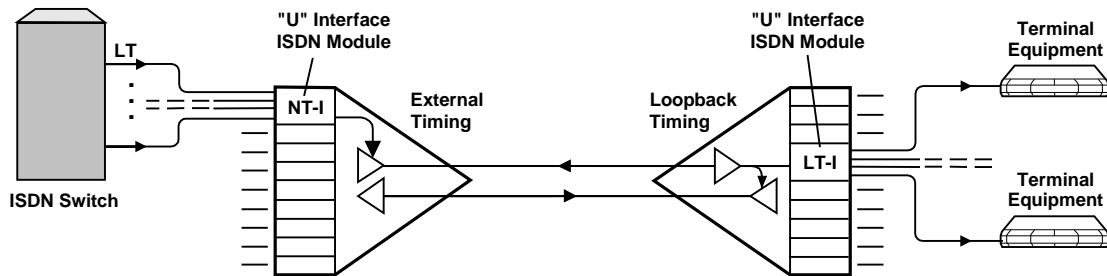


Figure 1-22. Timing Modes for ISDN Channels with "U" Interface

- **NT-I Mode:** In the NT-I mode, the receive clock of one of the ISDN channels, which is recovered from the line signal received from the line termination unit to which the channel is connected, must be selected as reference for the Megaplex nodal timing. As a result, the nodal timing is locked to the network timing, and can be distributed to the remote Megaplex unit. This also ensures that the channel transmit timing is also locked to the network timing.
- **LT-I Mode.** In the LT-I mode, the Megaplex nodal timing determines the timing of the data transmitted to the user's terminal equipment connected to the "U" interfaces. The receive timing is recovered from the line signal received from the user's terminal equipment.

Therefore, to ensure that the same timing is used on the receive direction (from the user's terminal equipment to the "U" interface), the user's terminal equipment must operate with loopback timing.

#### Note

When the ISDN network timing is available at the two Megaplex sites from other sources, for example, from clock distribution units, it is also possible to use the station clock mode at both ends of the link, instead of the modes described above.

## System Management Capabilities

The Megaplex supervision and configuration activities can be performed using supervision terminals, SNMP-based network management stations, and IP hosts using the Telnet protocol.

The activities that can be performed include:

- Megaplex system configuration.
- Reading of Megaplex system status.
- Megaplex system testing.

- Display of alarm status and history.
- Reading of external alarm conditions and generation of control signals by means of relay contacts (for systems including the ACM module).

## Database Management

The Megaplex system is designed for unattended operation. The configuration of the Megaplex system and of each of its modules, that is, the complete collection of the operating parameters, are determined by databases stored in the non-volatile memory of the Megaplex control module, CL (configuration databases).

For flexibility, up to ten configuration databases can be prepared and stored, to cover various system configurations, to enable rapid recovery from critical failure conditions, or to provide optimized configurations at different times of the day, during week-ends, etc.

To simplify the preparation of databases, and to provide network administrators with better control over the individual Megaplex units in their responsibility area, Megaplex systems support the uploading and downloading of Megaplex databases by transferring configuration files using the TFTP protocol.

This enables the network administrators to distribute verified configuration files to all the managed Megaplex units in the network, from a central location.

To further expedite the process, it is also possible to upload the configuration data stored by a Megaplex unit to the management station as a standard disk file, and then distribute this file to other units which use similar configuration.

The uploading and downloading of configuration files is made on-line, through any CL port configured to carry management traffic, without stopping the operation of the Megaplex system. Any PC that supports the TFTP protocol can be used for file transfer.

## Selecting the Active Database

The user can select one of the databases as the active database (the active database is automatically loaded upon power-up). The other databases can be automatically activated in accordance with predefined conditions (time-of-day, certain user-specified fault conditions, etc.).

The conditions for the activation of various databases are defined by means of a special database, called *flip database* – used to flip (switch between) databases.

Since Megaplex units are often operated in networks that include many interconnected links, configuration changes must usually be made simultaneously at several Megaplex units, because this minimizes service disruptions inherent to reconfiguration. For this purpose, the Megaplex system offers two options:

- Synchronized database flipping under manual command. To synchronize network reconfiguration, the manual command is broadcast to all the systems in the network, and the systems execute the flip after a user-selected delay.
- Automatic database flipping, in accordance with the predefined flip conditions.

To enable network-wide automatic flipping, each Megaplex system can be configured to broadcast its status information to the other Megaplex systems in the network, and read the status of the other systems as well. Using the information collected from these sources, each system decides whether to flip to another database.

To support large networks that cover large areas, and to enable to take into consideration the geographical location of the equipment, Megaplex systems support the definition of up to 255 different virtual networks, where each network can include up to 67 Megaplex system.

## Supervision Terminal Capabilities

All the Megaplex supervision and configuration functions, and in particular the initial system configuration activities, can be performed using a “dumb” ASCII terminal (or a PC running a terminal emulation program) controlled by the program stored in the CL module. No information has to be stored in the terminal.

## Management Access through LANs and WANs

CL modules equipped with Ethernet ports can connect directly to Ethernet LANs, thereby enabling local management stations attached to the same LAN to access the Megaplex management subsystem.

Moreover, the Ethernet ports also enable remote management stations to access the Megaplex, provided IP communication can be established to the CL module.

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**Note**

*When a CL module equipped with Ethernet port is installed in a chassis that also includes IP main link modules, the management traffic normally carried by the CL Ethernet port can be transferred through one of the IP main link module ports.*

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## SNMP Management Capabilities

The CL modules include an SNMP agent that enables full SNMP management of the Megaplex. The SNMP agent can communicate either out-of-band or inband.

### ***Out-of-Band Communication through CL Ports***

Out-of-band communication is performed via one of the CL module ports (either a serial port, or an Ethernet port, in accordance with the CL module version). For serial ports, the user can select between the Serial Link Internet Protocol (SLIP) and the Point-to-Point Protocol (PPP); Ethernet ports use IP.

---

**Note**

*The option for transferring the CL management traffic through an IP main link port is actually also a form of out-of-band management, because the management traffic is carried by a separate IP connection, and only the physical interface to the network (the Ethernet port) is utilized in common with the payload. This is different from the situation on TDM main links, for which the management traffic is multiplexed together with the payload in the same signal structure.*

---

When several Megaplex units are managed by daisy-chaining their serial management ports, a RAD proprietary routing protocol is used for management traffic handling. The user can also enable the transmission of RIP2 routing tables

through each port upwards toward the external network (in [Chapter 5](#) and [Chapter 7](#), these ports are referred to as SLIP NMS or PPP NMS ports), thereby enabling the transfer of the internal network topology to routers using the RIP2 protocol.

### ***Inband Communication through TDM Main Link Ports***

The user can select the main bandwidth allocated to management, and the management transmission and routing protocols. The available options are as follows:

- **Within the E1 or T1 frame overhead.** This mode uses a RAD proprietary protocol, which requires a small fraction of the main link bandwidth:
  - For E1 links, the management traffic is carried by means of the national bits in timeslot 0. The number of bits is selectable (1 or 5, corresponding to a data rate of 4 kbps for one bit, and 20 kbps for 5 bits).
  - For T1 main links, the management traffic is carried by the FDL channel. The data rate is 2 kbps.
- **In a dedicated timeslot.** The user can select the desired timeslot. The main link bandwidth allocated to management is 64 kbps.

When using a dedicated timeslot, the user can also select the transmission method:

- RAD proprietary protocol.
- PPP HDLC encapsulation.
- Frame Relay encapsulation in accordance with RFC 1490. In this mode, management messages are encapsulated in frames with a fixed DLCI (always DLCI 100).

When using PPP and Frame Relay protocols, the user can enable the transmission of RIP2 routing tables (separately through each main link), thereby permitting standard RIP routers to reach the SNMP agent through the assigned main link timeslots.

To support large networks, and to take into consideration management domains and the geographical location of the equipment, the SNMP agents support subnetting. For this purpose, the user can define filters for the IP addresses that are learned by its internal IP router. This enables the partitioning of the SNMP-managed network into several subnetworks.

### ***Management Communication through IP Main Link Modules***

When a Megaplex chassis includes both CL modules with Ethernet interface and IP main link modules, the CL Ethernet ports can be disabled and their management traffic can be routed through the external ports of the IP main link module. This saves the costs associated with providing an independent connection between the CL module and the management stations.

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**Note**

*As an alternative to the services provided by the ML-IP module, the CL module can also use ports of the HS-ETH/SW module. See the [HS-ETH/SW Installation and Operation Manual](#) for details.*

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The CL management traffic is handled as follows:

- The CL module traffic directed to the IP network is treated by the IP main link module as any other bundle
- In the receive-from-network direction, the IP main link module transfers to the CL module all the packets of types not processed by the IP main link module (for example, RIP, SNMP, etc.). The IP router of the CL module then analyzes these packets, processes those with management contents and discards the other packets.

To enable the CL module to communicate with management stations through the IP main link module, the IP main link module must also provide the routing services that would otherwise be performed by the CL management subsystem. For this purpose, the CL module downloads a copy of its routing table to the IP main link module, thereby providing the IP main link module with the management routing information.

The IP main link module will also handle ARP requests for the CL management subsystem. Therefore, the IP main link module serves as a proxy server for the CL management subsystem.

### **Remote Management using Telnet over IP**

As an alternative to SNMP management, the CL module also supports the Telnet communication protocol, which enables management using IP communication in parallel with the use of SNMP.

The functions available under the Telnet protocol are similar to those available from a supervision terminal. At any time, only one Telnet management session can be active.

### **Software Updating**

The CL module stores the software that determines the operational and management capabilities of the Megaplex. In addition to the application software stored in the CL module, each module has its own software, stored in firmware.

The software is stored in non-volatile flash memory, and thus it can be easily updated by downloading new software releases. The downloading can be performed in two ways:

- Off-line, using any PC directly connected to the serial port of the CL module. The downloading is performed by means of a small utility, supplied together with the application software on diskettes.
- On-line (without stopping system operation), using TFTP (Trivial File Transfer Protocol), part of the IP suite of protocols, e.g., through the management link connected to a network management station.

## **Diagnostic Capabilities**

The Megaplex system provides extensive diagnostics, supervision and maintenance capabilities for easy maintenance and rapid detection and location of faults.

## Performance Diagnostics

### *Performance Diagnostics for TDM Links*

When a T1 main link with ESF framing is used, the Megaplex can collect full ESF diagnostic statistics in accordance with ANSI Standard T1.403-1989 and provides local support of ESF diagnostics in accordance with AT&T Pub. 54016.

For E1 links, full diagnostic statistics can also be collected using the CRC-4 function.

### *Performance Diagnostics for LANs and IP Links*

Modules with Ethernet ports, for example, IP main link modules, Ethernet switch modules, etc., enables the collection of performance data, which enables the network operator to monitor the transmission performance and thus the quality of service provided to users, as well as identify transmission problems.

Two types of performance statistics are available:

- LAN interface performance statistics, which can be used to monitor the performance at the Ethernet level.
- Bundle performance statistics, which can be used to monitor the quality of transmission through the IP network

Performance parameters for all the active entities are continuously collected during equipment operation.

## Alarm Collection

### *Internal Alarm Collection*

The Megaplex diagnostics include automatic self-test upon power-up, and on-line monitoring of critical functions. The system generates time-stamped alarm messages that cover all the system events. The time stamp is provided by a real-time clock. The system supports five alarm priorities (severity levels), where the priority of each alarm can be customized in accordance with the application requirements.

The priority of each alarm can be defined by the user. For continuous system monitoring, the user can enable automatic transmission of alarm messages through the supervisory ports. The user can also configure the system to send only new alarm messages, or to send the complete current alarm status whenever a new alarm occurs. Alarm messages are also automatically sent as traps when the Megaplex SNMP agent is enabled, and also after the connection to a network management station is established for the first time.

Internally, the CL module stores alarms in two cross-sections:

- **Alarm history buffer** – the CL module can store up to 256 alarm messages, including their time stamps, in its memory. The alarm history buffer is organized as a FIFO queue, therefore after 256 alarms are written into the buffer, new alarms overwrite the oldest alarms.

When using the terminal, or a Telnet host, the user can clear (delete) the alarms stored in this buffer after reading them.

- **Alarm status buffer** – lists all the existing alarms, their state, and the number of times each alarm occurred. The user can clear the alarms that are in the “off” state.

The alarms can be read on-line by the system operator using the network management station, a Telnet host, or a supervision terminal. The system operator can then perform comprehensive testing on each type of module, to determine the causes of alarm messages and to return the system to normal operation.

In addition to the alarm collection and reporting facility, the MP-2100/MP-2104 has two alarm relays with floating change-over contacts: one relay for indicating the presence of major alarms and the other for minor alarms. Each relay changes state whenever the first alarm is detected, and returns to its normal state when all the alarms of the corresponding severity disappear.

The relay contacts can be used to report internal system alarms to outside indicators, e.g., lights, buzzers, bells, etc., located on a bay alarm or remote monitoring panel.

To expedite the handling of alarms, the user can use several tools:

- Masking of alarm conditions, to prevent continuous reporting of known alarm conditions, e.g., during maintenance activities.
- Inversion of selected alarm indications provided to the local operator by the ALARM indicator on the unit front panel and the two ALARM indicators located on the CL module panels, and by the two alarm relays. “Inverted” alarms are ignored while they are present, therefore the user will be alerted only upon return to normal operation.
- Filtering of alarms, to prevent unnecessary reporting of alarms during marginal conditions, which cause frequent changes in alarm states.

### ***External Alarm Collection***

Megaplex can be equipped with the ACM alarm control module. This module has eight inbound ports, which can be used to report alarms external to the Megaplex unit (for example, loss of mains power, air conditioning failures, opening of doors, activation of smoke alarms, etc.) to remote locations.

The alarm indications can be provided by means of contact closures, by environmental sensors connected to the ACM inbound ports, etc. The ACM module is configured by the user to “interpret” the state of each input and report the events to the CL module of the local Megaplex. For each event, the CL module will send the corresponding alarm message, respectively SNMP trap, to the supervision terminal and network management stations, thereby notifying the remote operators.

Furthermore, each event can be associated with a user-selected message of up to 35 characters that describes the situation, or prompts the remote user to take a prescribed action.

The Megaplex system can be configured to respond automatically to user-defined conditions, using the outbound ports of the ACM module. These ports are equipped with change-over dry relay contacts, whose default state can be selected by the user, individually for each outbound port.



The relay contacts can be used to report internal system alarms to outside indicators, e.g., lights, buzzers, bells, etc. located on a bay alarm or remote monitoring panel, and to control external devices or applications (fans, dialers, backup power sources, etc). Each relay can be controlled by one or more events in the network, in accordance with the configuration defined by the user.

## Tests and Loopbacks

The Megaplex systems include a wide range of maintenance support functions, which enable rapid identification of the problem without requiring the use of test equipment.

The primary maintenance feature is self-test, which is automatically performed upon power-up and resetting. The self-test results are available to a supervision terminal connected to the CL module, and are also reported to the management system through the various management communication ports.

Another important maintenance feature is the wide availability of loopbacks, which enable rapid and efficient isolation of the problem area. In addition to loopbacks, the Megaplex system also includes dedicated test stimulus generators and monitoring circuits, e.g., BER test subsystems, 1 kHz tone generators, etc., that allow on-line testing without the use of external test equipment.

Tests and loopbacks are available at two levels:

- I/O module level. At this level, the activation of local loopbacks enable the user to locate problems in the module and its channels, as well as problems in the connection of the user's equipment to the module ports. Remote loopbacks can be used for end-to-end testing of signal paths.

Built-in test equipment is also available on most I/O modules:

- Voice modules include 1 kHz tone generators that enable easy checking of signal paths down to the user's earphone.
- Most types of data modules include their own BER test subsystem, which can be used to check proper processing of signals on the module and ensure proper end-to-end transmission through data channels.
- Main link module level. The main link modules can also be checked in the same way as I/O modules. However, the dedicated test subsystems located on these modules can also be used to test for proper operation at the system level, as well as test network connections. This subsystem can be used to activate local and remote loopbacks at any desired level, starting with the connection to the local channels (through the chassis TDM buses), and up to the level of individual timeslots and even individual bits in timeslots with split assignment.

The test subsystems of the main link modules provide a central testing facility, which can send test signals to any desired direction. For example, a 1 kHz test can be sent to each voice module, whereas data paths toward the local side and the remote side can be tested by means of the BER test function.

A detailed description of the test and loopback functions is given in [Chapter 6](#), as well as in the Installation and Operation Manuals of each module.

## 1.4 Technical Specifications

<b>General</b>	<i>Number of TDM Buses</i>	1 to 8, each supporting up to 32 64-kbps timeslots
	<i>Internal Multiplexing Technique</i>	Time division, byte interleaved
	<i>Main Link Types</i>	<ul style="list-style-type: none"> <li>• TDM: E1 and T1, with electrical, optical or HDSL interfaces</li> <li>• <math>n \times 64</math> kbps serial synchronous interface at rates of 128 to 2048 kbps (equivalent to <math>n = 2, 3, 4 \dots 32</math>)</li> <li>• Packet-switched: IP over 10/100BaseT and 100Base-FX Ethernet interfaces</li> </ul>
<b>E1 Main Links</b>	<i>Bit Rate</i>	2.048 Mbps
	<i>Standards</i>	ITU-T Rec. G.704 and G.706
	<i>Framing Options</i>	<ul style="list-style-type: none"> <li>• Basic G.704 framing (G732N), with or without CRC-4 per ITU-T Rec. G.704</li> <li>• Timeslot 16 multiframe (G732S), with or without CRC-4 per ITU-T Rec. G.704</li> </ul>
	<i>Line Code</i>	HDB3 in accordance with ITU-T Rec. G.703
<b>T1 Main Links</b>	<i>Bit Rate</i>	1.544 Mbps
	<i>Framing Options</i>	SF (D4) and ESF, compatible with AT&T TR-62411, ANSI T1.403-1989 and ITU-T Rec. G.703, G.704, and G.733
	<i>Line Code</i>	Bipolar AMI
	<i>Zero Suppression</i>	<ul style="list-style-type: none"> <li>• Transparent (no zero suppression)</li> <li>• B7ZS</li> <li>• B8ZS</li> </ul>
<b>Electrical E1 Line Interface</b>	<i>Line Interfaces</i>	<ul style="list-style-type: none"> <li>• 4-wire, 120 <math>\Omega</math> balanced</li> <li>• Coaxial, 75 <math>\Omega</math> unbalanced</li> </ul>
	<i>Transmit Levels</i>	<ul style="list-style-type: none"> <li>• <math>\pm 3V \pm 10\%</math>, balanced</li> <li>• <math>\pm 2.73V \pm 10\%</math>, unbalanced</li> </ul>
	<i>Receive Levels</i>	<ul style="list-style-type: none"> <li>• 0 through -12 dB for low sensitivity</li> <li>• 0 through -36 dB for high sensitivity</li> </ul>
<b>Electrical T1</b>	<i>Line Interface</i>	4-wire, 100 $\Omega$ balanced

<b>Line Interface</b>	<i>Transmit Levels</i>	<ul style="list-style-type: none"> <li>DSU emulation: <math>\pm 3V \pm 10\%</math>, software-adjustable for line lengths of 0 to 655 feet in accordance with AT&amp;T CB-119</li> <li>CSU mode: 0, -7.5, -15, -22.5 dB software-selectable LBO</li> </ul>
	<i>Receive Equalizer Gain</i>	30 dB or 36 dB, software selectable
	<i>Receive Levels</i>	0 through -36 dB for maximum equalizer gain
<b>E1/T1 Optical Line Interface</b>	<i>Optical Performance</i>	Refer to <a href="#">Table 1-4</a>

Table 1-4. E1/T1 Fiber-Optic Interface Characteristics

Wavelength	Fiber Type	Transmitter Type	Power Coupled into Fiber	Receiver Sensitivity	Optical Budget	Maximum Receiver Input Power	Receiver Dynamic Range	Typical Maximum Range
850 nm	62.5/125 $\mu\text{m}$ multi-mode	Laser	-18 dBm	-38 dBm	20 dB	-10 dBm	28 dB	5 km (3 mi)
1310 nm	9/125 $\mu\text{m}$ single-mode	Laser	-12 dBm	-40 dBm	28 dB	-12 dBm	28 dB	62 km (38 mi)
1550 nm	9/125 $\mu\text{m}$ single-mode	Laser	-12 dBm	-40 dBm	28 dB	-12 dBm	28 dB	100 km (62 mi)

<b>IP Link Interface</b>	<i>Functions</i>	<ul style="list-style-type: none"> <li>Transmission of payload over IP networks using the TDMoIP protocol</li> <li>Transmission of CL traffic over IP networks</li> </ul>
	<i>IP Routing Support</i>	<ul style="list-style-type: none"> <li>Limited-function internal IP router, also supports user-configurable static routing table</li> <li>Can serve as proxy server for the CL IP router</li> </ul>
	<i>Number of External Ports</i>	<ul style="list-style-type: none"> <li>Two uplink Ethernet ports (NET 1 and NET 2)</li> <li>1 user Ethernet port (USER)</li> <li>Full port interconnectivity via internal Ethernet switch</li> </ul>
	<i>Total Uplink Payload from Internal Megaplex Modules</i>	User configurable, from minimum of 16 kbps (2 bits) to maximum of 3.968 Mbps (62 timeslots)
	<i>Uplink Payload from Other Ports</i>	Each Ethernet port can carry payload from external sources connected to the other ports

*External Port Interfaces*

<i>NET 1, NET 2</i>	10/100BASE-T or 100BASE-FX, in accordance with order (see <a href="#">Table 1-6</a> )
<i>USER</i>	10/100BASE-T

*Table 1-5. IP Link Fiber-Optic Interface Characteristics*

Interface Type and Wavelength	Transmitter Type	Typical Power Coupled into Fiber	Receiver Sensitivity	Maximum Receiver Input Power	Typical Maximum Range (km/miles)
850 nm, 62.5/125 $\mu$ m multimode fiber, ST, FC connectors	VCSEL	-9 to -3 dBm	-32 dBm	-3 dBm	2/1.2
1310 nm, 62.5/125 $\mu$ m multi-mode fiber, LC connectors	LED	-19 to -14 dBm	-32 dBm	-10 dBm	2/1.2
1310 nm, 9/125 $\mu$ m single-mode fiber, ST, LC or FC/PC connectors	Laser	-15 to -8 dBm	-34 dBm	-3 dBm	25/12.4

**LAN Interface (I/O Modules)**

<i>Interface Type</i>	IEEE 802.3 and Ethernet V.2
<i>Standards Compliance</i>	IEEE 802.3, 802.1p, 802.1Q, 802.3U
<i>Interface Operating Modes (for 10/100BASE-T Interfaces)</i>	<ul style="list-style-type: none"> <li>• 10 or 100 Mbps, full-duplex or half-duplex</li> <li>• Selection by operator or by auto-negotiation</li> </ul>
<i>Physical Interface</i>	10BASE-T (UTP), 100BASE-T, 100BASE-TX (in accordance with module type)
<i>Range</i>	Up to 100 m/330 ft using Cat. 5 cable
<i>LAN Interface Connector</i>	8-pin RJ-45 per port

**Nodal Timing**

<i>Receive Timing</i>	Recovered from received data
<i>Transmit Timing Source</i>	<ul style="list-style-type: none"> <li>• Internal, accuracy <math>\pm 32</math> ppm</li> <li>• External, from high-speed channel operating at rate of <math>n \times 56</math> kbps or <math>n \times 64</math> kbps</li> <li>• External, from station clock</li> <li>• External, from TDM main link module port (loopback timing)</li> <li>• Adaptive timing, from recovered bundle clock</li> </ul>

<b>System Management</b>	<i>Management Capabilities</i>	<ul style="list-style-type: none"> <li>• ASCII supervision terminal, connected either directly or via modem</li> <li>• Telnet</li> <li>• SNMP (RADview and any other SNMP-based network management stations)</li> </ul>
	<i>Management Interfaces</i>	<ul style="list-style-type: none"> <li>• Serial ports on CL.2 modules, support the supervision terminal</li> <li>• 10BASE-T port on CL.2 modules, support Telnet and SNMP</li> <li>• Inband via main link ports, support Telnet and SNMP</li> </ul>
<b>Serial Ports Characteristics</b>	<i>Interface</i>	RS-232 asynchronous DCE port
	<i>Data Rate</i>	0.3, 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, and 57.6 kbps; 115.2 kbps for downloading purposes
	<i>Data Word Format</i>	<ul style="list-style-type: none"> <li>• 1 start bit</li> <li>• 7 or 8 data bits</li> <li>• Parity: none/odd/even</li> <li>• 1 or 2 stop bits</li> </ul>
	<i>Connector</i>	CONTROL DCE: 9-pin D-type female
<b>Ethernet Port Characteristics</b>	<i>Interface Type</i>	10BASE-T or 10BASE-2, in accordance with order
	<i>Interface Operating Mode</i>	10 Mbps half-duplex station port
	<i>Interface Connector</i>	8-pin RJ-45
<b>External Alarm Interfaces</b>	<i>Alarm Outputs</i>	<ul style="list-style-type: none"> <li>• Major alarm indication by relay with floating dry change-over contacts</li> <li>• Minor alarm indication by relay with floating dry change-over contacts</li> </ul>
	<i>Output Contact Ratings</i>	<ul style="list-style-type: none"> <li>• Max. 60 VDC/30 VAC across open contacts</li> <li>• Max. 1 ADC through closed contacts</li> </ul>
<b>Diagnostics</b>	<i>Main Link Tests</i>	<ul style="list-style-type: none"> <li>• Local main link loopback</li> <li>• Local main link loop towards remote unit</li> </ul>

	<i>Tests</i>	<ul style="list-style-type: none"> <li>• Local and remote BERT on channels, ports, bundles, individual timeslots and individual bits in a timeslot</li> <li>• Local and remote loopbacks on channels, ports, and timeslots</li> <li>• Forward and remote tone injection in individual timeslots (voice channels only)</li> <li>• IP connectivity check (<i>ping</i>)</li> </ul>
	<i>Alarms</i>	<ul style="list-style-type: none"> <li>• Time and date stamped</li> <li>• Last 256 alarms stored in RAM on CL module, readable by management system or terminal</li> <li>• Current alarms status</li> </ul>
	<i>Statistics</i>	<ul style="list-style-type: none"> <li>• AT&amp;T statistics when using ESF framing for T1 trunks, or CRC-4 multiframing for E1 trunks</li> <li>• Performance statistics for bundles and LAN ports</li> </ul>
<b>PS Modules for Megaplex-2100</b>	<i>Model</i>	<b>Input</b>
	<i>PS/AC</i>	<ul style="list-style-type: none"> <li>• 110/115 VAC (allowed range: 85 to 150VAC), 50/60Hz</li> <li>• 220/230 VAC (allowed range: 150 to 264VAC), 50/60Hz</li> <li>• Maximum AC input power: 250W + power supplied for ring and feed voltage purposes (drawn directly from external supply)</li> <li>• Total output power: 200W</li> </ul>
	<i>PS/DC</i>	<ul style="list-style-type: none"> <li>• -48 VDC (allowed range: -36 to -57 VDC)</li> <li>• 24 VDC (allowed range: 18 to 40 VDC)</li> <li>• Maximum input power: 315W + power supplied for ring and feed voltage purposes (drawn directly from external supply)</li> <li>• Total output power (without ring and feed voltage): 250W</li> </ul>

**Note**


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*The DC input is primarily designed for -48 VDC operation (grounded positive pole). However, the DC input voltage can be floated with respect to Megaplex-2100 ground by means of field-selectable jumpers. Internal jumpers can also be set to match operational requirements that need the + (positive) terminal of the power source to be grounded. Contact RAD Technical Support Department for detailed information.*

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		<b>Max. Power Supply Output Currents</b>			
		<b>+5V</b>	<b>-5V</b>	<b>+12V</b>	<b>-12V</b>
	<i>PS/AC</i>	40A	6.5A	2A	2A
	<i>PS/24, PS/48</i>	40A	6.5A	2A	2A
<b>Internal Power Supply for Megaplex-2104</b>	<i>AC Power Supply</i>	<ul style="list-style-type: none"> <li>• 110/115 VAC (allowed range: 90 to 150VAC), 50/60Hz</li> <li>• 220/230 VAC (allowed range: 150 to 264VAC), 50/60Hz</li> <li>• Maximum AC input power: 300W with ringer, 160W without ringer</li> <li>• Total output power: 225W with ringer, 120W without ringer</li> </ul>			
	<i>DC Power Supply</i>	<ul style="list-style-type: none"> <li>• -48 VDC (allowed range: -36 to -57 VDC) or 24 VDC (allowed range: 18 to 36 VDC), in accordance with order</li> <li>• Maximum input power: 160W + power supplied for ring and feed voltage purposes (drawn directly from external supply)</li> <li>• Total output power (without ring and feed voltage): 120W</li> </ul>			

**Note** *The positive terminal of DC input voltage is normally connected to Megaplex-2104 ground. Floating DC input is available upon specific order.*

		<b>Max. Power Supply Output Currents</b>					
		<b>+5V</b>	<b>-5V</b>	<b>+12V</b>	<b>-12V</b>	<b>-48V</b>	<b>+72V/+60V</b>
	<i>AC Power Supply</i>	15A	3.5A	1A	1A	*	*
	<i>DC Power Supply</i>	15A	3.5A	1A	1A	*	*
	<i>AC Power Supply with Ringer</i>	15A	3.5A	1A	1A	2A	0.85A@72V
	<i>DC Power Supply with Ringer</i>	15A	3.5A	1A	1A	*	1A@60V

The asterisk \* indicates a feedthrough connection for ring and feed voltages (drawn directly from external input voltage)

<b>Megaplex-2100 Chassis</b>	<i>Number of Module Slots</i>	16-slot card cage	
	<i>Slot Usage</i>	<ul style="list-style-type: none"> <li>• 2 power supply slots</li> <li>• 2 common logic slots</li> <li>• 12 identical slots for I/O (voice, data, etc.) and main link modules</li> </ul>	
<b>Megaplex-2104 Chassis</b>	<i>Number of Module Slots</i>	6-slot card cage	
	<i>Slot Usage</i>	<ul style="list-style-type: none"> <li>• 1 integral power supply (with optional ringer)</li> <li>• 1 common logic slot</li> <li>• 5 identical slots for I/O (voice, data, etc.) and main link modules</li> </ul>	
<b>Chassis Dimensions</b>		<b>Megaplex-2100</b>	<b>Megaplex-2104</b>
	<i>Enclosure Height</i>	18 cm/7 in (4U)	9 cm/3.5 in (2U)
	<i>Enclosure Width</i>	44 cm/17 in	44 cm/17 in
	<i>Enclosure Depth (without handles)</i>	33 cm/13 in	33 cm/13 in
<b>Note</b>	<i>Equipment weight depends on configuration:</i>		
	<ul style="list-style-type: none"> <li>• Empty MP-2100 chassis with single PS module and single CL.2 module weights 3.5 kg (7.7 lb).</li> <li>• Fully equipped MP-2100 chassis (2 PS modules, 2 CL.2 modules, 12 I/O modules) weights approx. 17 kg (37.5 lb).</li> </ul>		
<b>Rack Installation Kits</b>	<i>Megaplex-2100</i>	RM-MP-MX-23/19 for 19" and 23" racks	
	<i>Megaplex-2104</i>	MP2104/RM for 19" racks	
<b>Note</b>	<i>Enclosure handles installed on the rack mount brackets add 4 cm (1.6 in) to the total depth.</i>		
<b>Environment</b>	<i>Operating Temperature</i>	-10°C to 55°C (14°F to 131°F)	
	<i>Storage Temperature</i>	Storage temperature: -20°C to +70°C (-4°F to +158°F)	
	<i>Humidity</i>	Up to 95%, non-condensing	



# Chapter 2

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## Installation and Setup

This chapter provides installation and operation instructions for the Megaplex systems, and for the installation of the CL and PS modules that are part of the basic system configuration.

After installing the system, it is necessary to configure it in accordance with the specific user's requirements. The preliminary system configuration is always performed by means of a supervision terminal (procedures for using the terminal are given in Chapter 4). The software necessary for using the terminal is stored in the CL module: if the CL module is not yet loaded with the required software, refer to Chapter 7 for detailed software installation instructions.

After the preliminary configuration, the system can also be managed by means of Telnet hosts or SNMP-based network management stations, e.g., RADview. Refer to the User's Manual of the network management station for operating instructions.



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### 2.1 Site Requirements and Prerequisites

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Before connecting this product to a power source, make sure to read the Handling Energized Products section at the beginning of this manual.

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#### AC Power

AC-powered Megaplex units should be installed within 1.5m (5 feet) of an easily-accessible grounded AC outlet capable of furnishing 115 or 230 VAC.

#### DC Power

DC-powered Megaplex units require a -48 VDC (-36 VDC to -57 VDC) or 24 VDC (20 VDC to 40 VDC) power source (in accordance with the nominal mains voltage of the ordered PS module).

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#### **Caution**

1. MP-2100: Internal jumpers on the PS modules can be set to match operational requirements that need either the + (positive) or - (negative) terminal of the power source to be grounded. The normal factory setting is for a power source with the +(positive) terminal grounded (the power supply module jumpers installed in the BGND=FGND and GND=FGND positions). When it is necessary to use a power source with the - (negative) terminal grounded, or a floating power source, the jumpers must be disconnected.

Check the position of jumpers in the MP-2100 power supply module (see [Figure 2-8](#)) before connecting the DC supply voltage.

2. MP-2104: the +(positive) terminal of the power source is normally grounded. If this is not desired, you may order the DC-powered MP-2104 with a floating DC power input.
3. **If the Megaplex chassis must be operated with floating ground, it may also be necessary to disconnect the ground reference on the power supply modules, and check the ground and shield wiring on the cables connected to the chassis.** This may require replacing the cables with cables suitable to your specific application. For more information on floating ground, see *Frequently Asked Questions* section in *Chapter 6*.
4. The Megaplex chassis must always be connected to FGND.

Special ordering options with preconfigured floating ground settings are available. Contact your local distributor for more information. When working with FXS voice modules, see also *Frequently Asked Questions* section in the *VC-4/4A/8/8A/16 Installation and Operation Manual*.

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## Connecting to Megaplex Links

### Connecting to TDM Links

Megaplex systems have one RJ-45 connector for each balanced E1 or T1 port, and for each HDSL port. For E1 interfaces, there are two additional coaxial connectors for the unbalanced interface (BNC or mini-BNC, depending on module type).

HDSL interface comply with ETS 101 135 requirements.

Fiber-optic interfaces are equipped with ST, FC/PC or SC connectors, in accordance with order.

The maximum allowable line attenuation between a Megaplex port and the network interface depends on the type of port interface, and therefore it is given in the Installation and Operation Manual of each specific module.

The electrical E1 and T1 interfaces of Megaplex systems must not be connected directly to unprotected public telecommunication networks. The connections must be made through a network termination unit that provides separation between the interface conductors and the telecommunication network conductors in accordance with the applicable local regulations

### Connecting to IP Main Links

The IP main links have 10/100BASET Ethernet interfaces terminated in RJ-45 connectors for connection to LANs operating on UTP media. The interface connector is wired for connection through a "straight" (point-to-point) cable to a hub port.

Fiber-optic interfaces comply with 100BASE-FX requirements. Current versions operate at 850 or 1310 nm; the physical interface can be ordered with ST, FC/PC or LC connectors, for operation over single-mode or multi-mode fiber.

The user can enable auto-negotiation, or can select the desired interface operating mode.

## Connecting to Ethernet Ports of I/O Modules

The I/O modules with Ethernet interfaces offered by RAD have various types of interfaces, in accordance with the specific module (see details in the module Installation and Operation Manual):

- 10BASE2 Ethernet interfaces terminated in BNC connectors, for LANs using coaxial cables.
- Basic 10BASET or 10/100BASET Ethernet interfaces terminated in RJ-45 connectors for connection to LANs. The interface connector is wired for connection through a “straight” (point-to-point) cable to a hub port.
- 10BASET/100BASETX Ethernet interfaces terminated in RJ-45 connectors. These interfaces support MDI/MDIX crossover and therefore such port can always be connected through a “straight” (point-to-point) cable to any other type of 10/100BASET Ethernet port (hub or station).

For interfaces supporting both 10 Mbps and 100 Mbps, the user can enable auto-negotiation, or can select the desired interface operating mode.

## Connecting the External (Station) Clock

TDM main link modules include the external (station) clock interface of the Megaplex chassis, which can be used to lock the nodal timing of the Megaplex to an external clock signal, as well as distribute the clock signal to other equipment. This interface can accept 2.048 MHz or 1.544 MHz signals, in accordance with the main link type.

The external clock interface is terminated in a separate RJ-45 connector. The clock connector includes the following inputs and outputs:

- External clock input:
  - Balanced (100/120  $\Omega$ ) or unbalanced (75  $\Omega$ ) interface, which accepts a “all-ones” AMI-coded clock signal. The interface type is user-selectable.
  - Squarewave clock input at RS-422 levels.
- External clock outputs. Two outputs are provided:
  - Balanced (100/120  $\Omega$ ) or unbalanced (75  $\Omega$ ) interface, which outputs a AMI-coded clock signal. The interface type is user-selectable.
  - Squarewave clock output at RS-422 levels.

These outputs provide a convenient means to distribute the external clock signal by chaining the clock connectors of Megaplex units.

## Connecting to I/O Channels

Channel connection data for the various I/O modules is given in each module Installation and Operation Manual.

Special cables can be ordered to connect the Megaplex I/O modules either directly to the user's equipment, or via a main distribution frame.

## Connecting to Alarm Relays

For CL modules with two serial interfaces, the dry-contact alarm interface is included in one of the module connectors (see [Section 2.6](#) and [Appendix A](#)), whereas CL modules with Ethernet port have separate connectors for each relay.

The relays are controlled by software, and therefore the default state (that is, the state during normal operation) can be selected by the user in accordance with the specific system requirements.

### **Caution**

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The alarm relay contacts are rated at maximum 60 VDC across open contacts, and maximum 1 ADC through closed contacts. Protection devices must be used to ensure that these ratings are not exceeded, e.g., use current limiting resistors in series with the contacts, and place voltage surge absorbers across the contacts.

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## Connecting to Management Ports

Megaplex systems have two types of out-of-band management ports, located on the CL modules:

- Supervisory port. This port has a 9-pin D-type female connector with DCE RS-232 interface. This enables direct connection to terminals and management stations; when the interface is configured as DTE, it is necessary to use a cross-cable
- Network port, for connection to network management stations. This port has a 10BASET Ethernet interface with RJ-45 connector, for connection to LANs operating on UTP or STP media. The connector is wired as a station port, for connection through a “straight” (point-to-point) cable to a hub port.

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**Note** *When using redundant CL modules, you can connect the terminal, respectively the modem, in parallel to the corresponding serial port connectors of the two modules by means of a simple Y-cable, because at any time only one module interface is active.*

*Ethernet ports of redundant CL modules do not require any special connections.*

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## Front and Rear Panel Clearance

Allow at least 90 cm (36 inches) of frontal clearance for operator access. Allow the same clearance at the rear of the unit for interface cable connections and module replacement.

## Ambient Requirements

The ambient operating temperature range of the Megaplex is 32 to 113°F (0 to +45°C), at a relative humidity of up to 90%, non-condensing.

Megaplex and all their modules are cooled mainly by free air convection. The following units have cooling fans:

- MP-2100: PS power supply modules have a miniature cooling fan installed on their front panels. The fan operates only when the temperature is high.
- MP-2104: the unit chassis includes a miniature cooling fan on its power supply side.

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**Caution** The enclosure cooling vents are located in the top and bottom covers, and therefore it is necessary to install the enclosure in an horizontal position. Do not obstruct these vents.

When Megaplex is installed in a rack, allow at least 1U of space below and above the unit. Do not stack units.

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## Electromagnetic Compatibility Considerations

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**Note** *See also Electromagnetic Compatibility section at the beginning of this manual.*

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The Megaplex is designed to comply with the electromagnetic compatibility (EMC) requirements of Sub-Part J of FCC Rules, Part 15, and EN 55022 for Class A electronic equipment, and additional applicable standards.

To meet these standards, it is necessary to perform the following actions:

- Connect the Megaplex case to a low-resistance grounding system.
- Install blank panels to cover all empty slots. Appropriate blank panels can be ordered from RAD.
- In certain cases, the use of shielded cables or twisted pairs, or use of ferrite cores, is recommended. Refer to the individual module Installation and Operation Manual for details.



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**Covering all empty slots is also required for reasons of personal safety.**

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## Safety Precautions



**Warning**

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No internal settings, adjustment, maintenance, and repairs may be performed by either the operator or the user; such activities may be performed only by a skilled technician who is aware of the hazards involved. Always observe standard safety precautions during installation, operation, and maintenance of this product.

---

**Caution**

---

Megaplex modules contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, always hold the module by its sides, and do not touch the module components or connectors.

---

### Laser Safety Classification



**Warning**

---

Some of the Megaplex modules include Class 1 lasers. For your safety:

- Do not look directly into the optical connectors while the unit is operating. The laser beams are invisible.
- Do not attempt to adjust the laser drive current.

The use of optical instruments with this product will increase eye hazard. Laser power up to 1 mW at 1300 nm and 1550 nm could be collected by an optical instrument.

Use of controls or adjustment or performing procedures other than those specified herein may result in hazardous radiation exposure.

**Allow only authorized RAD service technicians to repair the unit.**

---

Megaplex modules equipped with laser devices comply with laser product performance standards set by government agencies for Class 1 laser products. The modules do not emit hazardous light, and the beam is totally enclosed during all operating modes of customer operation and maintenance.

Megaplex modules are shipped with protective covers installed on all the optical connectors. Do not remove these covers until you are ready to connect optical cables to the connectors. Keep the covers for reuse, to reinstall the cover over the optical connector as soon as the optical cable is disconnected.

### Grounding

Before switching on this equipment and before connecting any other cable, the protective ground terminals of the equipment must be connected to a protective ground. The grounding connection is made through the power cable, which must be inserted in a power socket (outlet) with protective ground contact. Therefore, the mains plug must always be inserted in a socket outlet provided with a protective ground contact.

In addition, the modules have a grounding screw on the front panel, which must be connected by means of a wide copper strap or thick lead to a low-resistance grounding system.

Whenever Megaplex units are installed in a rack, make sure that the rack is properly grounded and connected to a reliable, low-resistance grounding system.

## Protecting against ESD

An electrostatic discharge occurs between two objects when an object carrying static electrical charges touches, or is brought near enough, the other object. Static electrical charges appear as result of friction between surfaces of insulating materials, separation of two such surfaces and may also be induced by electrical fields. Routine activities such as walking across an insulating floor, friction between garment parts, friction between objects, etc. can easily build charges up to levels that may cause damage, especially when humidity is low.

---

**Caution**

Megaplex modules contain components sensitive to electrostatic discharge (ESD). To prevent ESD damage, always hold a module by its sides, and do not touch the module components or connectors.

If you are not using a wrist strap, before touching a module, it is recommended to discharge the electrostatic charge of your body by touching the frame of a grounded equipment unit.

---

Whenever feasible, during installation works use standard ESD protection wrist straps to discharge electrostatic charges. It is also recommended to use garments and packaging made of antistatic materials or materials that have high resistance, yet are not insulators.

## Proper Handling of Modules

Megaplex modules include small components installed on both sides of the printed circuit boards. These components are exposed as long as the modules are not installed in the chassis, are therefore may be unintentionally damaged. To prevent physical damage to modules:

- Always keep the modules in their protective shipping containers until installed in the chassis. These containers also protect against ESD.
- Avoid piling up modules.
- While inserting modules in their chassis slots, support the modules and make sure their components do not touch the chassis structure, nor other modules while sliding into position.

---

---

## 2.2 Package Contents

### MP-2100 Package Contents

The MP-2100 package includes the following items:

- MP-2100 chassis, including CL and PS modules in accordance with order
- Power cables in accordance with order, and a DC plug for the DC power cable
- Supervision terminal cable, CBL-DB9F-DB9M-STR
- Rack installation kit in accordance with order:

- RM-MP-MX-23/19: hardware kit for installing one MP-2100 in either a 19-inch or 23-inch rack
- MP-2100-RM-ETSI/19: hardware kit for installing one MP-2100 in a 23-inch ETSI rack (can also be used for installation in 19-inch rack)
- Multiservice Access Multiplexers Technical Documentation CD.

I/O modules are shipped either separately, or preinstalled in the chassis, in accordance with your order.

## MP-2104 Package Contents

The MP-2104 package includes the following items:

- MP-2104 chassis, including CL and PS modules in accordance with order
- Power cables in accordance with order, and a DC plug for the DC power cable
- Supervision terminal cable, CBL-DB9F-DB9M-STR
- MP2104/RM rack installation kit
- Multiservice Access Multiplexers Technical Documentation CD.

I/O modules are shipped either separately, or preinstalled in the chassis, in accordance with your order.

---

---

## 2.3 Required Equipment

The cables needed to connect to the MP-2100/MP-2104 modules depend on your specific application.

You can prepare the appropriate cables yourself in accordance with the information given in [Appendix A](#), or order cables from RAD.

---

---

## 2.4 Mounting the Products

### Installing the MP-2100 Enclosure

MP-2100 is intended for installation on shelves and racks. Do not connect power to the enclosure before it is installed in the designated position.

#### Installing in 19" Rack

For rack installation, it is necessary to install two brackets to the sides of the unit. As illustrated in [Figure 2-1](#), you may install the brackets in two ways, to orient the unit in accordance with your requirements (either with the MP-2100 front panel toward the front of the rack, or the module panels toward the front).



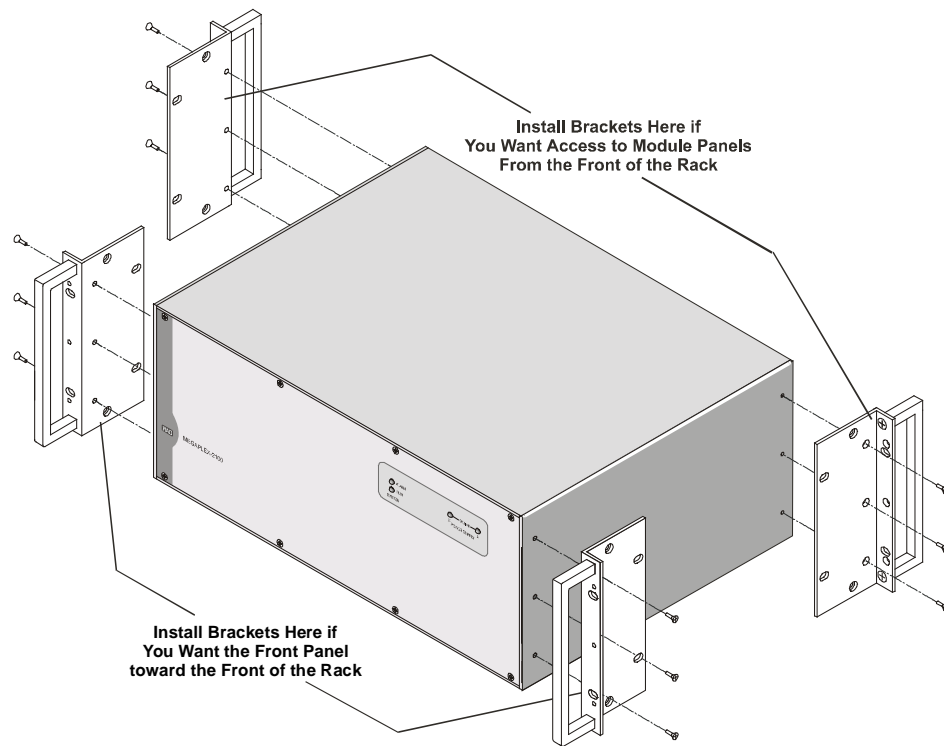


Figure 2-1. Attachment of Brackets to MP-2100 Case for Installation in 19" Rack

### Installing in 23" Rack

The same brackets can also be used to install the MP-2100 unit in a 23" rack. [Figure 2-2](#) shows how to attach the brackets for installation in 23" racks (only front installation is shown in this figure).

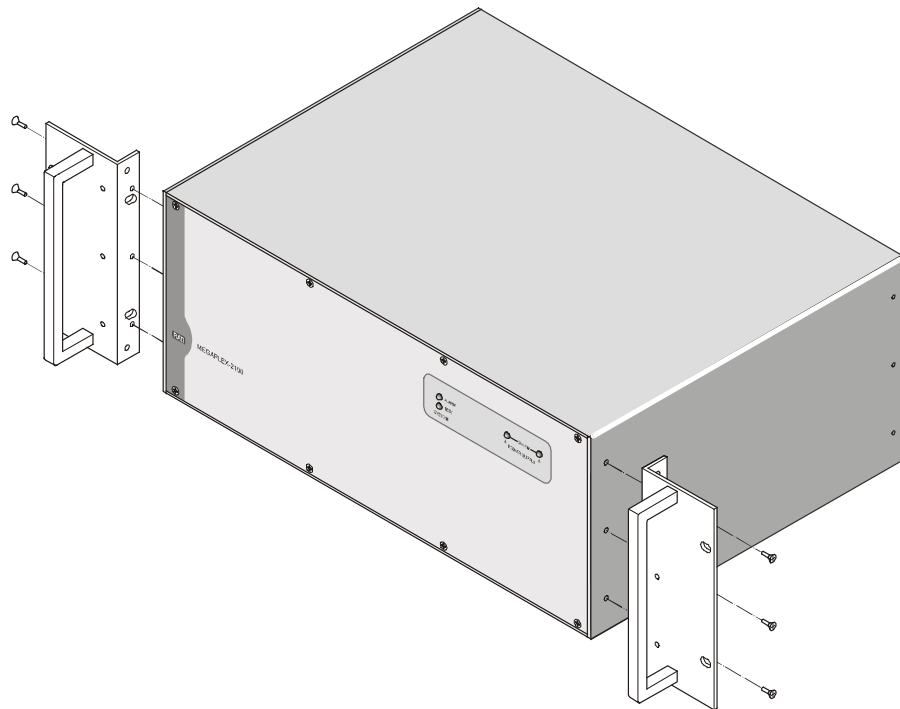


Figure 2-2. Attachment of Brackets for Installation of MP-2100 Unit in 23" Rack

After attaching the brackets, fasten the enclosure to the rack by four screws (two on each side).

After installing the enclosure, check and install the required modules, in accordance with the installation plan.



---

***BEFORE SWITCHING ON THIS INSTRUMENT, the protective ground terminals of this instrument must be connected to the protective ground conductor of the (mains) power cord. The mains plug shall only be inserted in a socket outlet provided with a protective ground contact.***

***Before connecting or disconnecting any communication cable, the unit must be earthed by connecting its power cord to a power outlet with an earth terminal, and by connecting the earth terminal on the panel (if provided) to a protective earth.***

***Make sure that only fuses of the required rating are used for replacement. The use of repaired fuses and the short-circuiting of fuse holders is forbidden. Whenever it is likely that the protection offered by fuses has been impaired, the instrument must be made inoperative and be secured against any unintended operation.***

---

## Installing the MP-2104 Enclosure

The MP-2104 can be installed on shelves and racks. In addition, a wall mounting kit is also available. Do not connect power to the enclosure before it is installed in the designated position.

### Installing MP-2104 on Racks

For rack installation, it is necessary to install two brackets to the sides of the unit. As illustrated in [Figure 2-3](#), you may install the brackets in two ways, to orient the unit in accordance with your requirements (either with the MP-2104 front panel toward the front of the rack, or the module panels toward the front).

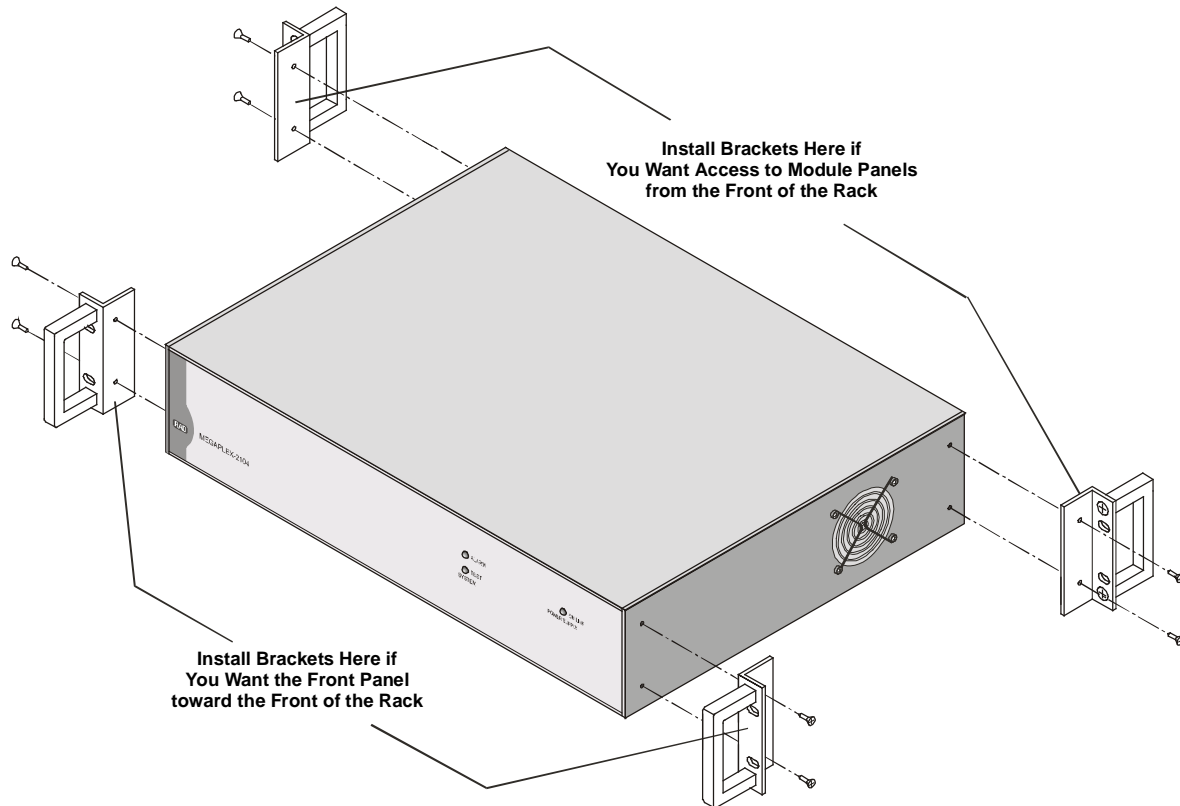


Figure 2-3. Bracket Installation Options for MP-2104

## Installing MP-2104 on Walls

For wall installation, attach the mounting wall mounting brackets to the sides of the MP-2104 unit, as shown in [Figure 2-4](#). After attaching the brackets, use four wall anchors to fasten the unit to the wall.

[Figure 2-5](#) shows the hole pattern for the wall anchors, and the area occupied by the unit when installed on the wall. [Figure 2-6](#) shows the height of the unit, relative to the wall.

In [Figure 2-6](#), the MP-2104 unit is shown installed on the wall in the recommended position. This position enables access to both the front and the rear panel, and in addition the cooling fan is located on the bottom side, where it is protected against small objects that may fall into the fan exhaust opening.

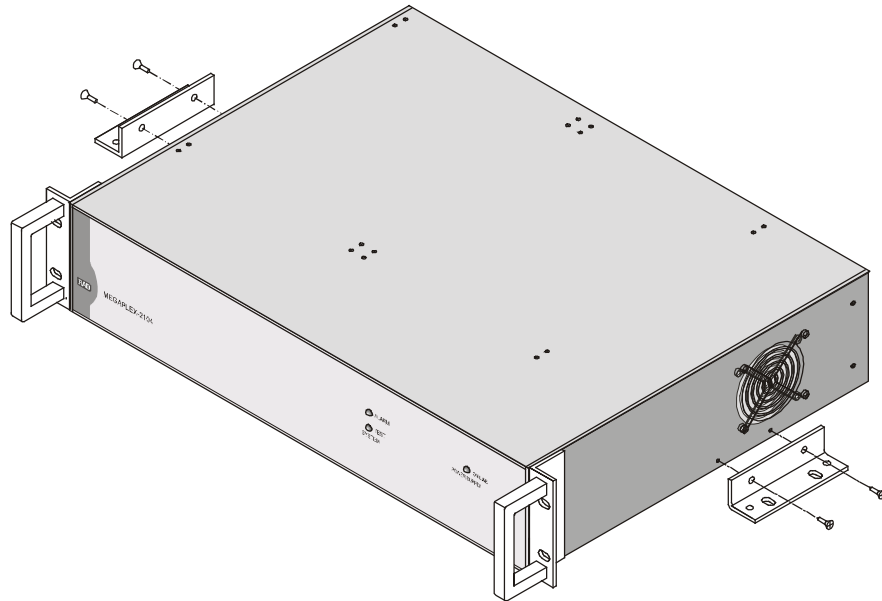


Figure 2-4. Installation of Brackets for Wall Mounting

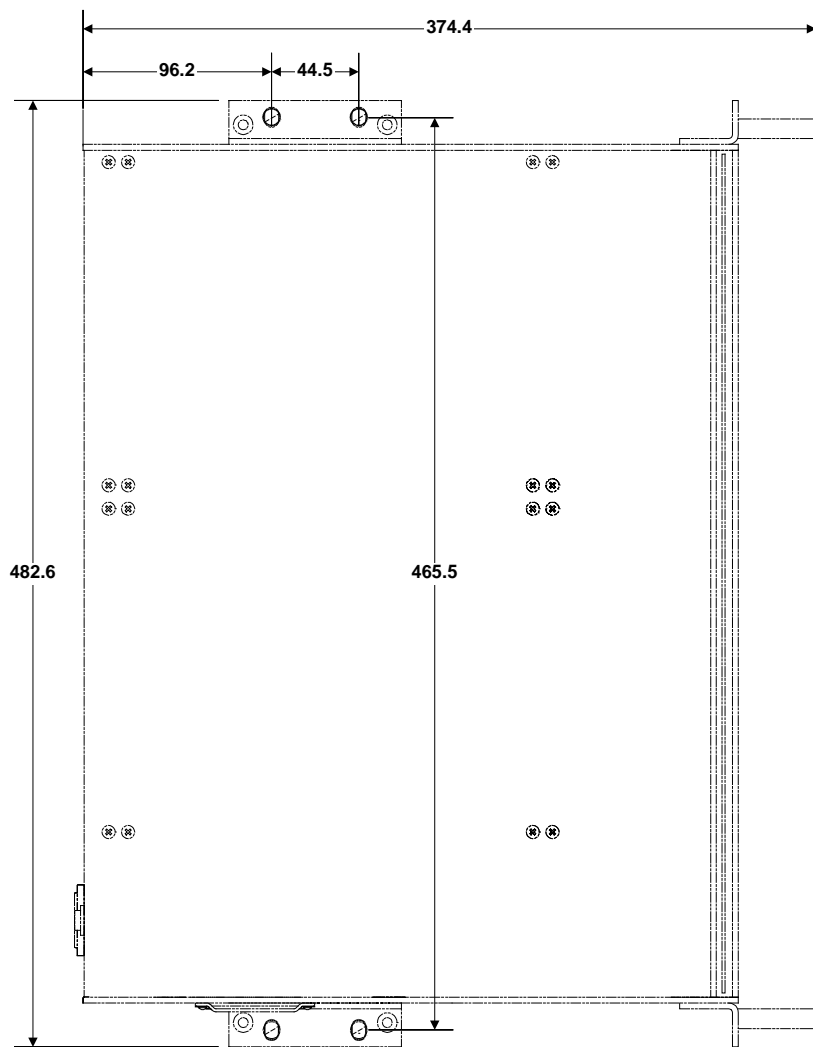
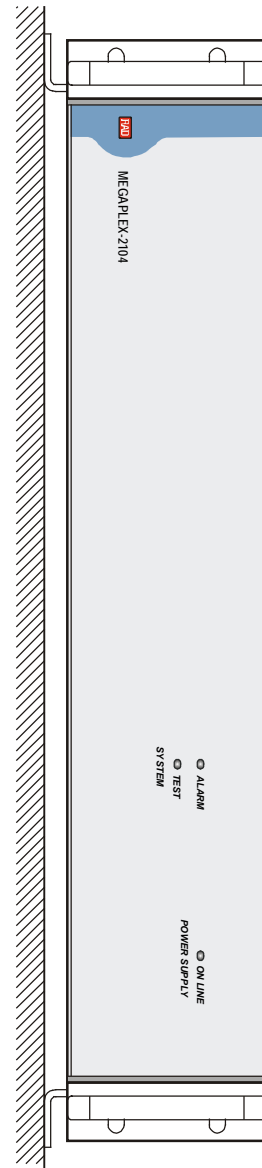


Figure 2-5. Wall Installation Data

Figure 2-6. Unit Height,  
Relative to Wall



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## 2.5 Installing the Modules

### Installing PS Modules in MP-2100 Chassis



**Warning**  
**High**  
**Voltage**

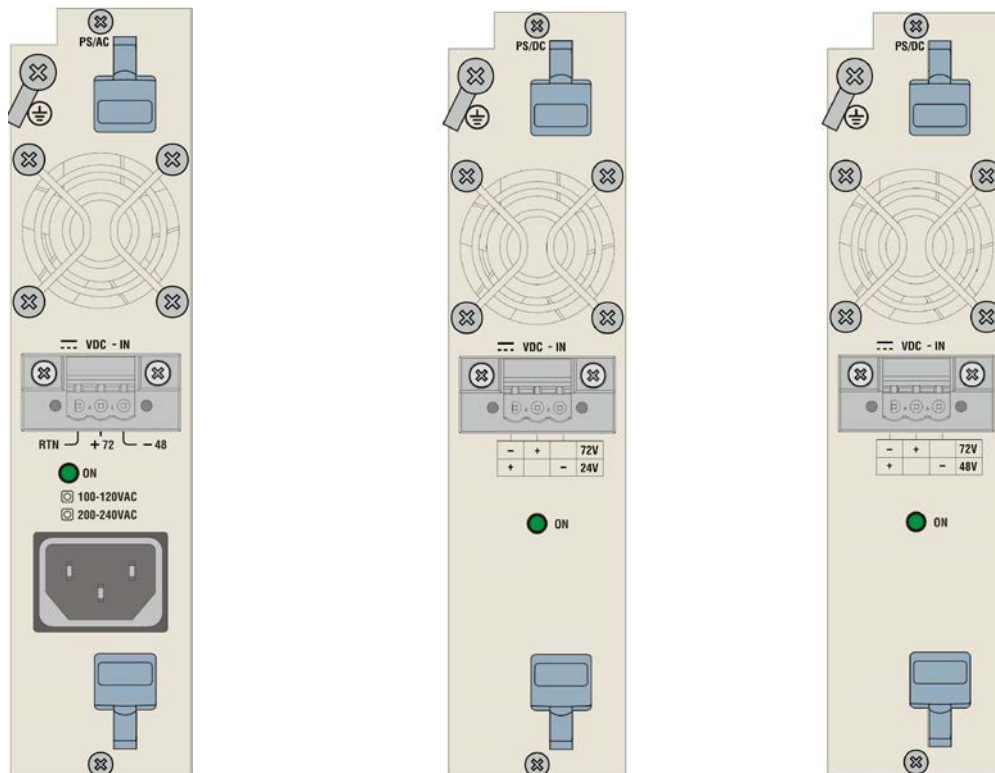
Dangerous voltages are present inside the PS module when it is connected to power. Do not connect the PS module to power before it is properly installed within the MP-2100 enclosure. Always disconnect the input power from the PS module before removing it from the enclosure. The installation and preparation of the module shall be done by a qualified person who is aware of the hazards involved.

---

## Module Panels

MP-2100 requires PS modules. The following PS versions are offered: 100/120 or 200/240 VAC, 50/60 Hz, AC-powered modules, and 24 VDC or -48 VDC DC-powered modules.

Typical PS panels are shown in *Figure 2-7*. PS modules do not include a power on/off switch and start operating as soon as power is applied. It is recommended to use an external power on/off switch, for example, the circuit breaker used to protect the supply line to the Megaplex-2100 may also serve as the on/off switch.



*AC-Powered Module*

*24 VDC-Powered Module*

*-48 VDC-Powered Module*

*Figure 2-7. MP-2100 PS Module Panels*

The PS modules connect to an external feed and ring voltage source, e.g., a Ringer-2200N standalone unit offered by RAD:

- The AC-powered PS versions have a separate connector, designated VDC-IN, for the external -48 VDC and +72 VDC voltages.
- The connection of the +72 VDC voltage to the DC-powered PS versions is made through the VDC-IN input connector. The 24/-48 VDC feed voltage is derived from the DC input voltage.

The PS modules have a miniature cooling fan on the front panel. Make sure to keep the fan opening free of obstructions.

## Internal Jumpers

The PS modules include two internal jumpers that control the connection of frame ground to the internal ground lines.

---

### Caution

If the MP-2100/MP-2104 chassis must be operated with floating ground, it may also be necessary to disconnect the ground reference on all the installed modules and check the ground and shield wiring on the cables connected to the chassis. This may require changing the hardware settings on the installed modules and appropriate cables.

Special ordering options with preconfigured settings are available. Contact your local distributor for more information.

---

The jumpers are shown in *Figure 2-8*.

- Jumper designated **GND=FGND**. This jumper controls the connection between the internal signal ground and the frame (enclosure) ground. The module is normally delivered with the jumper set to **YES**. If necessary, you can set the jumper to **NO** to float the signal ground with respect to the frame ground.
- Jumper designated **BGND=FGND**. This jumper controls the connection between the positive (+) line of the external 24/48 VDC voltage and the frame (enclosure) ground. The module is normally delivered with the jumper set to **YES**. If necessary, you can set the jumper to **NO** to float the external 24/48 VDC positive line with respect to the frame ground. This is usually necessary when the Megaplex chassis includes E&M voice modules.

---

### Note

To use a positive supply voltage, always disconnect the **BGND** from **FGND** (set jumper to **NO**).

---

If two power supply modules are installed, make sure that the internal jumpers are set to the same position on both modules.

---



Certain I/O voice modules may still cause the **BGND** to be connected to **FGND** or **GND** even after setting the jumpers to **NO**. Refer to the corresponding I/O manual for proper setting of their ground-control jumpers.

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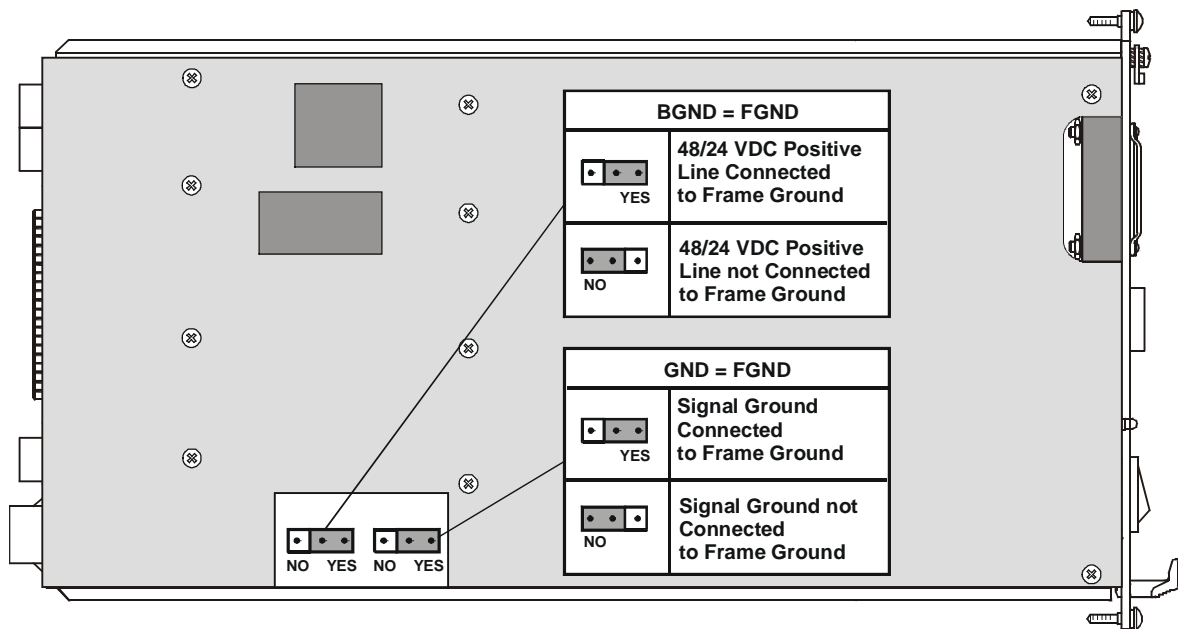


Figure 2-8. Typical PS Module, Location of Internal Jumpers

## Installing a PS Module



Do not connect the power and/or ring and feed voltage cable(s) to a PS module before you insert it in the MP-2100 chassis, and disconnect the cable(s) from the module before you remove it from the chassis.

1. Insert the PS module in the PS-A slot, and fasten it with the two screws.
2. Connect the power cable according to voltages indicated on the panel.
3. If an additional redundant module is used, install it in the PS-B slot.

**Note** You can install a redundant module in an operating enclosure without turning the MP-2100 power off. In this case:

- First insert the module in its slot
- Connect its power cable.

## Removing a PS Module

1. Disconnect the power cable(s) connected to the module.
2. Release the two module screws
3. Pull the PS module out.

## Installing CL Modules in MP-2100 Chassis

### Module Panels

Figure 2-9 shows a typical CL module panel. Table 2-1 describes the functions of the panel components.



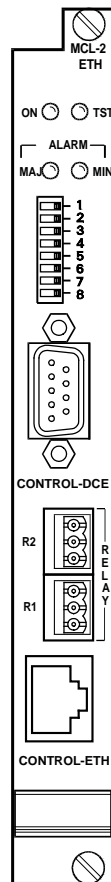


Figure 2-9. CL.2 Module Panel

Table 2-1. CL Module Panel Components

Item	Function
ON Indicator	Lights steadily on the master (active) module. Flashes when this module is in standby
ALARM MAJ Indicator	Flashes when a major or critical alarm (according to user's configuration) has been detected in the local Megaplex system. When the module is in standby, this indicator is always off, even in case an alarm condition is present
ALARM MIN Indicator	Lights steadily when any alarm (according to user's configuration) has been detected in the local Megaplex system. When the module is in standby, this indicator is always off, even in case an alarm condition is present
TST Indicator	Indicates that a test (or test loopback) is being performed in the local MP-2100 system. When the module is in standby, this indicator is always off

Item	Function
DIP Switch	<p>Eight-section switch. The default setting of all the sections is OFF (as seen in <a href="#">Figure 2-9</a>), and this is also the setting required for normal operation.</p> <ol style="list-style-type: none"> <li>Section 1 is used to enforce the selection of the terminal mode at the CONTROL-DCE, port. This overrides any other command received through the management port, and allows the user to connect a terminal to the CONTROL-DCE, port and perform configuration activities. The default communication parameters of the port, with section 1 set to ON, are 9.6 kbps, eight data bits, no parity, one stop bit.</li> <li>Section 4 is used for off-line (cold) software loading, as explained in Chapter 7.</li> </ol>
CONTROL-DCE Connector	9-pin D-type female connector with DCE interface, for connection to system management. Connector pin allocation is given in <a href="#">Appendix A</a>
R2 Connector	3-pin male connector for connection to the contacts of relay 2
R1 Connector	3-pin male connector for connection to the contacts of relay 1
CONTROL-ETH	RJ-45 connector for the 10BASET interface, for connection to an Ethernet LAN. Connector pin allocation is given in <a href="#">Appendix A</a>

### Notes

- The indicator functions listed in [Table 2-1](#) are the default functions. When the alarm masking and/or alarm inversion functions are used (see Chapter 6 for details), the meaning of the various indications may change.
- The alarm severity (warning, minor, major or critical) can be defined by means of the DEF AP command.
- The default alarm severity levels that activate the ALARM MIN and ALARM MAJ indicators can be changed by means of the DEF AR command.

### Installing a CL Module

- Set section 1 of the CL.2 front-panel DIP switch to ON, to enable preliminary configuration by means of a supervision terminal. Set all the other sections to OFF.
- Install the CL.2 module in either one of the two slots, CL-A or CL-B, and fasten it with the two screws.
- If an additional CL.2 module is to be installed, insert it in the other CL slot.

### Note

When two CL.2 modules are installed, common logic redundancy is available. In this case, the module installed in slot CL-A will be automatically selected as the master module, provided that it operates normally and stores all the required configuration parameters. The redundant CL modules must have identical HW & SW versions.

### Removing a CL Module

#### ► To remove a CL module:

- Fully release the two screws fastening the module to the chassis.
- Disconnect any cables connected to the module.
- Pull the module out.

## Replacing a CL Module during Equipment Operation

### *MP-2100 Chassis with two CL Modules (Hot Swapping)*

In a Megaplex-2100 equipped with two properly functioning CL modules, the standby module can be removed/replaced without disrupting MP-2100 services.

If you replace the on-line CL module, MP-2100 will automatically switch to the standby module, provided that that module is properly functioning. However, to prevent any disruption in operations and management communication, it is recommended to first switch (flip) to the standby module before replacing the on-line module.

You can identify the active and standby modules by their ON indicators.

- 
- Caution**
- Check that the ON indicator of the CL module you want to remove is flashing. If not, use the supervisory terminal (or any other management facility) to reset the module to be replaced, and wait for execution of this command before continuing.
  - Do not plug in a CL module immediately after being removed, but wait at least 10 seconds. This will prevent any disruptions (for example, resetting) to I/O modules.
- 

➤ **To flip to the other CL module using the supervision terminal:**

1. Identify the on-line CL module: this is the module with the lit ON indicator.
2. Whenever possible, connect the supervision terminal directly to the CONTROL DCE connector of the on-line CL module.
3. Send a **Reset** command to the module to be replaced.
4. Wait for the flipping to be executed. After it is executed, the ON indicator of the CL module the supervision terminal is connected to starts flashing, while that of the other module stops flashing and lights steadily.

**Note**

---

*The command will not be executed if a fault is detected in the module that is to become the on-line module. In this case, the ON indicators state will not change.*

---

5. You can now disconnect the supervision terminal, and remove the module.
6. After installing again a CL module in the slot of the removed module, you may initiate flipping to the original module by resetting the current on-line CL module. However, you should wait at least 10 seconds before the reset command.

### *Megaplex 2100 Chassis with Single CL Module*

In a MP-2100 equipped with a single CL module, it is recommended that before replacing that CL module, a properly functioning module is installed in the free CL slot. The replacement can be temporary.

In this case, after inserting the additional CL module, it is first necessary to let it update its database from the information provided by the existing CL module:

1. After inserting the new CL module, you will see the alarm **COPY DB'S TO RDN CL IN PROCESS**.

2. Wait until the alarm **COPY DB'S TO RDN CL COMPLETED** is displayed.
3. At this stage, continue accordance with the steps listed above for a MP-2100 with two CL modules.

If the only CL module in the chassis is replaced, no management access is possible while no CL module is present. Therefore, be prepared and perform the replacement as rapidly as possible.

Among other steps, make sure to upload the existing configuration database to a host, using TFTP.

---

**Note**

*Resetting the CL module will cause a momentary interruption of management communication.*

---

After replacement is completed, download the database to the new CL module, to continue normal operation in accordance with the previous configuration.

## Installing Modules in MP-2104 Chassis

Refer to the above sections for MP-2100. The only difference is that the power supply is internal and there is a single CL module.

---

**Caution**

To prevent physical damage to the electronic components assembled on the two sides of the module printed circuit boards (PCB) while it is inserted into its chassis slot, support the module while sliding it into position and make sure that its components do not touch the chassis structure, nor other modules.

This precaution is particularly important when installing modules into the two lower I/O slots (**2** and **5**) of the MP-2104 chassis: take special care to support the module from below, while pushing it in gently.

---

---

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## 2.6 Connecting to Power

### Grounding

Connect a short, thick copper braid between the grounding screw on the PS module panel and a nearby grounding point.

### Connecting Power

Connect the power cable(s) first to the connector on the PS module, and then to the power outlet. For DC cables, pay attention to polarity.

---

**Note**

*When redundant power supplies are used, it is recommended to connect the power cables to outlets powered by different circuits.*

---

## Connecting External Feed and Ring Voltages

If the MP-2100 is powered from AC and does not include a Ringer-2100R module, it may be necessary to supply external feed and ring voltages. These voltages are required by voice modules and by ISDN interface modules.

The recommended source for external voltages is the Ringer-2200N, or Ringer-2000 offered by RAD. These are standalone units intended for rack mounting. Refer to the *Ringer-2200N* or *Ringer-2000 Installation and Operation Manual* for connection instructions.

---

**Caution**

Turn on the Ringer or the external voltage source, or connect the external voltages, only after the MP-2100 is turned on.

Turn off the Ringer or the external voltage source, or disconnect the external voltages, before the MP-2100 is turned off.

---

---

## 2.7 Connecting to the CL Module

This section provides information on the connections required by the various CL.2 module versions.

### Connecting to the CONTROL-DCE Connector

The CONTROL-DCE connector is an RS-232 asynchronous DCE port, terminated in a 9-pin D-type female connector, intended for direct connection to supervision terminals.

- Since terminals usually have DTE interfaces, the connection to this port is made by means of a straight-through cable.
- For connection to a modem, you need a cross cable (also called null modem cable).

➤ **To connect to an ASCII terminal:**

1. Connect the male 9-pin D-type connector of CBL-DB9F-DB9M-STR straight cable available from RAD to the CONTROL connector.
2. Connect the other connector of the CBL-DB9F-DB9M-STR cable to an ASCII terminal.

---

**Caution**

Terminal cables must have a frame ground connection. Use ungrounded cables when connecting a supervisory terminal to a DC-powered unit with floating ground. Using improper terminal cable may result in damage to supervisory terminal port.

---

### Connecting to the CONTROL-ETH Connector

The RJ-45 connector of the 10BASET interface is wired as a station port, and can be connected directly to an Ethernet hub port using a straight cable.

## Connecting to the Relay Connectors

The connection to the R1 and R2 connectors of CL modules with Ethernet interface is made by means of a male mating header (RIACON Cat. No. 31169103). The male connector has three screw terminals for the connection of the external alarm cable conductors.

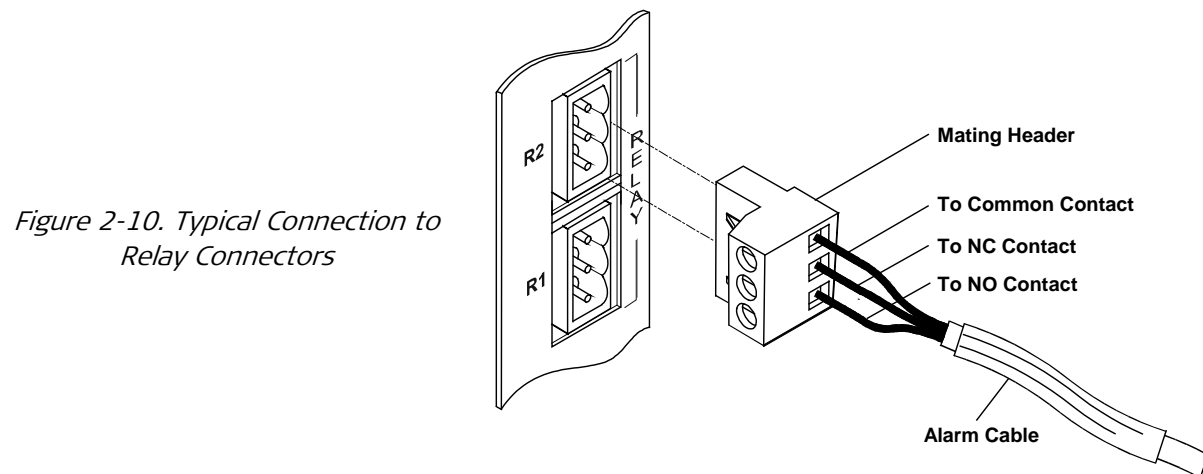
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### Caution

Prepare the connections to the header before inserting the header into the mating relay connector. After fastening the screw terminals, isolate the screws, to prevent the possibility of ESD when touched by the bare hand.

---

*Figure 2-10* shows the connection method of the cable to the header. Check for correct connections.




---

### Caution

To prevent damage to relay contacts, it is necessary to limit, by external means, the maximum current that may flow through the contacts (maximum allowed current through closed contacts is 1 A). The maximum voltage across the open contacts must not exceed 60 VDC.

---



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## 2.8 Connecting to Main Link and I/O Modules

Refer to the corresponding module Installation and Operation Manual.

# Chapter 3

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## Operation

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### 3.1 Turning On the Units

- To turn the MP-2100/MP-2104 on:

**Caution**

When an external feed and ring voltage source is connected to the PS modules installed in MP-2100/MP-2104, always turn that source on only after the PS module(s) have been turned on.

---

1. Turn the power on.

**Note**

*The Megaplex modules do not include a power switch. Use an external power ON/OFF switch, for example, the circuit breaker used to protect the power lines.*

---

2. Wait for the completion of the power-up initialization process. During this interval, monitor the power-up indications as described below.
- 

### 3.2 Indicators

#### Indicator Position and Function

The front panel of the MP-2100/MP-2104 enclosure includes labels for the system status indicators.

*Figure 3-1 and Figure 3-2* identify the front panel indicators for MP-2100 and MP-2104, respectively. *Table 3-1* describes the indicator functions.

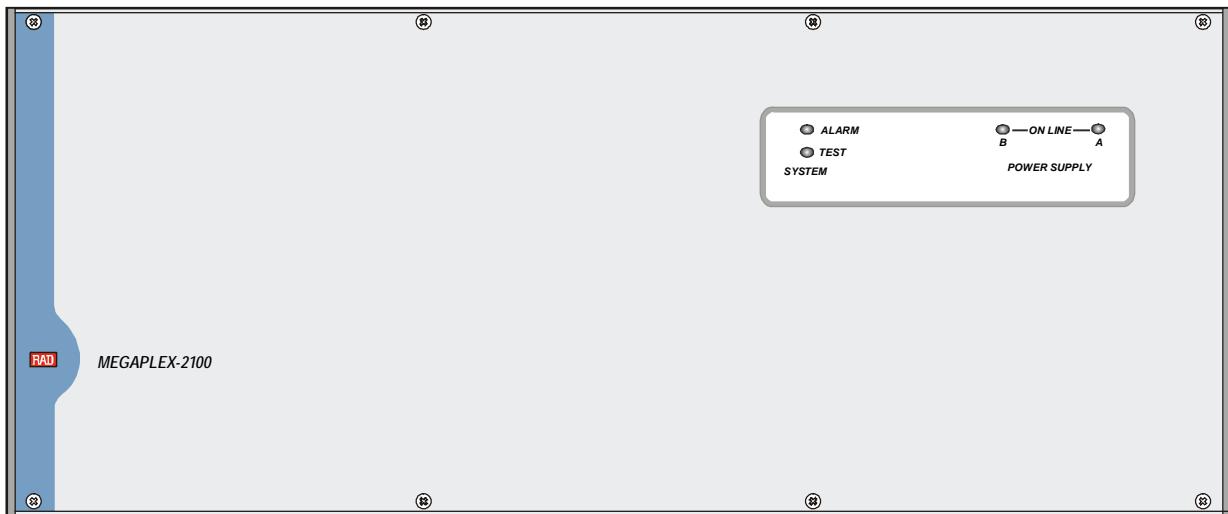


Figure 3-1. MP-2100 Enclosure, Front Panel

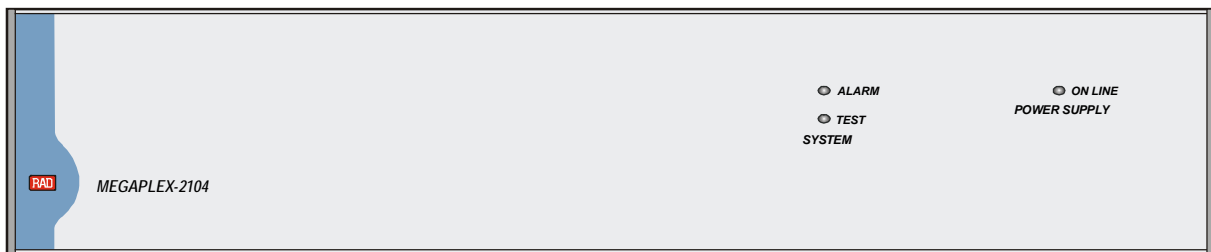


Figure 3-2. MP-2104, Front View

Table 3-1. MP-2100/MP-2104 Front Panel Indicators

Indicator	Description
ON LINE	Lights steadily when the corresponding PS module is on and the CL module is active
TEST	Indicates that a test (or test loopback) initiated by the local CL module is being performed in the local or remote MP-2100 system. When using the R2 signaling protocol, selecting the <b>Block</b> option using the DEF TEST command will not turn the TEST indicator ON
ALARM	Flashes when a major and/or critical alarm has been detected in the local MP-2100/2104 system.

### Notes

1. The indicator functions listed in Table 3-1 are the default functions. When the alarm masking and/or alarm inversion functions are used (see Chapter 6 for details), the meaning of the various indications may change.
2. The alarm severity (event, warning, minor, major or critical) can be defined by means of the DEF AP command.
3. The indications provided by the ALARM indicator can be changed by means of the DEF AR command.



## Normal Indications

- **PS Module(s):** The POWER indicator(s) on the rear panel(s) of the PS module(s) light to indicate proper operation. The ON-LINE front panel indicators will also light.

**Note**

*The indications appearing on the CL module and on the MP-2100 front panel can be modified by means of the alarm masking and/or alarm inversion commands, explained in [Chapter 6](#). This section explains the default indications.*

- **CL Module(s):** After turn-on, all the module indicators light for a few seconds, and then the ALARM and ON indicators must turn off. The TST indicator then starts flashing while the CL module decompresses the software stored in its flash memory. After the software is successfully decompressed, the TST indicator turns off, the front panel ON indicator turns on, and the system starts normal operation.

If two CL modules are used, the ON indicator lights only on the module selected as master, and flashes on the slave module. The other indicators of the slave module are always off. The TST indicator of the master module must remain off, but may turn on after a test loop is activated on the CL or one of the I/O modules.

**Note**

*If alarms are present in the system, the ALARM indicator (MAJOR and/or MINOR), of the master module does not turn off. In this case, use a supervision terminal or a network management station to read the alarms and then clear them: the ALARM indicators should turn off. If the indicators do not turn off, this indicates the presence of state alarms.*

- **Main Link Module(s):** The ON-LINE indicator of an active module (a module configured to carry traffic) must light; if an additional module is used (redundant pair), its ON-LINE indicator flashes.

The TST indicator must be off, but may turn on after a test loop is activated on the main link module. If the other communication equipment on the link is not yet operative, the module ALARM indicator and/or LOC S. LOSS (RED ALARM) and/or REM S. LOSS (YEL ALARM) indicator may light. These indicators turn off as soon as the link with the remote unit is established.

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### 3.3 Turning Off the Unit

- To turn the MP-2100/MP-2104 unit off:
  - Disconnect the power cord from the power source.



# Chapter 4

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## Management and Security

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### 4.1 Management Using Terminals and Telnet

This chapter provides general information related to the management of Megaplex systems by means of ASCII terminals. IP hosts using the Telnet protocol can also manage the Megaplex system using the procedures described in this chapter.

This chapter includes the following information:

- Introduction to configuration and management activities – this Section.
- Connection methods for terminals and Telnet hosts – this Section.
- Preliminary configuration – [Section 4.2](#).
- Concise description of the set of commands available for the supervision terminal – [Section 4.3](#). The same set is available to Telnet users.

The instructions appearing in this Chapter assume that the supervision terminal operator is familiar with the Megaplex system and its configuration parameters.

If necessary, review Appendix B for a description of the Megaplex operating environment, and refer to Chapter 1 for a functional description of the Megaplex system.

### Overview of Configuration and Management Activities

Before a Megaplex system can be used in its intended application, it is necessary to perform two types of activities:

- Preliminary configuration, which prepares the Megaplex system for using any of the management facilities supported by the system. The preliminary configuration of the Megaplex system must always be performed using an ASCII terminal equipped with an RS-232 communication interface, directly connected to the CL supervisory port (the CONTROL-DCE connector). The ASCII terminal can be a standard “dumb” communication terminal, or a personal computer running a terminal emulation or communication program.

The preliminary configuration activities are covered by [Section 4.2](#).

- System configuration, used to specify the system operational parameters needed by the Megaplex system to fulfill its intended function in the user’s environment.

After performing the preliminary configuration, and during regular operation, you can configure the Megaplex system using any of the following options:

- Use the terminal as a supervision terminal, for performing all the management activities supported by the Megaplex system. The software

necessary to run the Megaplex system supervision program is contained in the CL module of the Megaplex system. Moreover, the CL module stores all the configuration information generated or altered during the communication with the terminal.

- Configure the Megaplex system from any IP host using the Telnet protocol. After establishing a Telnet session with the Megaplex system, the Telnet protocol offers the same functionality as the supervision terminal, and in addition enables remote access over IP networks.

Typically, the Telnet host is a PC or a UNIX station with the appropriate suite of TCP/IP protocols. The host can be directly connected to the managed Megaplex system unit using one of the CL communication ports (serial or Ethernet). However, the host may also be located at a remote site, the only requirement being that IP communication be established between that site and the managed Megaplex system (either out-of-band, through a separate network, or through inband channels) provided by the TDM and IP main link modules).

- Configure the Megaplex system by means of SNMP-based network management stations, for example, RADview.

## Connecting to a Management Facility

This section presents information regarding the connection of a management facility (supervision or alarm monitoring terminal, Telnet host, SNMP network management station, etc.) to a Megaplex system. General information on various system management topologies is presented in Chapter 8.

In addition to the information presented in this section, the Megaplex systems also support management by a remote facility, connected to another RAD equipment unit (for example, DXC multiservice access nodes, FCD-E1 and FCD-T1 fractional E1, respectively T1, integrating multiplexers, etc.) that is connected to one of the Megaplex links (this management method is called *inband management*). When the Megaplex unit includes ML-IP modules, it is also possible to communicate inband through one of the ML-IP ports. Specific information regarding inband management is presented in [Handling Inband Management Traffic](#) section below.

### Out-of-Band Access Ports

Out-of-band management access is supported through the supervisory ports and the Ethernet ports of the CL module:

- **Supervisory Port Interface Characteristics.** The Megaplex has an RS-232 asynchronous DCE port, designated CONTROL-DCE. This port has a 9-pin D-type female connector, and is intended for direct connection to terminals.

Since terminals usually have DTE interfaces, the connection to this port is made by means of a straight-through cable. For connection to a modem, you need a cross cable (also called null modem cable).

The supervisory port supports the following data rates: 300, 1200, 2400, 4800, 9600, 19200, 38400, or 57600 bps. The word format consists of one start bit, 7 or 8 data bits, and one stop bit. Parity can be odd, even or disabled. Always make sure the communication interfaces of the equipment

(terminal, modem, etc.) connected to the supervisory port and the port itself are configured for operation with the same parameters.

The CL port continuously monitor the incoming data stream and will immediately respond to any input string received through the port; moreover, when configured to support SLIP or PPP, messages in the corresponding protocol are automatically identified and processed.

- **Ethernet Ports Characteristics.** The CL modules are also offered with one CONTROL-DCE RS-232 asynchronous DCE port and one 10BaseT Ethernet port, that can be directly connected to a LAN using the same media.

## Connecting a Supervision Terminal

Supervision terminals are supported through the supervisory ports located on the CL module:

- **Direct Connection to CONTROL-DCE Port.** The CONTROL-DCE port enables direct connection to terminals. Usually, terminals have DTE interfaces, therefore the terminal connection to the CONTROL-DCE port is made by means of a straight cable (a cable wired point-to-point). Refer to *Appendix A* for cable data.
- **Multidrop Connections.** You may use a multidrop configuration to connect the supervisory ports of several Megaplex systems located in close proximity to a common supervision terminal. The connection is made by means of multidrop modems or digital sharing devices: these devices enable to connect a single terminal to many Megaplex system units.

For multidrop operation, each Megaplex system must be assigned a node address in the range of 1 through 255.

### Note

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*Megaplex systems also support address 0: assigning address 0 to a Megaplex system means that it will accept and answer any message: this is not permitted in multidrop operation. Address 0 is however recommended for use with both direct connections, and point-to-point or dial-up modem links.*

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- **Connecting to Redundant CL Modules.** When two CL modules are installed in the Megaplex system, the transmit outputs of the slave module in the serial supervisory port connectors are disconnected, to enable simultaneous connection of the serial ports of both modules by means of an Y-cable.

Therefore, when CL redundancy is used, the supervisory port connectors of the two CL modules can be connected in parallel, since at any time only the port of the master CL module is active.

## Connecting Telnet Hosts

Telnet enables communication with multiple Megaplex units, using either inband or out-of-band communication.

- For communicating out-of-band, the Telnet host can either be connected to the Ethernet port, or to a serial port of a Megaplex system.
- For inband communication, the user can enable the transfer of management traffic through E1 or T1 ports, or through one of the ML-IP ports.

The Telnet protocol operates over IP. Since the IP traffic is automatically routed to the desired unit through the internal IP routers of chained equipment, the

connection of a Telnet host to one Megaplex unit may provide management access to many interconnected Megaplex system units, as well as to many other types of equipment that support this type of management (this includes many RAD network products, for example, Megaplex-4100, DXC multiservice access nodes, FCD-E1 and FCD-T1 fractional E1, respectively T1, integrating multiplexers, etc.).

- **Connection to Serial Ports (Out-of-Band Communication).** The connection to the supervisory port is made as explained above in the *Connecting a Supervision Terminal* section. Both direct connection, and connection through a modem link, are possible. The use of multidrop configurations is not recommended.
- **Connection to Ethernet Port (Out-of-Band Communication).** The Ethernet 10BaseT port available on CL modules with Ethernet port can be directly connected to a LAN. This enables Telnet hosts attached to the same LAN to communicate with the Megaplex system.

Remote Telnet hosts can also communicate with the Megaplex system, provided IP communication can be established from their location to the LAN to which the Megaplex Ethernet port is attached.

- **Connecting SNMP Management Stations.** The SNMP protocol also operates over IP, therefore all the requirements described above for Telnet management also apply to the connection of SNMP network management stations.

Multidrop configurations must not be used with SNMP, because multidrop operation requires that all the units strictly observe the rules of polled communication. This is not true for SNMP agents, because they can initiate transmissions on their own (whenever they have a trap to transmit).

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## 4.2 Preliminary Configuration

The scope of the preliminary configuration activities is to enable management communication with the Megaplex system.

For the preliminary configuration session, set section 1 of the DIP switch located on the CL module to ON, and connect the terminal directly to the CONTROL-DCE connector on the module panel. This enforces the use of the terminal, and selects the default communication parameters for the supervisory port. The default parameters are 9600 bps, one start bit, eight data bits, no parity, one stop bit and no flow control.

### Preparing for Directly Connecting a Supervision Terminal

1. Turn the supervision terminal on.
2. Configure the terminal for the communication parameters used by the Megaplex CONTROL-DCE port, select the full-duplex mode, and turn the terminal echo off.

**Note**

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*For the preliminary configuration session, always use the default communication parameters.*

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3. Connect the communication cable of the supervision terminal to the CONTROL-DCE connector located on the CL module.

Now you are ready to start the configuration session.

## Preparing for Connecting a Supervision Terminal through Regular Modem Links

This section explains how to connect a supervision terminal through a regular modem link having an RS-232 communication interface. In this method, the connection to the remote Megaplex is done via the telephone network using a modem. Therefore, both the modem and the Megaplex should be configured to support this type of connection. Note that the Megaplex supports only dial-in, that is, it cannot dial out.

► **To enable a dial-in modem connection:**

1. Configure the dial-in modem connected to the Megaplex.
2. Configure the Megaplex to support dial-in modem communication.
3. Connect the modem to the Megaplex.
4. Access the dial-in modem connected to the Megaplex via the telephone network.

### Configuring the Modem

► **To configure the dial-in modem:**

1. Connect your dial-in modem to one of the serial ports of your PC (COM1 or COM2).
2. Configure terminal parameters to support the modem as follows:

Connection	Direct to COM1 or COM2
Baud rate	Any baud rate supported by the modem
Data bits	8 bits
Stop bits	1 bit
Parity	None
Flow control	None
3. Configure the modem according to the following parameters:

AT and D2	Modem hang-up on DTR on to off
ATS0 = 1	Auto answer after one ring
ATQ1	Inhibit result code to DTE
ATE0	Turn off command echo.

### Configuring the Megaplex Unit

► **To configure the Megaplex to accept the dial-in modem:**

1. Connect the terminal to the CONTROL-DCE port of the Megaplex.

2. Configure the terminal parameters as follows:
  - Connection    Direct to COM1 or COM2
  - Baud rate     9600
  - Data bits     8 bits
  - Parity        None
  - Stop bits     1 bit
  - Flow control   None
3. Press **<Enter>** several times. The Megaplex should reply with a prompt.

## Preliminary Configuration Sequence

**Note** For detailed instructions regarding the use of the Megaplex command line interface, refer to [Section 4.3](#).

### Loading the Default Parameters

Enter the DB INIT command, followed by the DB UPD 1 command, for loading the default parameters for the Megaplex system being configured.

### Selecting the Supervisory Terminal Control Sequences

Select the terminal control sequences for the terminal type in use by entering the command DEF TERM 'terminal\_type'. 'terminal\_type' stands for one of the following types: ANSI, VT-52, VT-100, TV-920, FREEDOM-100, FREEDOM-110, FREEDOM-220.

In your terminal requires control sequences differing from those used by the terminals listed above, type the command DEF TERM and enter your terminal control sequences.

## Configuring Megaplex for Using Terminals

The activities described below prepare the Megaplex system for configuration by means of a supervision terminal.

Even in case you will manage the Megaplex system using only Telnet hosts and/or SNMP management stations, first you must use the supervision terminal to configure the supervisory port and the SNMP agent.

### Configuring the CONTROL-DCE Port

1. Configure the CONTROL-DCE port of the Megaplex system by entering the command DEF SP.
2. You will see the supervisory port configuration data form. A typical form with the default values is shown below:

BAUD RATE	PARITY	DATA BITS	STOP BITS	AUXILIARY DEVICE
9.6 KBPS	NONE	8 BITS	1 BIT	TERMINAL

3. Enter in each field the value corresponding to the configuration of the network management port to which this port will be connected.



4. In the **AUXILIARY DEVICE** field, select **TERMINAL**. After selecting the desired parameters, enter the **DB UPD 1** command.
5. Now return section 1 of the DIP switch located on the CL module to OFF, and continue working with the terminal.

## Setting the Time and Date for the Internal Clock

Set the time of the internal clock of the Megaplex system by entering the command **TIME**, and then set the date by entering the command **DATE**

At this stage, you can start using the supervision terminal to perform Megaplex configuration in accordance with Chapter 5.

## Activating Password Protection

To prevent unauthorized modification of the Megaplex system parameters, you can use a password. Set the password by entering the command **DEF PSW**, and then enter the **DB UPD 1** command.

## Configuring Megaplex for Telnet or SNMP Management

To prepare the Megaplex system for configuration by means of Telnet hosts and/or SNMP management stations, use the supervision terminal to configure the supervisory port and the SNMP agent as explained below.

To prevent unauthorized access, this can be done only when section 1 of the CL module DIP switch is set to ON.

### Configuring the SNMP Agent

1. Define the SNMP agent parameters using the **DEF AGENT** command. The IP address and the subnet mask, as well as the various community names, must match those of the IP host.

A typical SNMP agent parameters data form is shown below:

```

Enter Mux Name (Up To 22 Characters):    Megaplex 15
Enter The IP Address (xxx.xxx.xxx.xxx):  192.112.11.24
Enter Subnet Mask (xxx.xxx.xxx.xxx):     255.255.255.000
Enter Default Gateway (xxx.xxx.xxx.xxx): 0.0.0.0
Enter Net Id (1 To 255):                 010
Enter SNMP Read Community (Up To 8 Characters): public
Enter SNMP Write Community (Up To 8 Characters): private
Enter SNMP Trap Community (Up To 8 Characters): public

```

2. After selecting the desired parameters, enter the **DB UPD 1** command.

### Configuring CL Service Ports for Telnet and SNMP Access

To use a CL serial port for Telnet and SNMP access, use the **DEF SP** and/or **DEF SP CON2** commands, as applicable, and select the following parameters:

1. Select the appropriate data rate in the **SPEED** field.
2. For the CONTROL-DCE port, select **SLIP NMS** or **PPP NMS** in the **AUXILIARY DEVICE** field.

3. Select RIP2 or NONE in the **ROUTING PROTOCOL** field. The RIP2 selection is needed only when the management traffic must pass through standard routers.

After selecting the desired parameters, enter the DB UPD 1 command.

At this stage, you can start using Telnet hosts or SNMP management stations to perform Megaplex configuration in accordance with Chapter 5.

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## 4.3 Megaplex Supervision Language

This section explains the Megaplex supervision language syntax, usage, and presents a concise description of the Megaplex set of commands.

For a detailed description of the Megaplex command set, see Chapter 5.

Megaplex operating mode, and all of its functions, are controlled by a set of configuration parameters. These parameters can be determined by the user, in accordance with the requirements of the specific applications.

The preparation of the desired set of configuration parameters is made in accordance with a set of rules, which together form the Megaplex supervision language. The supervision language is used to communicate with the central control subsystem of the Megaplex located in the CL module, using a supervision terminal connected to a supervisory port of the CL module. The same language can also be used by Telnet hosts.

### Preparing a New Set of Configuration Parameters

During the preparation of the configuration parameters, the central control subsystem of the Megaplex dedicates a section of its RAM, called editing buffer, to this process. The editing buffer contains a copy of the current configuration parameters, and this copy is modified by the commands entered by the user.

When the preparation of the new set of configuration parameters is ended, the user can make a preliminary check of its validity by means of a special command (DB CHK), which performs a "sanity check" on the configuration parameters stored in the editing buffer. This command provides messages which help identify conflicting parameters, inconsistent selection of related parameter values, etc., so the parameters can be corrected before proceeding.

After the check is successfully passed, the user can save the new set of configuration parameters as a database. If the new set is saved under the number of the active configuration database, the Megaplex system will start operating in accordance with the new configuration, by means of the DB UPD D command (where D is 1 to 10). If parameters are changed but no DB UPD command is issued after the prompt returns, the Megaplex will display a **CONFIGURATION DATABASE WAS CHANGED, ENTER UPDATE DB TO ACTIVATE** message to remind the user to save the changes.

The DB UPD command also performs a "sanity check" on the configuration parameters before updating (modifying) the stored parameters. If the "sanity check" is successfully passed, this command stores the new set of configuration parameters in the non-volatile memory of the CL module, and reconfigures the system modules according to the new parameters.

Since the last validated set of configuration parameters is stored in non-volatile memory, Megaplex configuration is not affected when the power is turned off.

Upon turn-on, the Megaplex central control subsystem checks the validity of the configuration data stored in non-volatile memory, and if everything is OK, it loads the data into the working memory and reconfigures the system accordingly. Therefore, if the stored configuration does not require modification, the Megaplex is ready for operation immediately after power is applied. However, if

the configuration data is not valid, the stored database will not be activated; instead, the default database will be activated. To facilitate the correction of the database, edit the original database that was not activated and correct whatever was wrong.

After the operating parameters have been loaded, a process called configuration set-up, the Megaplex no longer requires operator attendance.

## Supervision Language Syntax

- Except when starting a new session, commands can be entered only when a prompt is displayed. The prompt always appears at the beginning of a new line, and the cursor appears to the right of the prompt (except when using a multidrop configuration).
- Commands are case-insensitive. For example, you can type commands in either lower case and/or upper case letters, and they will be interpreted as upper case only. Logical names entered in the user-defined section of the prompt can however use lower-case and upper-case letters, as entered by you.
- Commands addressed to a specific module must identify the module using the chassis slot number. For example, a main link module is identified by the number of the I/O slot, for example, 1.

Channels are identified by entering their number after a colon or space; for example, channel 3 of the module in I/O 7 is identified by 7:3 or 7 3. All the channels of that module are identified by 7:\* or 7 \*.

When it is necessary to discriminate between internal and external ports, identify the port by using the designations EX1, EX2, etc. for external ports, and IN1, IN2, etc. for internal ports (ports that connect to a TDM bus).

- The supervisory ports are identified as CON1 (CONTROL-DCE port) and CON2 (CONTROL-ETH port). For CON1, you can omit the specification altogether.
- To correct typing errors, backspace by pressing the BACKSPACE key until the error is cleared, and then type the correct characters.
- To clear the whole command string before its entry is completed, press **CTRL-C** (that is, hold the **<CTRL>** key down and type **C**), or press **<ESC>**. This will display of the Megaplex prompt, and you can enter a new command.
- Use space as a separator between command fields and/or parameters.
- Leading zeroes may be omitted.
- Commands must end with a carriage return **<Enter>**.
- If you are *not* using the multidrop mode, then you can edit the previous command by pressing **CTRL-A**. Megaplex stores the last command in a special buffer, and **CTRL-A** retrieves the previous command from that buffer. The retrieved command appears on the command line, and can be edited as desired.
- If you are *not* using the multidrop mode, press **CTRL-D** to execute again the last command.
- To obtain help, type **H**.

## Command Options

The following general types of options are available with some commands. See details in the command set index, [Table 4-1](#).

Option	Meaning	Example of Usage
/A	All	DSP ALM /A Displays all the alarms stored by the alarm buffer (including alarms that have been cleared by the user)
/C	Clear	DSP ALM /C Display all the alarms stored by the alarm buffer and then clear all the event alarms and the alarm buffer
*	Display/edit all the relevant or optional information for the requested item	DEF CH IO-1: * Define the parameters of all the channels of the module installed in slot IO-1 of the Megaplex

## Command Protocol

### Command Evaluation and Execution

- The first prompt displayed when the session is started is **PASSWORD>** and the addressed Megaplex waits for the password before continuing. After the correct password is received, the Megaplex sends the working prompt.

The default password is **<Enter>**.

#### Note

*When the supervision terminal is directly connected to the CL module and section 1 of the CL module is set to ON, it is not necessary to enter a password to establish a configuration session from the supervision terminal.*

- If working in multidrop mode, the password prompt appears only after the node address conditions are fulfilled.  
To send a command to a specific Megaplex, send before each command the desired Megaplex node number: **NODE 'NODE NUMBER'<Enter>**
- After a working prompt is displayed, every character typed on the terminal keyboard is immediately evaluated by the Megaplex and echoed to the terminal screen. Full duplex communication with the terminal is therefore necessary, to provide on-line feedback to the terminal operator.
- Command evaluation starts only when the **<Enter>** key is pressed.
- In general, if an error is detected during command evaluation, the command is not executed. Instead, the Megaplex will send an error message to the terminal. The correct command must then be sent again.

This however does not apply to parameters defined during database editing: such errors must be corrected by the user.

- The command is executed only after it is validated.

- After the command is executed, you will see the prompt again. If the time stamp is included in the prompt, it will be displayed in the following format:

**time:HH:MM:SS date:MM:DD:YYYY**

In the multidrop mode (node address not 0), the prompt displayed is **<Multidrop mode>**. This is to remind the operator to enter a node number before typing any command.

If the command modifies either the configuration database or the flip database, the Megaplex reminds you that it is necessary to use the DB UPD command (for changes in the configuration database) or the FLIP UPD command (for changes in the flip database) to activate these changes. For example, after a change in the configuration database, the message **Attention! Database was changed, enter DB UPD to activate or DB UNDO to undo** is displayed on the terminal.

- Command execution can be interrupted by pressing **CTRL-C** or **<ESC>**. This will result in the display of the Megaplex prompt, and a new command can be entered.

## Command Fields

- When a command has several fields, use the space bar to move the cursor among the various fields. However, for some commands, the **<Enter>** key is used instead: this is indicated in the command description.
- When a field has a limited range of values, the available values can be displayed by scrolling. Scrolling is performed by bringing the cursor to the desired field, and then pressing the F (forward) or B (backward) key until the desired value is displayed.
- If a certain field is not applicable to the current command, the field shows N/A and scrolling is not possible. N/A will usually appear in fields of a DEF command that specify parameters not used in the selected operating mode.

## Ending a Session

Megaplex will deactivate the current session in the following cases:

- When the BYE command is received.
- After no terminal activity is detected for the log-off time-out interval (3 or 10 minutes).

After the session is ended, it is necessary to enter the correct password again to start a new session.

## Index of Commands

*Table 4-1* lists the Megaplex commands in ascending alphabetical order.

*Table 4-1. Megaplex Command Set Index*

Command	Purpose	Options
ADD AI	Change (invert) the interpretation of a selected alarm condition with respect to Megaplex visual indications and alarm relay	
ADD AM	Mask a specified alarm	
ADD BND	Add new timeslot bundle for ML-IP configuration	
ADD CH	Add new internal port to a selected module.	
ADD FLIP ENTRY	Add a new entry to flip database	
ADD FLIP EVENT	Add a new event to flip database	
ADD MANAGER LIST	Add a new entry to the managers' table	
ADD NET ENTRY	Add a new entry to the net routes table	
ADD PERMANENT AM	Mask the specified alarm and save it in the non-volatile memory	
ADD RIP2 AGENT	Add new entry to the agents table	
ADD ROUTE	Add new static entry to the routing table, used by the ML-IP or HS-ETH/SW modules	
BYE	Deactivate the current password and end the terminal session	
CLR ALM	Clear the alarms stored in the history alarm buffer and the events from the status buffer. You can selectively clear only the alarms of a specified module or module channel (only from the status buffer)	
CLR AT&T	Clear the AT&T statistics counters of a specified main link module	
CLR BERT CNT	Clear (reset to 0) the BER and loss-of-sync counters	
CLR STAT CH	Clear the statistics collected for a specified port	
CLR STAT BND	Clear the ML-IP bundle statistics	
CLR STAT LAN	Clear the ML-IP Ethernet port statistics	
CLR TEST	Clear the user-initiated loopbacks or tests of a specified module or channel	
DATE	Set the date for the Megaplex internal clock	
DB CHK	Perform a sanity check on the database being edited	
DB INIT	Load the default parameters into the database being edited	
DB NET GO	Simultaneously activate on all the Megaplex units in the network the database selected with the DB NET UPD or FLIP NET UPD command	
DB NET UPD	Copy database from edit buffer to non-volatile memory, and wait for DB NET GO command to activate it	
DB UNDO [CHANGES]	Cancel all the changes made in the configuration database being edited since the last DB UPD command	
DB UPD	Copy the edited database into the non-volatile memory, and activate it if it matches the flip database algorithm	
DEF AF	Define filtering values for a selected state alarm	

<b>Command</b>	<b>Purpose</b>	<b>Options</b>
DEF AGENDA	Define week day types	
DEF AGENT	Define the parameters of the Megaplex SNMP agent	
DEF AP	Define the priority (severity) of the selected alarm	
DEF AR	Define the alarm reporting method, and the alarm indications, for each alarm level	
DEF AT	Define threshold values for a selected event alarm	
DEF AW	Define an observation window (time interval) for the filtering of alarms	
DEF BND	Change bundle parameters	
DEF CH	Configure the parameters of a selected module, module channel or module port	
DEF DEFAULT DB	Select one of the valid databases as the default database	
DEF F	Select the codes for "clear the screen", "cursor home", and "cursor right"	
DEF FLIP BROADCAST	Enable/disable flip event broadcasting to other Megaplex units, and define the time interval between broadcasts	
DEF FLIP ENTRY	Edit the desired flip database entry	
DEF FLIP EVENT	Edit the parameters of an existing flip event	
DEF MANAGER LIST	Change manager station parameters	
DEF MMI	Define the working prompt to be displayed on the supervision terminal	
DEF NAME	Define the parameters of the Megaplex SNMP agent	
DEF NET DELAY	Define the delay between the reception of a DB NET GO broadcast message, or a flip event broadcast message, and database activation	
DEF NET ENTRY	Edit net route parameters	
DEF PING	Define the parameters used to ping a selected IP address	
DEF PROFILE	Define profile parameters	
DEF PROMPT	Define the working prompt to be displayed on the supervision terminal	
DEF PSW DEF PWD	Define a new password, and/or display the current password	
DEF RDN ST	Control the state (enable/disable) of a port which is a member of a redundancy pair	
DEF RDN ST BND	Control the state (enable/disable) of a bundle which is a member of a redundancy pair	
DEF ROUTE	Modify existing static entry in the routing table, used by the ML-IP or HS-ETH/SW modules	
DEF SP	Configure the parameters of the specified supervisory port	
DEF SPLIT TS	Define bit-level timeslot assignment	



<b>Command</b>	<b>Purpose</b>	<b>Options</b>
DEF SYS	Define the system configuration	
DEF TERM	Define the terminal type and control sequences	
DEF TERMINAL ACCESS	Disable or enable terminal access	
DEF TEST	Control the tests to be performed on the Megaplex modules	
DEF TS	Define the timeslot assignment for a selected E1 or T1 port	
DEF VAR PORTID	Edit the parameters of the ports located on the module installed in a specified I/O slot, in an existing variant. The user can specify: <ul style="list-style-type: none"> <li>• All the lines of a specified I/O module</li> <li>• All the lines of a specified channel of an I/O module</li> <li>• A specific timeslot of a specified port of a legacy main link module</li> </ul>	
DEL AI	Cancel the inversion of a specified alarm	
DEL AM	Cancel the masking of a specified alarm	
DEL AT	Delete the alarm thresholds of a specified alarm	
DEL BND	Delete a timeslot bundle	
DEL DB	Delete a selected database from the non-volatile memory	
DEL FLIP ENTRY	Delete a selected entry from flip database	
DEL FLIP EVENT	Delete a selected event from flip database	
DEL MANAGER LIST	Delete an entry from network management stations table	
DEL NET ENTRY	Delete an existing entry from net filtering table	
DEL PERMANENT AM	Cancel the masking of a specified alarm and delete it from the non-volatile memory	
DEL RIP2 AGENT	Delete selected entry from the agents table	
DEL ROUTE	Delete a static entry from the routing table, used by the ML-IP or HS-ETH/SW modules	
DSP AF	Display the filtering values for a selected state alarm	
DSP AGENDA	Display the week day definitions defined in the edited database	
DSP AGENT	Display the SNMP agent parameters	
DSP AI	Display the inverted alarms	
DSP ALM	Display, and optionally clear, the contents of the history alarm buffer	/C, /A
DSP ALM ST	Display and optionally clear, the status alarms. You can specify a specific module or module channel to display	/C
DSP AM	Display the masked alarms	
DSP AP	Display the alarm priority/severity	
DSP AQ	Display, and optionally clear, the contents of the history alarm buffer	/C, /A
DSP AR	Display the alarm reporting method and indications	

<b>Command</b>	<b>Purpose</b>	<b>Options</b>
DSP AS	Display, and optionally clear, the status alarms. You can specify a specific module or module channel to display	
DSP ASP	Display the alarms at the specified priority, and higher	
DSP AT	Display the thresholds of a specified alarm	
DSP AT&T 15M DSP AT&T 24H	Display the 15-minute, respectively 24-hour, AT&T statistics and optionally reset the statistics	/C
DSP AW	Display the filtering time window	
DSP BERT	Display the results of the BERT test running on a module channel or port	/C
DSP BND	Display the parameters of a timeslot bundle	
DSP DB LIST	Display list of valid databases stored in the non-volatile memory	
DSP DEFAULT DB	Display the number of the database defined as default database	
DSP FLIP BROADCAST	Display the flip broadcasting parameters	
DSP FLIP ENTRY	Display the entries defined in the edited flip database	
DSP FLIP EVENT	Display the events defined in the edited flip database	
DSP MANAGER LIST	Display the network management stations table	
DSP MMI	Display the user-selected prompt parameters	
DSP NAME	Display the SNMP agent parameters	
DSP NET DELAY	Display the net delay defined in the edited database	
DSP NET ENTRY	Display the net address filtering table	
DSP PING	Display the results of a ping command	
DSP PROFILE	Display a signaling profile	
DSP PROMPT	Display the user-selected prompt parameters	
DSP REM AGENT	Display the remote SNMP agents parameters	
DSP REM NAME	Display the remote SNMP agents parameters	
DSP REV	Display the configured and installed modules, and their hardware and software revisions	
DSP RIP2 AGENT	Display the agents table	
DSP RDN ST	Display the state of a port which is a member of a redundancy pair	
DSP RDN ST BND	Display the state of a bundle which is a member of a redundancy pair	
DSP ROUTE	Display the parameters of a static entry in the routing table, used by the ML-IP or HS-ETH/SW modules	
DSP SIG TS	Display the current state of the signaling information sent by a selected voice channel	
DSP SP	Display the parameters of the specified supervisory port	
DSP ST AGENDA	Display the week day types defined in the current flip database	

<b>Command</b>	<b>Purpose</b>	<b>Options</b>
DSP ST CH	Display the active parameters of the specified channel	
DSP ST DEFAULT DB	Display the number of the default database defined in the current (active) database	
DSP ST FLIP BROADCAST	Display the flip broadcast state defined in the current (active) flip database	
DSP ST FLIP ENTRY	Display entries defined in the current (active) flip database	
DSP ST FLIP EVENT	Display events defined in the current (active) flip database	
DSP ST SPLIT TS	Display the current (active) bit-level timeslot assignment	
DSP ST SYS	Display system status	
DSP ST TS	Display the timeslot assignment in the current database	
DSP STAT BND	Display ML-IP bundle statistics	
DSP STAT CH	Display the statistics collected for a specified port	
DSP STAT LAN	Display ML-IP Ethernet port statistics	
DSP TERM	Display the current terminal control sequences	
DSP TEST	Display the currently active tests	
DSP TS	Display the timeslot assignment in the edited database	
F	Select the "clear the screen", "cursor home", and "cursor right" codes	
FLIP [DB] CHK	Check the flip database correctness	
FLIP [DB] NET GO	Simultaneously activate on all the Megaplex in the network the flip database selected with the FLIP NET UPD command	
FLIP [DB] NET UPD	Copy flip database from edit buffer to non-volatile memory and wait for DB NET GO command to activate	
FLIP [DB] UNDO [CHANGES]	Cancel the changes in the flip database	
FLIP [DB] UPD	Copy flip database to non-volatile memory and activate it	
H HELP	Display a concise index of commands and option switches	
INIT AP	Return the alarm priorities to the default values	
INIT DB	Load the default parameters for the modules installed in the Megaplex to the database being edited	
INJER	Inject one error in the test sequence during BER testing	
LOAD DB	Copy a selected database from non-volatile memory to the edit buffer	
RESET	Reset the module installed in a specified slot	
TIME	Set the time of the Megaplex internal clock	

---

---

## 4.4 SNMP Environment

This section provides the specific information required for the management of Megaplex equipment by means of the Simple Network Management Protocol (SNMP). Part of the information presented in this section is also applicable to Telnet management.

The SNMP management functions of the Megaplex are provided by an internal SNMP agent located on the CL module.

The SNMP management communication uses the User Datagram Protocol (UDP), a connectionless-mode transport protocol, part of the suite of protocols of the Internet Protocol (IP). This section covers the information related to the SNMP environment.

---

### Note

*Telnet management uses the TCP protocol over IP for management communication. After a Telnet session is started, the management interface is similar to that used for the supervision terminal.*

*For a description of the IP environment, refer to [Appendix B](#).*

---

## SNMP Principles

The SNMP management protocol is an asynchronous command/response polling protocol: all the management traffic is initiated by the SNMP-based network management station (except for trap messages), which addresses the managed entities in its management domain. Only the addressed managed entity answers the polling of the management station.

The managed entities include a function called an “SNMP agent”, which is responsible for interpretation and handling of the management station requests to the managed entity, and the generation of properly-formatted responses to the management station.

## SNMP Operations

The SNMP protocol includes four types of operations:

<b>getRequest</b>	Command for retrieving specific management information from the managed entity. The managed entity responds with a <b>getResponse</b> message.
<b>getNextRequest</b>	Command for retrieving sequentially specific management information from the managed entity. The managed entity responds with a <b>getResponse</b> message.
<b>setRequest</b>	Command for manipulating specific management information within the managed entity. The managed entity responds with a <b>setResponse</b> message.
<b>trap</b>	Management message carrying unsolicited information on extraordinary events (e.g., alarms) reported by the managed entity.

## The Management Information Base

The management information base (MIB) includes a collection of *managed objects*. A managed object is defined as a parameter that can be managed, such as a performance statistics value.

The MIB includes the definitions of relevant managed objects. Various MIBs can be defined for various management purposes, types of equipment, etc.

An object's definition includes the range of values and the "access" rights:

<b>Read-only</b>	Object value can be read, but cannot be set.
<b>Read-write</b>	Object value can be read or set.
<b>Write-only</b>	Object value can be set, but cannot be read.
<b>Not accessible</b>	Object value cannot be read, nor set.

## MIB Structure

The MIB has an inverted tree-like structure, with each definition of a managed object forming one leaf, located at the end of a branch of that tree. Each "leaf" in the MIB is reached by a unique path, therefore by numbering the branching points, starting with the top, each leaf can be uniquely defined by a sequence of numbers. The formal description of the managed objects and the MIB structure is provided in a special standardized format, called Abstract Syntax Notation 1 (ASN.1).

Since the general collection of MIBs can also be organized in a similar structure, under the supervision of the Internet Activities Board (IAB), any parameter included in a MIB that is recognized by the IAB is uniquely defined.

To provide the flexibility necessary in a global structure, MIBs are classified in various classes (branches), one of them being the experimental branch, and another the group of private (enterprise-specific) branch. Under the private enterprise-specific branch of MIBs, each enterprise (manufacturer) can be assigned a number, which is its enterprise number. The assigned number designates the top of an enterprise-specific sub-tree of non-standard MIBs. Within this context, RAD has been assigned the enterprise number **164**.

Therefore, enterprise MIBs published by RAD can be found under **1.3.6.1.4.1.164**.

MIBs of general interest are published by the IAB in the form of a Request for Comment (RFC) document. In addition, MIBs are also often assigned informal names that reflect their primary purpose. Enterprise-specific MIBs are published and distributed by their originator, which is responsible for their contents.

## MIBs Supported by the Megaplex SNMP Agent

The interpretation of the relevant MIBs is a function of the SNMP agent of each managed entity. The general Megaplex SNMP agent currently supports RFC 1213 (the standard MIB-II).

In addition, the Megaplex SNMP agent supports RAD private enterprise-specific MIBs, to manage specific system parameters, and in particular the RAD-private (enterprise-specific) MIB identified as (read the following as a continuous string):

```
iso(1).org(3).dod(6).internet(1).private(4).enterprises(1).
rad(164).radGen(6).systems(1).radSysWan(3).X
```

where **x** stands for the specific equipment version:

- 1 **Megaplex-2100**
- 2 **Megaplex-2104**

Enterprise-specific MIBs supported by RAD equipment, including the Megaplex, are available in ASN.1 format from the RAD Authorized Partner.

## Management Domains under SNMP

SNMP enables, in principle, each management station that knows the MIBs supported by a device to perform all the management operations available on that device. However, this is not desirable in practical situations, so it is necessary to provide a means to delimit management domains.

### SNMP Communities

To enable the delimitation of management domains, SNMP uses "communities". Each community is identified by a name, which is a case-sensitive alphanumeric string defined by the user (the Megaplex SNMP agents support community names of up to 8 characters).

Any SNMP entity (this term includes both managed entities and management stations) can be assigned by its user community names.

### Access Restriction Using SNMP Communities

In general, SNMP agents support two types of access rights:

- **Read-only:** the SNMP agent accepts and processes only SNMP `getRequest` and `getNextRequest` commands from management stations which have the same read-only community name.
- **Read-write:** the SNMP agent accepts and processes all the SNMP commands received from a management station with the same write community name.

For each SNMP entity it is possible to define a list of the communities which are authorized to communicate with it, and the access rights associated with each community (this is the SNMP community name table of the entity).

For example, the SNMP community name table of the SNMP agent of the Megaplex can include three community names.

In accordance with the SNMP protocol, the SNMP community of the originating entity is sent in each message.

When an SNMP message is received by the addressed entity, first it checks the originator's community: if the community name of the message originator differs from the community name specified for that type of message in the agent, the message is discarded (SNMP agents of managed entities report this event by means of an authentication failure trap).

### Megaplex Communities

The SNMP agent of the Megaplex is programmed to recognize the following community types:

<b>Read</b>	SNMP community that has read-only authorization, i.e., the SNMP agent will accept only <code>getRequest</code> and <code>getNextRequest</code> commands from management stations using that community.
<b>Write</b>	SNMP community that has read-write authorization, i.e., the SNMP agent will also accept <code>setRequest</code> commands from management stations using that community.
<b>Trap</b>	SNMP community which the SNMP agent will send *within trap messages.

## Handling of Management Traffic

The SNMP agent of the Megaplex includes an IP router function, that is used to route management messages automatically. The IP router function of each SNMP agent operates both on the inband, as well as on the out-of-band traffic, depending on the selected communication method.

### Handling Out-of-Band Communication

Out-of-band communication is performed via the management ports of the CL module. The communication method and protocol depends on the specific CL version.

#### *CL Modules with Serial Interfaces*

The user can select, for each port, between the Serial Link Internet Protocol (SLIP) and the Point-to-Point Protocol (PPP).

Out-of-band management uses a RAD proprietary protocol for management traffic handling. The user can also enable the transmission of RIP2 routing tables through each serial port, thereby enabling the transfer of management traffic through routers using the RIP2 protocol.

#### *CL Modules with Ethernet Interfaces*

Typically, for the CL module versions with Ethernet interface, the serial CONTROL-DCE port is configured by the user to serve as an access port for supervision terminals, and the Ethernet port, CONTROL-ETH, is used for out-of-band communication.

When using out-of-band communication through the Ethernet port of a CL module, the IP router uses the IP protocol for management traffic. In this case, the CL module also serves as a proxy ARP agent to enable a management station connected to its Ethernet port to manage remote equipment, using inband communication.

When the Megaplex includes ML-IP modules, the user can redirect the management traffic from the CL Ethernet port to the ML-IP module (in this case, the CL Ethernet port is disabled). When this option is used, the CL module traffic directed to the ML-IP network is treated by the IP module as any other bundle, whereas in the receive-from-network direction, the ML-IP module transfers to the CL module all the packets of types not processed by it (for example, RIP, SNMP, etc.). The IP router of the CL module then analyzes these packets, processes those with management contents and discards the other packets.

To enable the CL module to communicate with management stations through the IP link, the ML-IP module also provides the routing services that would otherwise be performed by the CL management subsystem. For this purpose, the CL module downloads a copy of its routing table to the ML-IP module, thereby providing the module with the management routing information.

The ML-IP module also handles ARP requests for the CL management subsystem. Therefore, the IP main link module serves as a proxy server for the CL management subsystem.

## Handling Inband Management Traffic

When using inband communication, the IP router of the CL module can receive the management traffic through each TDM port, either internal or external (main link), via user-specified timeslots. Different protocols and routing methods can be configured for each TDM port.

### *Inband Communication Ports and Protocols*

When using inband communication, the user can select the bandwidth allocated to management, and the transmission and routing management protocols:

- Management traffic carried within the E1 or T1 frame overhead (not available on internal TDM ports). This communication mode uses a RAD proprietary protocol, which requires a small fraction of the link bandwidth:
  - For E1 links, the management traffic is carried by means of the national bits  $S_{a4}$  to  $S_{a8}$  in timeslot 0. The number of bits is selectable in the range of 1 to 5, corresponding to a data rate of 4 kbps for one bit, and 20 kbps for 5 bits.
  - For T1 links, the management traffic is carried by the FDL channel. The data rate is then 4 kbps.
- Management traffic carried in a dedicated timeslot. In this case, the management data rate is 64 kbps. The management can use the RAD proprietary protocol, PPP, HDLC encapsulation or Frame Relay encapsulation in accordance with RFC 1490, and if required, the RIP2 routing protocol.

This mode enables using routers for connecting the management traffic to the managed Megaplex.

---

**Note** *Inband management is not possible on T1 links using the B7 line code.*

---

### *Routing of Inband Management Traffic*

The CL IP router function uses the RAD proprietary routing protocol whenever it operates in a network environment consisting of RAD products.

In addition, when connecting directly to a router the CL IP router can be configured by the user to use standard protocols (PPP, Frame Relay, and RIP2).

- The RAD proprietary routing protocol is used with the timeslot 0 (or FDL) option, and the dedicated timeslot option.

When the CL IP router function is configured to use the RAD proprietary protocol, it collects information on the other SNMP agents by exchanging routing information (including the contents of each router's routing table),



with its neighbors. This automatic learning capability enables using any network topology, including topologies with closed loops.

Note that an SNMP agent accepts routing information messages only through the port defined as the AGENT port or through inband management.

- The RIP2 protocol can be enabled when using the dedicated timeslot, PPP and Frame Relay options.
- When the management traffic is carried in a dedicated timeslot, it is also possible to use Frame Relay encapsulation in accordance with RFC 1490 (and if required, the RIP2 routing protocol). This enables using Frame Relay routers to carry the management traffic to the managed Megaplex:
  - In the transmit direction, the SNMP agent encapsulates the management messages in frames with a predetermined DLCI (always DLCI 100), and sends them at the selected rate through the selected main link timeslot.
  - In the receive direction, the SNMP agent monitors the specified timeslot, analyzes packets received with DLCI 100, and analyzes the received data to detect management messages (any such messages are then processed as usual).

Note that the Megaplex SNMP agent does not support Frame Relay management protocols (ANSI T1.617 Annex D, LMI, etc.), nor is such support required.

The RAD proprietary protocol provides better routing capabilities, therefore it is recommended to use it whenever feasible.

### ***Preventing Management Access to the Other Network Equipment***

By default, the internal IP router function of the Megaplex SNMP agent will route management traffic received through any link configured for management access, to all the other links and ports that are also configured for management access.

There are certain applications in which this is not desirable: a particular configuration of this type is a link that ends in equipment managed by a “foreign” management station, which should not be able to access the other equipment in the network.

To prevent that management station from accessing other equipment through the IP router function of the Megaplex SNMP agent, the user can configure that link for operation using a dedicated timeslot for management traffic, but without enabling any routing protocol (i.e., neither the RAD proprietary, not the RIP2 routing protocol).

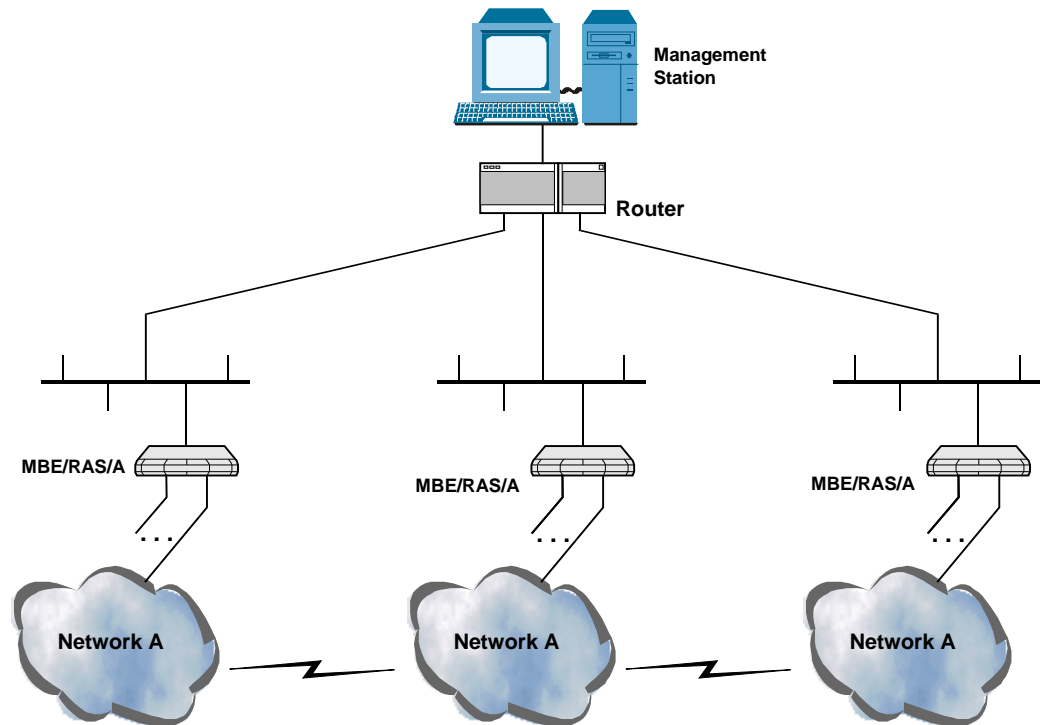
### **Subnet Addressing**

When a large number of Megaplex units is managed by an SNMP management station, significant management traffic may be generated. Since large networks generally have more than one management station, the management traffic load becomes even higher.

The usual approach to the management of a large network is to split the network into management domains. In this case, from the point of view of system management, the network can be split into several subnetworks, as shown in [Figure 4-1](#).

For this purpose, the IP router function of Megaplex SNMP agents supports learning filters. A learning filter is defined by means of a subnet IP address, and a subnet mask. The IP router will learn only addresses of agent IP addresses, which when viewed through the mask, match the subnet IP address. Therefore, the IP router can be instructed to learn only IP addresses of Megaplex units within predefined subnetworks. In the example of *Figure 4-1*, Megaplex units in network A need only learn the addresses of other units in the same network; the same is true for the units in networks B and C.

Each pair of subnet IP address and subnet mask is called a net entry.



*Figure 4-1. Management System Topology Using Subnetting*

## SNMP Traps

The SNMP agent of the Megaplex supports the MIB-II authentication trap, and in addition generates the following enterprise-specific traps:

- Each alarm message
- The result of each sanity check
- Updating of active database
- Updating of flip database.

Traps are also sent to notify the management station of the following events:

- Resetting of the CL module (cold start trap)
- When the management link changes status (up or down).

# Chapter 5

---

## Configuration

This chapter provides a detailed description of the Megaplex supervision language.

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### 5.1 Introduction

The information appearing in this chapter assumes that the user is familiar with the Megaplex system and with its configuration parameters. If necessary, review [Appendix B](#) for a description of the Megaplex operating environment, [Chapter 4](#) for a general description of the Megaplex supervision language syntax, and [Chapter 1](#) for a functional description of the Megaplex system.

---

**Note** *All the parameter values appearing in the following screens are given for illustration purposes only, and do not reflect recommended values.*

---

This chapter describes the Megaplex commands. The commands are listed in alphabetical order (see [Table 4-1](#) for a complete list).

The description includes command format, use, and options. The following notational conventions are used:

- [ ] Square brackets enclose an optional entry/parameter
- { } Parentheses enclose a list of entries/parameters from which one must be selected
- <Enter> Indicates the pressing of the carriage return key
- <SP> Indicates the pressing of the spacebar
- SS Indicates the number of the Megaplex slot in which a module is installed
- CC Indicates the channel number within the module installed in the specified I/O slot
- CON# Indicates the supervisory port number, CON1 (CONTROL-DCE) or CON2 (ETHERNET)
- EX# Indicates the number of an external port
- IN# Indicates the number of an internal port
- TT Indicates the number of a timeslot
- A Indicates the number of an alarm
- B Indicates the number of a timeslot bundle
- D Indicates the number of a database
- E Indicates the number of a flip database entry

N	Indicates the number of a net entry
R	Indicates the number of a route in the static IP routing table
S	Indicates the number of a signaling profile
V	Indicates the number of a flip event

---



---

## 5.2 Command Set Description

### ADD AI

#### Purpose

Change (invert) the interpretation of a selected alarm condition with respect to Megaplex visual indications and alarm relay:

- Normally, an alarm is interpreted as being active when the associated condition is present (*true*).
- When the alarm is inverted, the normal condition is the presence of an alarm condition, and the condition that requires alerting is the absence of the alarm state.

For example, when a main link is temporarily out of service, the alarm indication related to loss-of-sync on the corresponding main link can be inverted.

As a result, the ALARM indicator on the front panel of the Megaplex and the ALARM indicators on the CL panel will be turned off as long as the loss-of-sync condition is present, and will turn on when the main link returns to normal operation. The same is true with respect to the alarm relays: if one of the alarm relays is to be activated by that alarm, then inverting the alarm returns the alarm relay to its non-alarm state while the alarm state is present.

For event alarms with thresholds (see the DEF AT command), an alarm condition changes state only when the corresponding threshold is exceeded.

Alarm inversion does not affect the state of the alarm recorded in the alarm buffer (the alarm buffer shows the true state). Moreover, when an alarm is inverted, it is not masked, even in case it is defined as a masked alarm by means of the ADD AM command.

---

**Note** *When alarms are displayed by means of the DSP AS command, inverted alarms are identified by an I appearing at the right-hand side of the alarm line.*

---

#### Syntax

```
ADD AI A[:SS[:CC]]
```

#### Use

1. To invert an alarm with respect to a specific module port, type:

```
ADD AI A:SS:CC<Enter>
```

where A is the alarm number.

2. To invert an alarm with respect to a specific module, type:  
**ADD AI A:SS<Enter>**
3. To invert an alarm with respect to Megaplex system, type:  
**ADD AI A<Enter>**

## ADD AM

### Purpose

Mask a specified alarm. The alarm can be masked at the level of a module or at the level of a module port.

A masked alarm does not affect the Megaplex alarm status. As a result, the ALARM indicator on the front panel of the Megaplex and the ALARM indicators on the CL panel will not turn on a result of a masked alarm and the generation of the corresponding trap is disabled. The only exception is an event alarm for which a threshold has been defined using the DEF AT command: if the threshold is exceeded, the alarm takes effect even if it is masked.

To cancel alarm masking, use the DEL AM command.

The masking of alarms defined by means of this command is temporary, therefore if the Megaplex is reset or is turned off and then back on, the masking is automatically canceled. You can use the ADD PERMANENT AM command to cause the mask definition to be stored in the Megaplex non-volatile memory: the masking is then active until it is deleted by means of the DEL PERMANENT AM command.

---

**Note** *When alarms are displayed by means of the DSP AS command, masked alarms are identified by an **M** appearing at the right-hand side of the alarm line.*

---

### Syntax

ADD AM A:SS[:CC]

### Use

- To mask an alarm with respect to a specific module port, type:  
**ADD AM A:SS:CC<Enter>**  
where A is the alarm number.
- To mask an alarm with respect to all the ports of a specific module port, type:  
**ADD AM A:SS:\*<Enter>**  
where A is the alarm number.

## ADD BND

### Purpose

Add a new timeslot bundle for ML-IP configuration.

If you want to modify the parameters of an existing bundle, use the DEF BND command.

The total number of bundles that can be defined on a Megaplex chassis is 120.

The total number of bundles that can be defined on an ML-IP module depends on the internal port configuration:

- Without support for CAS signaling: up to 24 bundles per ML-IP module
- With support for CAS signaling: up to 14 bundles per ML-IP module.

Bundles are identified by a number in the range of 1 to 120. The bundle number must be unique within a Megaplex chassis, irrespective of the number of ML-IP modules installed in the chassis.

### Syntax

ADD BND B

### Use

1. To define a new bundle, type:

```
ADD BND B<Enter>
```

where B is the number of the new bundle, in the range of 1 to 120.

2. You will see the first line of the bundle data form. After selecting the desired values, press <Enter> to continue to the next line. Proceed until all the data form lines have been defined.

A typical data form, as seen after all the lines have been displayed, is shown below:

Connect	ML-IP Slot	ML-IP TDM	Destination IP	Next Hop IP
-----	-----	-----	-----	-----
ENABLE	I/O-2	IN1	172.17.156.2	0.0.0.0
IP TOS	Ext Eth	Dest Bundle	Jitter Buffer	Name
-----	-----	-----	-----	-----
0	AUTO	BND1	3 msec	
TDM Bytes In Frame		Voice OOS	Data OOS	Far End Type
-----	-----	-----	-----	-----
48		00	00	E1
OAM Connectivity	VLAN Tagging	VLAN Id	VLAN Priority	
Redundancy				
-----	-----	-----	-----	-----
DISABLE	NO	N/A	N/A	YES
Redundancy Bundle	Recovery Time			
-----	-----			
BND3	00			

## Command Fields

The fields appearing in the data entry form are as follows:

<b>Connect</b>	<p>Controls the activation of the bundle.</p> <p>The available selections are:</p> <p><b>ENABLE</b> The bundle is activated.</p> <p><b>DISABLE</b> The bundle is not active. You can still program the desired parameters, so that the bundle will be ready for activation when needed.</p> <p>The default selection is DISABLE.</p>
<b>ML-IP Slot</b>	<p>Selects the local ML-IP module on which the bundle will be defined. The module is specified by indicating the number of the I/O slot in which the desired module is installed.</p> <p>The allowed range depends on the number of I/O slots in the Megaplex chassis:</p> <ul style="list-style-type: none"><li>• Megaplex-2100: IO-1 to IO-12.</li><li>• Megaplex-2104: IO-1 to IO-5.</li></ul> <p>The default selection is IO-1.</p>
<b>ML-IP TDM</b>	<p>Selects the internal TDM port of the local ML-IP module on which the bundle will be defined. The available selections are IN1 and IN2.</p> <p>Make sure that the selected internal port has already been defined as “connected”.</p> <p>The default selection is IN1.</p>
<b>Destination IP</b>	<p>Specifies the IP address of the destination bundle, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).</p> <p>When the destination bundle is located on an ML-IP module, this field specifies the IP address of the internal TDM port on which the bundle is defined.</p> <p>The default selection is 0.0.0.0.</p>
<b>Next Hop IP</b>	<p>Specifies an IP address to which the bundle packets will be sent, to enable reaching the destination IP address (use the dotted-quad format).</p> <p>The next hop address is usually the address of an IP router port.</p> <p>You need to specify a next-hop IP address only when the destination address is not within the IP subnet of the local internal TDM port on which the bundle is defined.</p> <p>To use the default gateway, leave this field at the default value, 0.0.0.0.</p> <p>The default selection is 0.0.0.0.</p>

<b>IP TOS</b>	<p>Specifies the IP type-of-service parameter for this bundle. The specified value in the range of 0 to 255 is inserted in the <b>IP TOS</b> field of the bundle IP packets.</p> <p>When supported by an IP network, the type-of-service parameter is interpreted, in accordance with RFC 791 or RFC 2474, as a set of qualitative parameters for the precedence, delay, throughput and delivery reliability to be provided to the IP traffic generated by this bundle.</p> <p>These qualitative parameters may be used by each network that transfers the bundle IP traffic to select specific values for the actual service parameters of the network, to achieve the desired quality of service.</p> <p>The default selection is 0.</p>
<b>Ext Eth</b>	<p>Specifies the external (LAN) port of the module through which the bundle IP traffic is transmitted to the IP network.</p> <p>The available selections are as follows:</p> <p><b>EXT1</b> The bundle traffic is transferred through the NET1 port. This selection can be used only when the bundle <b>VLAN Tagging</b> parameter is <b>YES</b>.</p> <p><b>EXT2</b> The bundle traffic is transferred through the NET2 port. This selection can be used only when the bundle <b>VLAN Tagging</b> parameter is <b>YES</b>.</p> <p><b>AUTO</b> The external port (NET1 or NET2) is automatically selected by the internal Ethernet switch. However, it is not recommended to select this option when the bundle <b>VLAN Tagging</b> parameter is <b>NO</b>.</p> <p>The default selection is AUTO.</p>
<b>Dest Bundle</b>	<p>Specifies the number of the destination bundle at the remote device.</p> <p>The supported range is 1 to 2016.</p> <p>The range of values that can be used in any given application is device-specific. For example, for an IPmux-1 the only allowed value is 1, whereas for another ML-IP module is 1 to 120.</p> <p>The default selection is 1.</p>
<b>Jitter Buffer</b>	<p>Specifies the value of the jitter buffer to be used on this bundle.</p> <p>The allowed range is 3 to 300 msec, in 1-msec steps.</p> <p>The default selection is 3 msec</p>
<b>Name</b>	<p>Optional field up to 8 alphanumeric characters, can be used to assign a logical name to the bundle.</p> <p>The default selection is empty string.</p>
<b>TDM Bytes in Frame</b>	<p>Specifies the number of TDM bytes of bundle payload to be inserted in each packet.</p> <p>The available selections are 48, 96, 144, 192, 240, 288, 336 and 384 bytes.</p> <p>The default selection is 48.</p>



<b>Voice OOS</b>	<p>Specifies the code transmitted in the bundle timeslots defined as voice timeslots, during out-of-service periods.</p> <p>The available selections are 00 to FF (hexa).</p> <p>The default selection is FF.</p>
<b>Data OOS</b>	<p>Specifies the code transmitted in the bundle timeslots defined as data timeslots, during out-of-service periods.</p> <p>The available selections are 00 to FF (hexa).</p> <p>The default selection is 7E.</p>
<b>Far End Type</b>	<p>Specifies the type of interface used by the destination IPmux unit.</p> <p>The available selections are as follows:</p> <p><b>E1</b> E1 interface.</p> <p><b>T1 ESF</b> T1 interface with ESF framing.</p> <p><b>T1 D4</b> T1 interface with SF (D4) framing.</p> <p>This parameter must be specified only when the bundle is terminated at an IPmux unit. However, even when the bundle is terminated at another ML-IP module, make sure to select the same value at both ends.</p> <p>The default selection is E1.</p>
<b>OAM Connectivity</b>	<p>Controls the use of the RAD proprietary OAM connectivity protocol, used to detect loss of communication with the destination of TDMoIP traffic to enable taking steps that prevent the resulting flooding of this traffic.</p> <p>The available selections are as follows:</p> <p><b>DISABLE</b> OAM connectivity protocol not used. In this case, the detection of loss of communication is performed by periodical ping.</p> <p><b>ENABLE</b> Use of OAM connectivity protocol. This option can be selected only when the ML-IP operates in a link with another ML-IP module, or with an IPmux TDMoIP gateway.</p> <p>The default selection is DISABLE.</p>
<b>VLAN Tagging</b>	<p>Controls the use of VLAN tagging for this bundle. The available selections are as follows:</p> <p><b>YES</b> VLAN tagging is enabled.</p> <p><b>NO</b> VLAN tagging is disabled. This is the option to be used when the RFER protocol is used (applicable only to ring topologies).</p> <p>When several bundles are routed through the same external port, tagging must be either enabled or disabled on all these bundles.</p> <p>The default selection is NO.</p>
<b>VLAN ID</b>	<p>When VLAN tagging is enabled, specifies the VLAN ID number inserted in the frames of this bundle.</p> <p>The allowed range is 1 to 4000.</p> <p>When VLAN tagging is disabled for this bundle, this parameter is always <b>N/A</b> (not applicable).</p> <p>The default selection is 1.</p>

<b>VLAN Priority</b>	<p>When VLAN tagging is enabled, specifies the priority assigned to the bundle traffic.</p> <p>The allowed range is 0 (highest priority) to 7 (lowest priority).</p> <p>The default selection is 1.</p>
<b>Redundancy</b>	<p>Controls the use of bundle redundancy.</p> <p>The available selections are as follows:</p> <p><b>NO</b> Redundancy disabled for the bundle being configured.</p> <p><b>YES</b> Redundancy function is enabled. In this case, the two bundles configured as a redundancy pair transmit in parallel the same data. Therefore, the remote unit can select the bundle from which to retrieve the payload, and does not have to synchronize its selection with that at the local Megaplex unit.</p> <p>The default selection is NONE.</p>
<b>Redundancy Bundle</b>	<p>Selects the number of the other bundle of a redundancy pair (the selection must always be symmetrical).</p> <p>The allowed range is BND1 through BND120.</p> <p>This field is displayed only when the redundancy option is enabled (<b>Redundancy</b> is <b>YES</b>).</p> <p>The default selection is BND1.</p>
<b>Recovery Time</b>	<p>Selects the minimum time interval between two consecutive redundancy flips. The allowed range is 0 through 99 seconds.</p> <p>The remote unit must use a different value.</p> <p>This field is displayed only when the redundancy option is enabled (<b>Redundancy</b> is <b>YES</b>).</p> <p>The default selection is 00.</p>

## ADD CH

### Purpose

Add a new internal (WAN) port to a HS-ETH/SW module.

This section explains the general use of this command. For descriptions of the specific parameters available for each type of internal port of the HS-ETH/SW module, refer to the *HS-ETH/SW Installation and Operation Manual*.

### Syntax

ADD CH SS

### Use

- To add a new internal port and configure its parameters, type:

```
ADD CH SS<Enter>
```

where SS is the number of the slot in which the desired HS-ETH/SW module is installed.

- The first line of the selected module data form is displayed. The form identifies the module type and the port being configured, and presents the defaults parameter values.

The data form includes several lines, displayed sequentially by pressing **<Enter>**. To change parameters on the current line, proceed as follows:

- Bring the cursor to the field to be changed by pressing the spacebar.
  - To change the selected field:
    - If the field can assume only discrete values, press F or B to scroll among the available selections.
    - For free-text fields, type in the required value or text string.
  - When the desired selection is displayed, press the spacebar to move to the next field.
  - After completing all the fields in the current line, press **<Enter>** to display the next line.
- After the all desired parameter values are selected, press **<Enter>** to end.

If the command is accepted, Megaplex reminds you that it is necessary to use the DB UPD command to activate the changed parameters, by displaying the following message on the terminal: **Attention! Database was changed, enter DB UPD to activate or DB UNDO to undo**

## ADD FLIP ENTRY

### Purpose

Add a new entry in the flip database, used to define the flip (automatic database changing) conditions.

The flip database can include up to 10 entries. A new entry can only be added if the desired entry index number is free. Before selecting a number, you can display the entry numbers already in use:

- To display the current entries in the edited flip database, use the command DSP FLIP ENTRY.
- To display the entries in the current flip database, use the command DSP ST FLIP ENTRY.

The new entry can only use valid configuration databases:

- You can see the flip events defined in the edited flip database of your Megaplex using the DSP FLIP EVENT command, and those in the current database – with the DSP ST FLIP EVENT command. The display includes the flip events defined only on the local Megaplex. If a desired flip event is not yet defined in any of the Megaplex in the network, use the ADD FLIP EVENT command.
- To see the existing configuration databases, use the DSP DB LIST command.

### Syntax

ADD FLIP ENTRY E

## Use

- To add a new flip database entry, type:

**ADD FLIP ENTRY E<Enter>**

where E is a new entry in the range of 1 through 10. If the number specified for the new entry is already in use, your command will not be accepted, and you will see a **FLIP ENTRY ALREADY IN USE** message.

- You will see the add flip entry data form. A typical data form is shown below:

Logical Expression	DB No	Discard Eligible
!1&3 2	01	N/A

- After defining the desired parameters, press **<Enter>**. Your entry is immediately evaluated. If an error is detected, you will see an error message: check and correct as required.

In addition, you will see a message that reminds you to update the flip database: **Attention! Flip Database was changed, enter FLIP UPD to activate (or FLIP UNDO).**

To activate the new flip database, use the FLIP UPD command.

## Display Fields

The fields appearing in the data entry form are as follows:

### Logical Expression

This field lets you type in up to 20 characters that define the conditions for flip. An expression includes event numbers and logical operators. The event number, the range of 1 through 512, is defined by means of the ADD FLIP EVENT: the number is equal to the number of the bit used to report the event. The logical operators specify relationships among the desired events, to define the exact conditions under which a flip occurs. The supported operators (listed in decreased precedence order) are as follows:

Operator	Name	Evaluation Example
!	NOT operator	<b>!3</b> is true when the event 3 does not occur
&	AND operator	<b>1&amp;2</b> is true when events 1 and 2 are simultaneously present
	OR operator	<b>1 2</b> is true when at least one of the events 1 and 2 occurs

The evaluation of the expression is performed in accordance with the following rules:

- The logic operations are applied in accordance with their precedence. For example: !1&2 is evaluated as (NOT 1) AND (2), and the result of the expression is true when event 1 does not occur while event 2 is present.
- Brackets ( ) can be used to change the order of evaluation, as in regular algebra.

**DB No** Use the F and B keys to display the number of the desired database, in the range of 1 through 10. The specified database will be automatically activated when the logical expression is true.

- Notes**
1. Logical expressions are evaluated sequentially, starting with the expression with the lowest index number. Therefore, when several logical expressions are evaluated as true at the same time, only the expression with the lowest index is actually executed.
  2. The default database is activated in case none of the logical expressions defined by means of flip events is true ("normal operation"). You can use the DEF DEFAULT DB command to select another database as the default database.

**DISCARD  
ELIGIBLE** This field always shows N/A.

## ADD FLIP EVENT

### Purpose

Add a new flip event to the database used to define the flip conditions.

The flip database can include up to 10 events. A new event can only be added if the desired entry index number is free. Before selecting a number, you can display the event numbers already in use:

- To display the current events defined in the edited flip database, use the command DSP FLIP EVENT.
- To display the events defined in the current flip database, use the command DSP ST FLIP EVENT.

This command can be used to define three different types of events:

- Predetermined daily database switching (flipping) schedules ("day/night" operation). Separate schedules can be defined for regular working days, partial working days, and weekends (this differentiation is defined by means of the DEF AGENDA command).
- Failures of critical links. Critical failure events defined by means of this command can be used as database flipping triggers. The flipping criteria are defined by logical expressions included in the flip database entries (see ADD FLIP ENTRY command for additional information).

When flip broadcasting has been enabled using the DEF FLIP BROADCAST command, the status of each event is reported to all the other equipment units in the network. Therefore, in addition to event definition, this command is also

used to select the identification number to this event. The identification number must be unique on a network-wide basis.

Event reporting is made by means of a 512-bit word, called network status word. Each bit in this word is assigned to a specific event in the network (in accordance with the event ID), and thus its state ("0" or "1") is an unambiguous indication for all the other equipment in the network whether this event occurred or not.

The network status word can support a maximum of 51 Megaplex systems.

To create virtual networks, in which each Megaplex reports to the other units the status of predefined events, each Megaplex is assigned a network number, in the range of 1 through 255. This number is assigned by means of the DEF AGENT command.

## Syntax

ADD FLIP EVENT V

## Use

- To define a new flip database event, type:

**ADD FLIP EVENT V<Enter>**

where V is a new event in the range of 1 through 10. If the number specified for the new event is already in use, your command will not be accepted.

- You will see the add flip event data form. By default, you will see the data form for time-activated events. If you change the **EVENT TYPE** field, the data form changes to enable the definition of failure events.

Typical data forms for each type of event, as seen after all the fields are displayed, are shown below:

- Time event data form:

Event Type	Bit No		
TIME	000		
Day Agenda	Start Time	End Time	
FULL	08:00:00	17:30:00	

- Failure events data form:

Event Type	Bit No		
PORT FAIL	102		
Slot	Port	In-Service Delay	Out-Of-Service Delay
IO-4	EX1	10	10

- After defining the desired parameters, press **<Enter>**. Your entry is immediately evaluated. If an error is detected, you will see an error message: **check and correct as required**.

In addition, you will see a message that reminds you to update the flip database: **Attention! Flip Database was changed, enter FLIP UPD to activate (or FLIP UNDO).**

Note that to update all the Megaplex systems in the network, you must use the FLIP NET UPD command, followed by the DB NET GO command, on each Megaplex.

## Display Fields

The fields displayed on the event definition data form are as follows:

<b>Event Type</b>	Select TIME to define a time event, or PORT FAIL to define a failure event.
<b>Bit No.</b>	Select a unique number in the range of 1 through 512. This number identifies this specific event, and therefore each event in the Megaplex network must be assigned a different bit number not be reused in the whole network. However, if an event is common to more than one Megaplex unit in the network it must be defined under the same number on all these Megaplex units.  The network number is assigned by means of the DEF AGENT command.

The fields appearing only on the time event data form are as follows:

<b>Day Agenda</b>	Select the day type to which the event is to be associated: FULL, PARTIAL, or WEEKEND (see DEF AGENDA command for additional details). The event will be activated on each day of the selected type.
<b>Start Time</b>	Select the event activation time, using the 24-hour military clock format.
<b>End Time</b>	Select the event deactivation time, using the 24-hour military clock format. Make sure the time entered in this field is later than the START TIME.  The latest end time is 23:59:59. If the time interval you want to define extends into the next day, it is necessary to split it into two events.  For example, to start at 9 p.m. and end at 7 a.m. on the next morning, you must define two events: 21:00:00 to 23:59:59, and 00:00:00 to 07:00:00.

The fields appearing only on the failure event data form are as follows:

<b>Slot</b>	Select the slot in which the relevant module is installed.  A failure event can be defined only for a slot in which a main link or data I/O module has already been configured.
<b>Port</b>	Select the number of the desired port.
<b>In-Service Delay</b>	Select the delay in seconds, between the instant a fault condition is corrected, until the failed state is canceled. The allowed range is 0 to 999 seconds.
<b>Out-of-Service Delay</b>	Select the delay, in seconds, between the instant the fault is detected on the link connected to the specified port, until a failed state is declared. The allowed range is 0 to 999 seconds.

## ADD MANAGER LIST

### Purpose

Define the network management stations to which the SNMP agent of this Megaplex system will send traps (by default, the Megaplex sends traps to all the management stations that can communicate with it). You can define up to ten managers. Each network management station is defined by entering its IP address and the corresponding subnet mask.

In addition, you can specify, separately for each management station, with types of traps that will not be sent to that station (*masked traps*). To modify the definition of an existing station, use the DEF MANAGER LIST command.

### Syntax

ADD MANAGER LIST

### Use

- To add a new management station, type:  
**ADD MANAGER LIST<Enter>**
- You will see the new manager data form. A typical data form is shown below:

No	IP Address	Trap Masking		
		Alarm	Cnfg DB Switch	Flip DB Switch
02	193.11.029.013	YES	YES	NO

The data form includes the following fields:

- No.** The index number of the new management station in the list of management stations (the next free index number is automatically assigned by the CL module).
- IP Address** Type in the IP address of the new management station. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).
- Trap Masking** Select the types of traps to be masked (YES) with respect to this management station (traps not masked are sent to the management station):
- **Alarm** – Trap generated when an alarm is detected.
  - **Cnfg DB Switch** – Trap generated when the active configuration database is changed.
  - **Flip DB Switch** – Trap generated when the active flip database is changed.



## ADD NET ENTRY

### Purpose

Define a filter for the IP addresses to be learned by the IP router function of the SNMP agent of the Megaplex. This filter is used to reduce the number of SNMP agents that are served by this SNMP agent (refer to Chapter 4).

The filter comprises a net IP address and a subnet mask: the IP router will learn only IP addresses that match the net IP address within the section defined by the subnet mask. This is expressed formally as:

```
{Learned IP Address AND Subnet Mask} = {Net IP Address AND Subnet Mask}
```

The number of net entries that can be defined for each SNMP agent is up to 10. If no entries are defined, the Megaplex will learn all the received IP addresses.

### Syntax

```
ADD NET ENTRY N
```

### Use

1. To define a new net entry, type:

```
ADD NET ENTRY N<Enter>
```

where N is the net entry number, in the range of 1 through 10.

2. You will see the first line of the net entry data form. After filling in the required data, press <Enter> to display the next line, and then fill it:

A typical data form, as seen after both lines have been filled in, is shown below:

```
NET IP ADDRESS (999.999.999.999): 192.221.345.000
NET IP MASK (999.999.999.999):    255.255.255.000
```

### Command Fields

The fields appearing on the data form are explained below.

<b>Net IP Address</b>	Type in the IP address of the net from which IP addresses will be learned by the SNMP agent. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods); the host section of the net address must consist of 0's.
<b>Net IP Mask</b>	Type in the subnet mask in the dotted-quad format. The mask consists of four groups of digits in the range of 0 through 255, separated by periods. The net and subnet sections must consist of 1's.

## ADD PERMANENT AM

### Purpose

Mask permanently a specified alarm.

This command is similar to the ADD AM command described above, except that the masking information is stored in the non-volatile memory, and therefore masking is still active after the Megaplex is reset, or is turned off and then back on.

To cancel the permanent alarm masking, use the DEL PERMANENT AM command.

### Syntax

```
ADD PERMANENT AM A[:SS[:CC]]
```

### Use

- To permanently mask an alarm with respect to a specific module port, type:

```
ADD PERMANENT AM A:SS:CC<Enter>
```

where A is the alarm number.

- To permanently mask an alarm with respect to all the ports of a specific module, type:

```
ADD PERMANENT AM A:SS:*<Enter>
```

- To permanently mask an alarm with respect to a specific slot, type:

```
ADD PERMANENT AM A:SS<Enter>
```

- To permanently mask an alarm with respect to all the slots, type:

```
ADD PERMANENT AM A:*<Enter>
```

- To permanently mask an alarm with respect to the Megaplex system, type:

```
ADD PERMANENT AM A<Enter>
```

## ADD RIP2 AGENT

### Purpose

Add a new entry (IP address) to the RIP2 agents table.

The RIP2 agents table contains IP addresses of other agents (nodes) in the network. For each table entry, the local CL management subsystem will use the routing information in the received RIP2 routing tables to learn the route to that agent. Therefore, when the network includes agents using the RIP2 protocol, management traffic addressed to their IP addresses (listed in the table) will be permitted to reach them through the local CL module.

The maximum number of entries in the RIP2 agents table is 30. You can display the currently defined agents by means of the DSP RIP2 AGENT command.

### Syntax

```
ADD RIP2 AGENT
```

## Use

1. To add a new entry to the RIP2 agents table, type:

```
ADD RIP2 AGENT<Enter>
```

You will see the IP address data form. The new entry is automatically assigned the first free index number in the table.

2. Type the desired IP address in the dotted quad format, and then press **<Enter>**. A typical data form, as seen after an IP address has been entered, is shown below:

No	IP Address
--	-----
03	192.168.23.102

## ADD ROUTE

### Purpose

Add a new static entry to the Megaplex routing table. The routes defined in this table are sent to the ML-IP and HS-ETH/SW modules installed in the enclosure. To modify an existing route, use the DEF ROUTE command.

There are three types of static entries:

- **Single IP** – specifies the static route to a specific IP address.
- **Subnet** – specifies the static route to a subnet.
- **VLAN ID** – specifies the VLAN ID to be used.

Although the routing table is used by all the installed ML-IP and HS-ETH/SW modules, **Single IP** is relevant only to ML-IP, whereas the other types are relevant to a specified HS-ETH/SW module.

The maximum number of entries in the routing table is 100. If you are not sure whether the number you want to assign to the new route is free, check using the DSP ROUTE command.

### Syntax

```
ADD ROUTE R
```

### Use

1. To add a new route, type:

```
ADD ROUTE R<Enter>
```

where R is the desired index number of the new route in the routing table.

You will see the first line of the route definition data form, which is used to select the static route type. A typical data form is shown below:

Entry Type
-----
<b>SINGLE IP</b>

2. Select the desired type, and then press **<Enter>**. You will see the route definition data form for the selected type.

## Command Fields – SINGLE IP

A typical data form for a SINGLE IP entry is shown below:

Entry Type			
-----			
SINGLE IP			
Destination Ip	Next Hop Ip	Subnet Mask	Metric
-----	-----	-----	-----
1.2.3.5	2.0.0.1	255.0.0.0	15

The fields displayed on the route definition data form are explained in [Table 5-1](#).

*Table 5-1. Static Route Parameters – SINGLE IP*

Parameter	Function	Values
<b>Destination IP</b>	Specifies the destination IP address	Type in the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods). <b>Default: 0.0.0.0</b>
<b>Subnet Mask</b>	Specifies the IP subnet mask associated with the destination IP address	Type in the appropriate subnet mask in the dotted-quad format <b>Default: 0.0.0.0</b>
<b>Next Hop</b>	The IP address to be used as the destination for the first hop en route to the specified destination. The next hop address must be in the same IP subnet with the IP address	Type in the next hop IP address using the dotted-quad format. To use the default gateway, leave this field at the default value, 0.0.0.0. <b>Default: 0.0.0.0</b>
<b>Metric</b>	Specifies the maximum number of hops that an IP packet can traverse before being discarded. Assigning a value of 1 means that a packet can reach only the specified next hop address	The allowed range is 1 to 15 <b>Default: 15</b>

## Command Fields – SUBNET

A typical data form for a SUBNET entry is shown below:

Entry Type				
-----				
SUBNET				
Related I/O Slot	Interface	Destination Ip	Subnet Mask	Metric
-----	-----	-----	-----	-----
IO-1	IN1	0.0.0.0	0.0.0.0	15

The fields displayed on the route definition data form are explained in [Table 5-2](#).

Table 5-2. Static Route Parameters – SUBNET

Parameter	Function	Values
Related I/O Slot	Selects the I/O slot of the HS-ETH/SW for which the entry is being defined	You can select any I/O slot in which a HS-ETH/SW module is installed. <b>Default: IO-1</b>
Interface	Selects the number of the HS-ETH/SW internal port for which the entry is being defined	You can select any internal port already defined for the corresponding module, in the range of IN1 to IN17. <b>Default: IN1</b>
Destination IP	Same as in <a href="#">Table 5-1</a>	
Subnet Mask	Same as in <a href="#">Table 5-1</a>	
Metric	Same as in <a href="#">Table 5-1</a>	

### Command Fields – VLAN TAG

A typical data form for a VLAN TAG entry is shown below:

<b>Entry Type</b>		
-----		
VLAN TAG		
<b>Related I/O Slot</b>	<b>Interface</b>	<b>VLAN Id</b>
-----	-----	-----
IO-1	IN1	1

The fields displayed on the route definition data form are explained in [Table 5-3](#).

Table 5-3. Static Route Parameters – VLAN TAG

Parameter	Function	Values
Related I/O Slot	Same as in <a href="#">Table 5-2</a>	
Interface	Selects the number of the HS-ETH/SW internal port for which the entry is being defined	You can select an external port (EX1 to EX4), or any internal port already defined for the corresponding module, in the range of IN1 to IN17. <b>Default: IN1</b>
VLAN Id	Selects the VLAN ID for the corresponding entry	The allowed range is 1 to 4094. <b>Default: 1</b>

## BYE

### Purpose

This command is used to deactivate the password entered to start the management session. This effectively ends the current session. After executing this command, you must to enter the password again before a new command can be sent to this Megaplex.

## Syntax & Use

- To end the session, type:  
**BYE<Enter>**
- You will see the password request.

## CLR ALM

### Purpose

Clear the alarms stored in the Megaplex history and events from the status alarm buffers.

You can clear all the alarms, or only the status alarms associated with a selected module, or module channel. This feature is useful after performing maintenance activities, or after changing the system configuration.

### Syntax

CLR ALM [SS][:CC]

### Use

- To clear all the history buffer and events from the status buffers of the local Megaplex, type:  
**CLR ALM<Enter>**
- To clear the events from the status buffer of the module installed in the desired slot, type:  
**CLR ALM SS<Enter>**
- To clear the events of all the channels from the status buffer of the module installed in the desired slot, type:  
**CLR ALM SS:\*<Enter>**
- To clear the events from the status buffer of a selected channel, type:  
**CLR ALM SS:CC<Enter>**

## CLR AT&T

### Purpose

Clear the line statistics stored by a module with E1 interface, or the AT&T statistics stored by a module with T1 interface installed in the local Megaplex.

This command is available only when the framing mode of the selected module is ESF for T1 interfaces, or when CRC-4 is enabled for E1 interfaces.

### Syntax

CLR AT&T SS [:CC]

## Use

- To clear the AT&T statistics for the module installed in the desired slot, type:  
`CLR AT&T SS<Enter>`
- To clear the AT&T statistics for a specified module channel, type:  
`CLR AT&T SS:CC<Enter>`

## CLR BERT CNT

### Purpose

Reset the BER and loss-of-sync counters of the local Megaplex, and the count of out-of-synchronization seconds. This action does not stop the ongoing BER tests.

You can reset all the BERT counters of all the modules on which the BER test is running, or only the counter of a selected module.

### Syntax

`CLR BERT CNT [SS]`

### Use

- To reset all the BER counters of the local Megaplex to 0, type:  
`CLR BERT CNT<Enter>`
- To reset only the BER counter for the module installed in a specific slot, type:  
`CLR BERT CNT SS<Enter>`
- If no BER test is currently active, the terminal displays **NO BERT IN PROGRESS**.

## CLR STAT

### Purpose

Clear the statistics collected for a specified port.

Currently, only the statistics collected by the HS-ETH/SW, VFS-24, VFS-30, VFS-48, and VFS-60 modules can be erased by means of this command.

### Syntax & Use

To clear the statistics collected for a specific port, type:

```
CLR STAT SS CC <Enter>
```

where SS is the slot number of the desired module and CC is the desired port number.

## CLR STAT BND

### Purpose

Clear ML-IP bundle statistics. This resets all the statistics counters for the selected bundle, and restarts the statistics collection interval for the specified bundle.

### Syntax & Use

To clear the statistics collected for a specific bundle, type:

```
CLR STAT BND B<Enter>
```

where B is the number of the desired timeslot bundle.

## CLR STAT LAN

### Purpose

Clear ML-IP Ethernet port statistics.

This resets all the statistics counters of the selected port, and restarts the statistics collection interval for the specified port.

### Syntax & Use

To clear the statistics collected for a specific ML-IP external port, type:

```
CLR STAT LAN SS CC<Enter>
```

where SS is the slot number of the desired ML-IP module and CC is the desired external port number.

## CLR TEST

### Purpose

Deactivate the user-initiated test(s) on a specified module, module channel or timeslot bundle.

This command provide a quick way to deactivate all the tests on the selected entity. The recommended way to deactivate a specific test is to use the DEF TEST command, because it provides better selectivity.

### Syntax

```
CLR TEST {[B] [SS] [SS CC]}
```

### Use

- To deactivate all the currently active tests on an I/O module installed in the local Megaplex unit, type:

```
CLR TEST SS<Enter>
```

where SS is the slot number of the desired module.



- To deactivate all the currently active tests on a specific module channel, type:  
**CLR TEST SS CC<Enter>**  
where SS is the slot number of the desired module and CC is the desired port number.  
If no test is currently active on the specified module channel, you will see **There is no active test.**
- To deactivate all the currently active tests on a specific bundle, type:  
**CLR TEST B<Enter>**  
where B is the number of the desired timeslot bundle.

## DATE

### Purpose

Set the date of the Megaplex internal real-time clock.

### Syntax

DATE

### Use

- To set the date, type:  
**DATE<Enter>**
- The Megaplex sends the date entry form, line by line. A typical date entry form, as seen after all the fields have been displayed, is shown below:  

<b>DAY =</b>	<b>06</b>	
<b>MONTH</b>	<b>=</b>	<b>06</b>
<b>YEAR</b>	<b>=</b>	<b>2000</b>
- Bring the cursor to the first field to be changed by pressing **<Enter>**.
- To change the selected field, press F to increase and B to decrease the displayed value. When done, press **<Enter>** to move to the next field.
- To end, press **<Enter>** after the **YEAR** field.

## DB CHK

### Purpose

Perform a sanity check on the configuration database being edited.

It is recommended to perform this action while editing the configuration database, to check for consistency and complete definition of parameters. Note that the database sanity check will not report conflicting parameters related to the remote equipment unit.

### Syntax

DB CHK

## Use

To initiate the configuration database sanity check, type:

```
DB CHK<Enter>
```

If errors are found, the terminal will display a list of error messages.

## DB INIT

### Purpose

Replaces the user configuration in the edited Megaplex database with the default parameters values.

When starting the configuration of a new Megaplex unit, this command causes the CL module to recognize the modules actually installed in the chassis. The installed modules are automatically loaded as programmed modules, and appear in the corresponding fields of the DEF SYS command.

---

**Note** *The DB INIT command affects only the configuration database. To reset the flip database to default, first delete all the events, and entries in the flip database and then enter the FLIP UPD command.*

---

### Syntax

```
DB INIT
```

### Use

To load the default parameters, type:

```
DB INIT<Enter>
```

### Default Parameter Values

The default values of the Megaplex parameters depend on the modules installed in the unit. [Table 5-4](#) lists the default values of the main parameters. Additional parameters are available for specific modules.

*Table 5-4. Default Values of Main Parameters Used with Supervision Terminal*

Parameter Type	Parameter Designation	Default Value
Link	Idle Code	FF (E1), 7F (T1)
	Inband Management	OFF
	Line Code	HDB3 for E1, B8ZS for T1
	Frame	G.732S for E1, ESF for T1
	Restoration Time	10 sec (T1), CCITT (E1)
	CRC-4 (E1 only)	NO
	Line Length (T1 only)	0-133ft
	Redundancy	NONE
Channels	CONNECT	NO

Parameter Type	Parameter Designation	Default Value
Database	Flip Database	NONE
	Default Database	01

## DB NET GO

### Purpose

Broadcast a command to all the Megaplex in the network, to activate the database specified by means of the DB NET UPD or FLIP NET UPD command.

The database that will be selected for activation is the database that has been selected in accordance with the conditions specified in the flip database (after evaluating again the flip expressions under the current conditions).

If the flip database is empty, the selected database will be the last database loaded in the non-volatile memory by means of a DB NET UPD command.

The delay between the reception of the command, and its actual execution (which results in a configuration change) is selected by means of the DEF NET DELAY command.

### Syntax & Use

To broadcast a command to activate the database in the whole network, type:

```
DB NET GO<Enter>
```

## DB NET UPD

### Purpose

Copy the specified configuration database from the edit buffer to the non-volatile memory, without activating it. You can use the DSP DB LIST command to view the list of existing databases.

Before any update, a sanity check is automatically performed, and the database update is performed only if no errors are detected. Errors are displayed in the same format used with the DB CHK command. If sanity warnings exist, the user is asked to confirm the update command, or cancel.

The specified database can be activated on all the Megaplex units in the network by means of the DB NET GO command.

### Syntax

```
DB NET UPD D
```

### Use

To save a desired configuration database in the non-volatile memory, type:

```
DB NET UPD D<Enter>
```

where D is the number of the active database (in the range of 1 through 10).

## DB UNDO [CHANGES]

### Purpose

Cancel all the changes made to the configuration database being edited since the start of this editing session. This action actually retrieves the contents of the edited database from the active configuration database.

Changes can be canceled only if the configuration database has not yet been activated by an DB UPD or DB NET UPD command.

### Syntax

DB UNDO [CHANGES]

### Use

To undo the changes, type:

```
DB UNDO CHANGES<Enter> Or DB UNDO<Enter>
```

## DB UPD

### Purpose

Copy the specified configuration database from the edit buffer to the non-volatile memory. You can use the DSP DB LIST command to view the list of existing databases.

Before any update, a sanity check is automatically performed, and the database update is performed only if no errors are detected. Errors are displayed in the format used with the DB CHK command. If sanity warnings exist, the user is asked to confirm the update command, or cancel.

The specified database will be automatically activated on this Megaplex, unless conditions specified by means of the flip database dictate that another database is to be activated.

---

**Note**

*This command enables masking only alarms, not events.*

---

### Syntax

DB UPD D

### Use

To activate the desired database, type:

```
DB UPD D<Enter>
```

where D is the number of the database to be activated (in the range of 1 through 10).

If errors are detected in the database, the terminal displays them before the time and date, and no change is made in the operating mode of the Megaplex.

## DEF AF

### Purpose

Define filtering values for a selected type of state alarm.

The purpose of filtering is to reduce the number of alarms generated under marginal conditions, when the alarm changes state often. For this purpose, the system monitors the alarm state during a fixed time window, defined by means of the DEF AW command:

- If the alarm is active for a specified fraction of the observation window (the *set* threshold), the alarm is declared active, and is reported.
- To cancel the alarm condition, it must be found active for a smaller fraction of the observation window (the *reset* threshold).

The filtering thresholds can be separately defined for each module port, or for the all ports of a module; it is also possible to define the same filtering values for all the modules installed in the Megaplex. The filtering values are stored in the non-volatile memory.

---

**Note** *This command enables masking only alarms, not events.*

---

### Syntax

DEF AF A

### Use

1. To define the filtering parameters, type:

**DEF AF A<Enter>**

where A is the event alarm number.

2. You will see the filtering window data form. A typical data form is shown below:

ALARM	SLOT	PORT	SET VALUE	RESET VALUE
---	---	---	---	---
001	IO-1	IN-1	50	20

### Command Fields

The fields appearing on the data form are explained below.

#### SET VALUE

The minimum percentage of the observation window during which the alarm must remain in the active state to be declared as *active*. The allowed range is 0 through 100.

#### RESET VALUE

imum percentage of the observation window during e alarm may remain in the active state to be declared as The allowed range is 0 through 100, but the number

in this field must be less than the number entered as the `slot` (if this is not true, you will see an ILLEGAL FILTERING EVENT message).

<b>SLOT</b>	Enter the number of the slot in which the desired module is installed. To use the specified values for all the modules installed in the Megaplex, enter an asterisk * in this field.
<b>CHANNEL</b>	Enter the number of the module port for which the defined values are used.  To use the specified values for all the module ports, enter an asterisk * in this field.

## DEF AGENDA

### Purpose

Define the week day types, for use with the ADD FLIP EVENT and DEF FLIP EVENT commands. The week days can be arbitrarily classified as full, partial, or week end.

**Note** *Several modules, for example HS-5, support independent selection of activity intervals (**agenda**) for the links connected to their interfaces. Their agenda is defined by means of the DEF CH command.*

### Syntax

DEF AGENDA

### Use

- To change the week day types, type:  
**DEF AGENDA<Enter>**
- You will see the week day data form. A typical data form is shown below.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
-----	-----	-----	-----	-----	-----	-----
FULL	FULL	FULL	FULL	PARTIAL	PARTIAL	WEEKEND

- After changing the week day types as required, press **<Enter>** to end.

## DEF AGENT

### Purpose

Define or modify the Megaplex logical name, and the parameters of its SNMP agent.

These parameters must be defined before it is possible to manage the Megaplex using SNMP-based management stations. Refer to Chapter 4 for additional information.

Note that the DEF MMI command allows you to instruct the Megaplex to display the selected name in the prompt line.

## Syntax

DEF AGENT

## Use

- To define the Megaplex name and SNMP parameters, type:
  - DEF AGENT<Enter>**
- You will see the first line of the SNMP data entry form (name entry form). After filling in the name, press **<Enter>** to display the next line; continue until all the required lines have been filled in.

Note that the SNMP community names are case-sensitive.

A typical data form, as seen after all the lines have been filled in, is shown below:

```

Enter Mux Name (Up To 8 Characters):      Megaplex
Enter The IP Address (XXX.XXX.XXX.XXX):  192.112.11.24
Enter Subnet Mask (XXX.XXX.XXX.XXX):     255.255.255.000
Enter Default Gateway (XXX.XXX.XXX.XXX): 0.0.0.0
Enter Net Id (1 To 255):                  010
Enter SNMP Read Community (Up To 8 Characters) : public
Enter SNMP Write Community (Up To 8 Characters): netmanag
Enter SNMP Trap Community (Up To 8 Characters) : public

```

## Command Fields

The fields appearing on the data form are explained below.

<b>Mux Name</b>	Type in the logical name (maximum 8 alphanumeric characters) assigned to the Megaplex unit.
<b>IP Address</b>	Type in the IP address assigned to the SNMP agent. Use the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods).
<b>Subnet Mask</b>	Type in the subnet mask in the dotted-quad format. The mask consists of four groups of digits in the range of 0 through 255, separated by periods. The net section must consist of 1's.
<b>Default Gateway</b>	Type in the IP address of the router to be used to communicate with IP entities connected to the Megaplex through a LAN, when the LAN IP address is different from that of the Megaplex IP address.
<b>Net Id</b>	Type in the network number, in the range of 1 through 255, assigned to the Megaplex unit.  The specified number is used for the evaluation of the flip conditions, in response to changes in the status of other Megaplex units: only status reports having the same net ID are evaluated (see description in ADD FLIP EVENT command).
<b>SNMP Read Community</b>	Type in the name of the SNMP community that has read-only authorization (the SNMP agent will accept only getRequest and getNextRequest commands from management stations using that community). You may enter up to eight alphanumeric characters.
<b>SNMP Write Community</b>	Type in the name of the SNMP community that has read-write authorization (the SNMP agent will accept setRequest commands from management stations using that community). You may enter up to eight alphanumeric characters.

<b>SNMP Trap Community</b>	Type in the name of the SNMP community under which the SNMP agent will send all the traps. You may enter up to eight alphanumeric characters.
----------------------------	---

## DEF AP

### Purpose

Define the priority (severity) of an alarm generated by the Megaplex. The Megaplex supports five alarm priorities: event (lowest level – level 1), warning, minor, major, and critical (highest level – level 5). The indications provided at each priority can be defined by means of the DEF AR command.

The alarm priorities are stored in the non-volatile memory, and therefore remain in effect even after the Megaplex is turned off and then on again.

### Syntax

DEF AP A

### Use

1. To define the priority of an alarm, type:

**DEF AP A<Enter>**

where A is the alarm number.

2. You will see the alarm priority data form. A typical data form is shown below:

Alarm Description	Priority	ACM Slot	ACM Ch
(A)(122)RTS IS OFF	Minor (3)	N/A	N/A

- To change the current priority, bring the cursor to the **PRIORITY** field, press the F or B keys to display the desired priority, and then press **<Enter>** to confirm.
- To enable the reporting of the alarm by means of one of the outbound ports of an ACM module, select the slot number of the ACM module in the **ACM Slot** field, and then select the ACM outbound port whose relay contacts will indicate this alarm, EX1 to EX4, in the **ACM Ch** field.

If no ACM module is installed, ignore the **ACM Slot** and **ACM Ch** fields.

---

**Note** *It is not possible to assign an event priority to a state alarm.*

---

## DEF AR

### Purpose

Define the alarm reporting method and indications for each alarm level.

### Syntax

DEF AR



## Use

1. To define the alarm reporting and indications, type:

**DEF AR<Enter>**

You will see the alarm data form. A typical data form is shown below:

ALARM	REPORT	LOG	RELAY1	RELAY2	MINOR LED	MAJOR LED
CRITICAL ON	YES	YES	YES	YES	YES	YES
CRITICAL OFF	YES	YES	N/A	N/A	N/A	N/A
MAJOR ON	YES	YES	YES	YES	YES	YES
MAJOR OFF	YES	YES	N/A	N/A	N/A	N/A
MINOR ON	YES	YES	NO	YES	YES	NO
MINOR OFF	YES	YES	N/A	N/A	N/A	N/A
WARNING ON	YES	YES	NO	NO	YES	NO
WARNING OFF	YES	YES	N/A	N/A	N/A	N/A
EVENT	YES	YES	NO	NO	YES	NO

2. To change the current selections, bring the cursor to the desired field, and then press the F or B keys to display the desired mode (YES or NO). When done, press <Enter> to end.

## Command Fields

The data form includes a list of the alarm conditions of interest, and five columns which are used to select the action to be taken for each alarm condition. The fields appearing on the data form are explained below.

<b>ALARM</b>	The alarm condition.
<b>REPORT</b>	YES indicates that the corresponding alarm condition is reported by means of messages sent to the terminal, and traps sent to management stations.
<b>LOG</b>	YES indicates that the corresponding alarm condition is recorded in the alarm buffer.
<b>RELAY1</b>	YES indicates that the major alarm relay is activated when the corresponding condition occurs. Default setting is to be activated for major and critical alarm levels.
<b>RELAY2</b>	YES indicates that the minor alarm relay is activated when the corresponding condition occurs. Default setting is to be activated for minor and higher alarm levels.
<b>MINOR LED</b>	YES indicates that the CL ALARM MIN indicator lights steadily when the corresponding condition occurs. Default setting is "active for all alarm levels (event level and higher)".
<b>MAJOR LED</b>	YES indicates that the front panel ALARM indicator and the CL ALARM MAJ indicator flash when the corresponding condition occurs. Default setting is "active for major and critical alarm levels".

To ensure consistent display and reporting of alarm conditions, pay attention to the following points:

- For any alarm function, once it is set to YES at a certain alarm level, it needs to be set to YES for all the alarm levels *above* it. For example, if the **MINOR LED** is set to be activated for minor alarms, it will also be activated for major and critical alarms.

- For any alarm condition, once it is set to NO at a certain alarm level, it needs to be set to NO for all the lower alarm levels. For example, if the **MAJOR LED** is set to be activated for major alarms, must also be deactivated for minor, warning and event alarms.

**REPORT** and **LOG** functions can also be independently set when a particular alarm condition ceases (for example, for MINOR OFF). In this case, all the OFF alarm conditions above that level must also be set to YES.

Relays and LEDs cannot be activated for alarm OFF conditions, and therefore N/A appears in the rows corresponding to the end-of-alarm conditions.

## DEF AT

### Purpose

Define threshold values for a selected type of event alarm.

The threshold values are used in conjunction with the filtering window defined by means of the DEF AW command to determine when to generate an alert because the frequency of the specified events is too high. Alerts generated when the specified threshold is exceeded cannot be masked, even in case the monitored event is masked by means of the DEF AM or DEF PERMANENT AM command.

A separately defined threshold is used to cancel the alert when the frequency of the monitored events decreases below that threshold. The filtering information is stored in the non-volatile memory.

---

**Note** *This command enables only the masking of events.*

---

### Syntax

DEF AT A

### Use

- To define the filtering thresholds for a specific event alarm, type:

**DEF AT A**<Enter>

where A is the event alarm number.

You will see the filtering window data form. A typical data form is shown below:

ALARM	SLOT	PORT	SET VALUE	RESET VALUE
20	IO-1	EX-1	020	010

### Command Fields

The fields appearing on the data form are explained below.

**SLOT** Enter the number of the slot in which the desired module is installed. To use the specified values for all the modules installed in the Megaplex, enter an asterisk \* in this field.

**CHANNEL** Enter the number of the module port for which the defined values

are used. To use the specified values for all the module ports, enter an asterisk \* in this field.

**SET VALUE** The minimum number of times the specified alarm must occur during the observation window for the alarm to be declared active. The allowed range is 0 through 100.

**RESET VALUE** The maximum number of times the specified alarm must occur during the observation window for the alarm to be declared inactive. The allowed range is 0 through 100, but the number entered in this field must be less than the number entered as the set threshold (if this is not true, you will see an ILLEGAL FILTERING ASSIGNMENT message).

## DEF AW

### Purpose

Define an observation window (time interval) for the filtering of alarms. The use of the window is described in the DEF AT and DEF AF commands.

### Syntax

DEF AW

### Use

1. To define the filtering window, type:

```
DEF AW<Enter>
```

You will see the filtering window data form. A typical data form is shown below:

```
ENTER TIME WINDOW VALUE (1 TO 255): 20
```

2. Enter the desired interval, in seconds, and then press <Enter>. The range of allowed values is 1 through 255 seconds.

## DEF BND

### Purpose

Change the parameters of an existing ML-IP timeslot bundle.

If you want to add a new bundle, use the ADD BND command.

### Syntax

DEF BND B

### Use

- To change the parameters of an existing ML-IP timeslot bundle, type:

```
DEF BND B<Enter>
```

where B is the desired bundle number. If the selected bundle has not yet been defined, you will see a BUNDLE NOT IN USE message.

You will see the first line of the bundle data form. After selecting the desired values, press **<Enter>** to continue to the next line. Proceed until all the data form lines have been defined.

A typical data form, as seen after all the lines have been displayed, is shown below:

Connect	ML-IP Slot	ML-IP TDM	Destination IP	Next Hop IP
-----	-----	-----	-----	-----
ENABLE	I/O-2	IN1	172.17.156.2	0.0.0.0
IP TOS	Ext Eth	Dest Bundle	Jitter Buffer	Name
-----	-----	-----	-----	-----
0	AUTO	BND1	3 msec	
TDM Bytes In Frame		Voice OOS	Data OOS	Far End Type
-----		-----	-----	-----
48		00	00	E1
OAM Connectivity	VLAN Tagging	VLAN Id	VLAN Priority	Redundancy
-----	-----	-----	-----	-----
DISABLE	NO	N/A	N/A	YES
Redundancy Bundle	Recovery Time			
-----	-----			
BND3	00			

For a description of the parameters appearing in the bundle data form, refer to the ADD BND command.

## DEF CH

### Purpose

Define the module parameters, and/or the parameters of the individual module channels.

This section explains the general use of this command, and in particular presents details on the parameters used to control the routing of the channel data stream within the Megaplex unit.

- Note**
- *Additional information regarding the use of this command with main link modules is presented in [Chapter 8](#).*
  - *For descriptions of the specific parameters available for each type of module, refer to the corresponding module's [Installation and Operation Manual](#)*

### Syntax

```
DEF CH {[SS] [SS CC][SS *]}
```

### Use

- To define the general module parameters, or the parameters of the composite channel of a specific module, type:

```
DEF CH SS<Enter>
```

where SS is the number of the slot in which the desired module is installed.

---

**Note** *For some modules, this command enables defining the parameters of all the module channels, just as the DEF CH SS \* command.*

---

- To define the parameters of a specific module channel, type:
 

```
DEF CH SS CC<Enter>
```

 where SS is the number of the slot in which the desired module is installed, and CC is the number of the desired channel within that module.
- To define the parameters of all the channels of a specific module, type:
 

```
DEF CH SS *<Enter>
```

 where SS is the number of the slot in which the desired module is installed.
- The first line of the selected module or module channel data form is displayed. The form identifies the module type, and the port being configured, and presents the last edited parameter values as defaults. The data form includes several lines, displayed sequentially by pressing <Enter>. To change parameters on the current line, proceed as follows:
  - Bring the cursor to the field to be changed by pressing the spacebar.
  - To change the selected field:
    - If the field can assume only discrete values, press F or B to scroll among the available selections.
    - For free-text fields, type in the required value or text string.
  - When the desired selection is displayed, press the spacebar to move to the next field.
  - After completing all the fields in the current line, press <Enter> to display the next line.
- After the all desired parameter values are selected, press <Enter> to end. If the command is accepted, Megaplex reminds you that it is necessary to use the DB UPD command to activate the changed parameters, by displaying the following message on the terminal: **Attention! Database was changed, enter DB UPD to activate or DB UNDO to undo**

## Internal Routing Parameters

The routing of channel payload data within the Megaplex unit requires the user to specify the following parameters:

---

**Note** *For ML-IP modules, you must specify the internal TDM port of the timeslot bundle that will carry the channel payload data (the bundle itself is selected using the DEF TS or DEF SPLIT TS command).*

---

- The routing mode:
  - Bidirectional (full duplex) routing
  - Unidirectional broadcast (simplex) routing. In this mode, the user can specify the desired direction of data flow:
    - Toward the main link port (transmit mode).

- From the main link port (receive mode)
    - Bidirectional broadcast (half-duplex) routing. In this mode, the user can also specify the direction of data flow.
- For voice channels: the handling of channel-associated signaling information.

---

**Note** *For voice channels transported through an ML-IP module, it is also necessary to configure CAS support for the corresponding ML-IP internal TDM port. See details in the [ML-IP Installation and Operation Manual](#).*

---

- The Megaplex TDM bus bandwidth (number of timeslots) that must be assigned to the channel, to support its payload data rate.
- The specific main link timeslots to be assigned to the channel.

Items 1 to 5 are always specified by means of the DEF CH command. With respect to item 6, the command to be used to assign specific timeslots depends on the channel routing mode:

- For the bidirectional (full duplex) mode, the main link timeslots are selected using the DEF TS command.
- For the unidirectional and bidirectional broadcast receive modes, in which several channels can be connected to the same main link timeslot, it is necessary to use the DEF CH command to select the main link timeslots from which the channel receives its payload.
- For the unidirectional and bidirectional broadcast transmit modes, in which several main link ports can be connected to the same channel, it is necessary to use the DEF TS command to select the main link timeslots that will transmit the channel payload.

---

**Note** *For channels transported through an ML-IP module, the channel is connected to a timeslot bundle. Therefore, the timeslots are assigned using the DEF TS or DEF SPLIT TS command on the ML-IP internal TDM port of the bundle.*

---

The selection of the channel payload routing parameters described above is controlled by means of common parameters, which are included in each DEF CH data form, irrespective of the module or channel type. These parameters are explained in [Table 5-5](#).

---

**Note** *For the routing parameters available in the DEF TS command, refer to the description of the DEF TS command.*

---

Table 5-5. Basic Channel Routing Parameters

Parameter	Description
<b>Connect</b>	<p>Determines whether the channel is connected to an internal bus:</p> <p><b>NO</b> The channel is not connected. You can still program the desired parameters, so the channel will be ready to operate when needed.</p> <p><b>YES</b> The channel is connected, and uses the regular signaling transfer mode.</p> <p><b>V5.1</b> Not relevant for the current version.</p> <p><b>V5.2</b> Not relevant for the current version.</p> <p><b>Default: NO</b></p>
<b>Oper Mode</b>	<p>Selects the channel operation mode:</p> <p><b>BI-DIR</b> Bidirectional (regular) mode.</p> <p><b>UNI-BRD TX</b> Unidirectional broadcast transmit mode.</p> <p><b>UNI-BRD RX</b> Unidirectional broadcast receive mode.</p> <p><b>BID-BRD RX</b> Bidirectional broadcast receive mode.</p> <p><b>Default: BI-DIR</b></p>
<b>ML Slot</b>	<p>Selects the I/O slot number of the destination main link port:</p> <ul style="list-style-type: none"> <li>• For ML-IP modules, always specify the internal TDM port.</li> <li>• For TDM main link modules, the selection depends on the operator mode: <ol style="list-style-type: none"> <li>1. When using the BI-DIR, UNI-BRD RX and BID-BRD RX modes, you can select the desired I/O slot number.</li> <li>2. When using the UNI-BRD TX, this field automatically changes to BRD, to remind you that the destination must be selected using the DEF TS command.</li> </ol> </li> </ul> <p><b>Default: I/O-1</b></p>
<b>ML Channel</b>	<p>Selects the number of the destination main link port.</p> <ul style="list-style-type: none"> <li>• For ML-IP modules always specify the internal TDM port.</li> <li>• For TDM main link modules, the selection depends on the operator mode: <ul style="list-style-type: none"> <li>▪ When using the BI-DIR, UNI-BRD RX and BID-BRD RX modes, you can select the desired external port number. The supported range depends on the number of external ports available on the main link module installed in the slot selected by the ML Slot parameter.</li> <li>▪ When using the UNI-BRD TX mode, this field automatically changes to BRD, to remind you that the destination port must be selected using the DEF TS command.</li> </ul> </li> </ul> <p><b>Default: EX1</b></p>
<b>Map Type</b>	<p>Selects the timeslot mapping method when the destination is a TDM main link port:</p> <ul style="list-style-type: none"> <li>• When using the BI-DIR and UNI-BRD TX modes, this field automatically changes to N/A, to remind you that the destination must be selected using the DEF TS command.</li> <li>• When using the UNI-BRD RX and BID-BRD RX modes, you can select the desired mode: <p><b>USER</b> You can select the desired main link timeslots on the timeslot map.</p> <p><b>SEQUENCE</b> The channel is assigned consecutive timeslots, starting with the timeslot specified by means of the Start TS parameter.</p> </li> </ul> <p><b>Default: N/A</b></p>

Parameter	Description
<b>Start TS</b>	<ul style="list-style-type: none"> <li>When using the SEQUENCE mapping mode, this field can be used to select the starting timeslot in the frame of the destination TDM main link port. The allowed range is 1 to 31 for E1 ports, and 1 to 24 for T1 ports.</li> <li>When using any other mode, this field automatically changes to N/A.</li> </ul> <p><b>Default: N/A</b></p>

If the **Map Type** parameter is **USER**, and you selected the UNI-BRD RX or BID-BRD RX mode, then after pressing **<Enter>** to end the selection of the routing parameters you will see the first line of the timeslot selection map.

<b>TS 01</b>	<b>TS 02</b>	<b>TS 03</b>	<b>TS 04</b>	<b>TS 05</b>	<b>TS 06</b>	<b>TS 07</b>
<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>

Move the cursor to the desired timeslot field by pressing the spacebar, and then type F or B to change the selection to YES. After making the selections in the first line, press **<Enter>** to continue to the second line (timeslots 8 to 14). Repeat the operations until the last line (ending in timeslot 31 for an E1 port, or in timeslot 24 for a T1 port).

You must select enough timeslots to carry the channel payload rate.

## DEF DEFAULT DB

### Purpose

Change the database used as a default for “normal operation” instead of the default database, which is 1. This selection is stored in the flip database.

“Normal operation” means that none of the flip conditions defined in the flip database is present, and therefore none of databases specified in the **DB No.** field of the ADD FLIP ENTRY commands, is in use.

The new selection must be a valid configuration database. You can see the existing configuration databases by means of the DSP DB LIST command.

### Syntax

DEF DEFAULT DB

### Use

- To define the default database, type:

**DEF DEFAULT DB <Enter>**

- You will see the default database selection form. A typical data form is shown below:

<b>Default Database No</b>
- - - - -
01

- Press the F or B keys to scroll among the currently defined databases. After displaying the desired database number, press **<Enter>** to end.



## DEF F

### Purpose

Defines the control sequences to be sent to the supervision terminal to perform the following terminal control functions:

- Clear screen.
- Move cursor to screen home position.
- Move cursor to the right by one position.

This command lets you enter manually the desired codes. However, if you are using a terminal of the following type: generic ANSI, VT-52, VT-100, TV-920, FREEDOM-100, FREEDOM-110, FREEDOM-220, or a terminal which is compatible with one of the terminals listed above, you can use the DEF TERM command to select automatically the corresponding control sequences.

### Syntax

DEF F

### Use

- To display the current control sequences, type:  
**DEF F<Enter>**
- The terminal control sequences data form is displayed. The top section lists the current control sequences, and is followed by a section which provides entry fields for each sequence. The entry section is displayed line after line, after pressing **<Enter>**.
- A typical screen, as seen after filling all the lines, is shown below:

```
Current Control Sequences:
CLEAR SCREEN =hhhhhhhh
CURSOR HOME  =hhhhhhhh
CURSOR RIGHT =hhhhhhhh
Enter New Control Sequences:
CLEAR SCREEN =hhhhhhhh
CURSOR HOME  =hhhhhhhh
CURSOR RIGHT =hhhhhhhh
```

where h indicates hexadecimal digits.

- To change a control sequence, bring the cursor under the first digit of the control sequence to be changed by pressing **<Enter>**, and type the new value.
- After the desired values are selected, press **<Enter>** to end. If the command is accepted, you will see the Megaplex prompt.

Note that if the selected control sequences are not correct, the cursor position will be incorrect. To recover from this situation, type the DEF F command again, and then correct as necessary.

## DEF FLIP BROADCAST

### Purpose

Control the distribution (broadcasting) of information of flip events to the other Megaplex units in the network.

### Syntax

DEF FLIP BROADCAST

### Use

- To change the current flip broadcasting state, type:

**DEF FLIP BROADCAST**<Enter>

You will see the flip broadcast data form. A typical data form is shown below:

Flip Broadcast	Broadcast Interval [sec]
OFF	60

The fields appearing on the data form are as follows:

#### FLIP BROADCAST

**OFF** – The broadcasting of flip event information by this Megaplex is disabled. In this case, the Megaplex will not broadcast information on flip events status.

**ON** – The broadcasting of flip event information by this Megaplex is enabled.

#### BROADCAST

The interval between consecutive broadcasts of events

#### INTERVAL

status information, applicable only when broadcasting is enabled. The allowed range is 10 to 60 seconds.

## DEF FLIP ENTRY

### Purpose

Modify an existing flip database entry.

You can use the DSP FLIP ENTRY command to display the entries included in the edited flip database, and the command DSP ST FLIP ENTRY for entries included in the current (active) flip database.

### Syntax

DEF FLIP ENTRY E

### Use

- To modify an existing flip database entry, type:

**DEF FLIP ENTRY E**<Enter>

where E is the desired entry number, in the range of 1 through 10.

2. You will see a data form which displays the current entry parameters. This data form is similar to the ADD FLIP ENTRY data form. For a description of data form fields and operations, refer to the ADD FLIP ENTRY command.

## DEF FLIP EVENT

### Purpose

Modify an existing flip database event.

You can use the DSP FLIP EVENT command to display the events included in the edited flip database, and the command DSP ST FLIP EVENT for events included in the current (active) database.

### Syntax

```
DEF FLIP EVENT V
```

### Use

1. To modify an existing flip database event, type:

```
DEF FLIP EVENT V<Enter>
```

where V is the desired event number, in the range of 1 through 10.

2. You will see a data form which displays the current event parameters. This data form is similar to the ADD FLIP EVENT data form. For a description of data form fields and operations, refer to the ADD FLIP EVENT command.

## DEF MANAGER LIST

### Purpose

Modify the definition of an existing network management station.

To define a new management station, use the ADD MANAGER LIST command.

### Syntax

```
DEF MANAGER LIST
```

### Use

1. To modify an existing management station, type:

```
DEF MANAGER LIST<Enter>
```

You will see the data form of the first management station. To select another station, press F or B when the cursor is in the **No.** column. A typical data form is shown below.

The data form includes the following fields:

No	IP Address	IP mask	Alarm	Trap Masking		
				Sanity	Cnfg DB Switch	Flip DB Switch
02	193.11.029.013	255.255.255.000	YES	NO	YES	NO

The data form is similar to the data form used to define a new management station. Refer to the ADD MANAGER LIST command for a description of the various fields.

## DEF MMI

### Purpose

Define the working prompt to be displayed by the Megaplex on the supervision terminal or Telnet host.

### Syntax

DEF MMI

### Use

- To define the working prompt displayed by the Megaplex, type:  
**DEF MMI<Enter>**
- The first line of the prompt definition screen appears. A typical display is shown below:

Alarm Status	Database	Mux Name	User Prompt	Time Stamp	Logoff Time
NO	NO	NO	NO	NO	3 MINUTES

- Change parameters as required, and then press **<Enter>** to display the second line. A typical display is shown below:

Date Format	Pop Alarm
DD-MM-YYYY	NO

- After the desired parameter values are selected, press **<Enter>**.
- If the **User Prompt** field is set to YES, you will be prompted to enter a new user prompt:

**User prompt (up to 10 characters): 'user prompt'**

Type in the desired user prompt, and then press **<Enter>** to end.

### Data Form Fields

The fields appearing on the data form are as follows:

- Alarm Status** Select YES to instruct the Megaplex to display \* **hhh** \* at the beginning of the prompt line whenever alarms exist in the system. **hhh** stands for the highest alarm level present in the system.

<b>Database</b>	Select YES to instruct the Megaplex to display the designation of the current editing database in the prompt line.
<b>Mux Name</b>	Select YES to instruct the Megaplex to display its logical name in the prompt. The logical name is defined by means of the DEF AGENT command.
<b>User Prompt</b>	Select YES to instruct the Megaplex to display the user prompt defined by you in the prompt.
<b>Time Stamp</b>	Select YES to instruct the Megaplex to display the time and date after a command is executed.
<b>Logoff Time</b>	Selects the idle disconnect time (the time the terminal session will be automatically disconnected if no input data is received from the terminal): 3 MINUTES or 10 MINUTES.
<b>Date Format</b>	Selects the date format: <ul style="list-style-type: none"> <li>• <b>DD-MM-YYYY</b> – the date appears as day/month/year.</li> <li>• <b>MM-DD-YYYY</b> – the date appears as month/day/year.</li> <li>• <b>YYYY-DD-MM</b> – the date appears as year/day/month.</li> <li>• <b>YYYY-MM-DD</b> – the date appears as year/month/day.</li> </ul>
<b>Pop Alarm</b>	Controls the automatic display of alarms on the terminal: <ul style="list-style-type: none"> <li>• <b>NEW</b> – the terminal automatically displays every event, and whenever an alarm status change state.</li> <li>• <b>STATUS</b> – the terminal automatically displays the complete alarm status whenever a new alarm occurs.</li> <li>• <b>OFF</b> – the automatic display feature is disabled.</li> </ul>

## DEF NAME

### Purpose

Define or modify the Megaplex logical name, and the parameters of its SNMP agent. This command is identical to the DEF AGENT command.

For a description of the display fields, refer to the DEF AGENT command above.

## DEF NET DELAY

### Purpose

Specify the delay between a DB NET GO command, and its actual execution (which results in a configuration change in all the Megaplex units in the network). This delay should be sufficiently long to ensure that the DB NET GO command is received by all the units in the network before the first unit starts executing it.

The same delay is also used in case a database flip decision is made in response to a flip event: the database flip will occur only if after the specified delay the flip condition is still present. This prevents flips (and the associated disruption in

service) that may occur under marginal conditions, when alarms change state at short intervals.

## Syntax

```
DEF NET DELAY
```

## Use

1. To change the delay, type:

```
DEF NET DELAY<Enter>
```

You will see the net delay selection form. A typical display is shown below:

```
Net Delay, sec
- - - - -
060
```

2. Select the desired delay, in the range of 000 to 999 seconds, by selecting each digit (bring the cursor under the required digit, and then change the digit by pressing F or B).
3. When the desired value is displayed, press <Enter>.

## DEF NET ENTRY

### Purpose

Modify an existing net entry.

These entries serve as filters for the IP addresses to be learned by the IP router function of the SNMP agent of the Megaplex. Refer to the ADD NET ENTRY command for details.

### Syntax

```
DEF NET ENTRY N
```

### Use

To modify an existing net entry, type:

```
DEF NET ENTRY N<Enter>
```

where N is the net entry number, in the range of 1 through 10.

You will see the first line of the specified net entry data form, used to enter the net IP address. After changing the required data, press <Enter> to display the second line, which is used to enter the subnet mask. After entering the new mask, press <Enter> to end.

A typical data form, as seen after both lines have been filled in, is shown below:

```
NET IP ADDRESS(999.999.999.999):    192.221.345.000
NET IP MASK(999.999.999.999):     255.255.255.000
```

For a description of the display fields, refer to the ADD NET ENTRY command.

## DEF PING

### Purpose

Define the parameters used to ping (check IP connectivity to) a selected IP address.

The ping is supported by HS-ETH/SW modules only.

### Syntax

```
DEF PING SS
```

### Use

- To define the ping parameters, type:

```
DEF PING SS<Enter>
```

where SS is the number of the slot in which the desired ML-IP or HS-ETH/SW module is installed.

- You will see the ping parameters data form. A typical display is shown below.

Ping IP Address	Packet Size	Timeout	Number of Requests
0.0.0.0	32	10	255

The command fields are explained in [Table 5-6](#).

*Table 5-6. DEF PING Command Parameters*

Parameter	Function	Values
<b>Ping IP Address</b>	Specifies the destination IP address for the ping packets	Type the desired IP address, using the dotted-quad format (four groups of digits in the range of 0 through 255, separated by periods)
<b>Packet Size</b>	Specifies the size of the ping request packets that will be sent	The allowed range is 32 to 1450 bytes
<b>Timeout (sec)</b>	Specifies the maximum time, in seconds, allocated to sending the specified number of ping request packets	The allowed range is 1 to 65 seconds
<b>Number of Requests</b>	Specifies the total number of ping request packets to be sent	The allowed range is 3 to 255. You can also enter the value 0, which is interpreted as a <i>stop current ping</i> command

## DEF PROFILE

### Purpose

Define signaling profiles. The signaling profile is used to select the TDM main link signaling mode (legacy or R2 CAS protocol), and the signaling parameters. Profiles can also be used to define the processing of signaling information by IP main link modules, for example, ML-IP.

Each Megaplex main link can use a different signaling profile. The total number of profiles that can be defined is up to 5, irrespective of its type (legacy or R2).

## Use – Selecting the Profile Type

### Syntax

```
DEF PROFILE S
```

### Use

- To define a profile, type:

```
DEF PROFILE S<Enter>
```

where S is the number of the desired signaling profile, 1 through 5.

You will see the first line of the profile data form. A typical display is shown below.

DEF PROFILE 3	
Signaling Type	Profile Name
-----	-----
LEGACY	STANDARD

The first line of the profile data form includes two fields, explained in [Table 5-7](#).

*Table 5-7. General Profile Parameters*

Parameter	Description
Signaling Type	Selects the signaling type (protocol):  <b>LEGACY</b> Standard CAS protocol. <b>R2 CAS</b> R2 signaling protocol. <b>Default: LEGACY</b>
Profile Name	Used to enter the desired name to the profile. The name can be any alphanumeric string of up to 12 characters

After pressing <Enter>, you will see the first section of the data form corresponding to the selected signaling type. The data forms for the two signaling types are explained below.

## Use – Configuring Legacy Signaling Profiles

A legacy signaling profile has two sections:

- Receive path section: defines the interpretation of the incoming signaling information. This section enables the user to select the translation of each incoming bit to the corresponding internal signaling bit (the signaling bit actually sent to each module which needs the signaling information received by a main link).

In addition to the translation of individual bits, the receive path section can also be used to define the signaling bit patterns that indicate the busy and idle states.



- Transmit path section: defines the translation of the internal signaling bits to transmitted signaling bits.

**Note**

When the Megaplex includes an audio interface module which supports the definition of its own profile, it is necessary to select a main link profile that does not affect the signaling bits of that module. This is obtained by selecting A=A, B=B, C=C, D=D in the active profile.

➤ **To configure a legacy profile:**

1. After selecting LEGACY for the **Signaling Type**, you will see the first section (RX TRANSLATION) of the selected legacy signaling profile. A typical display is shown below.

Rx Translation							
-----							
ABCD	INT:	A	B	C	D	BUSY	IDLE
-----							
ABCD	IN:	A	A	A	A	F	0

The top line lists the internal signaling bits and states, and the lower line is used to define the translations. Note that T1 ports (not yet supported) with SF (D4) framing support only signaling bits A and B.

The functions of the fields in the RX translation section are explained in [Table 5-8](#).

*Table 5-8. RX Translation Parameters*

Parameter	Description								
A, B, C, D	One field for each internal signaling bit. For each internal bit, you can select the method used to determine its value. The available selections are as follows: <table border="0" style="margin-left: 20px;"> <tr> <td style="padding-right: 20px;">A, B, C, D</td> <td>Bit value copied from the corresponding incoming bit.</td> </tr> <tr> <td>~A, ~B, ~C, ~D</td> <td>Inverted bit value related to the corresponding incoming bit.</td> </tr> <tr> <td>0</td> <td>Bit value is always 0.</td> </tr> <tr> <td>1</td> <td>Bit value is always 1.</td> </tr> </table> <p><b>Default:</b> A, B, C, D</p>	A, B, C, D	Bit value copied from the corresponding incoming bit.	~A, ~B, ~C, ~D	Inverted bit value related to the corresponding incoming bit.	0	Bit value is always 0.	1	Bit value is always 1.
A, B, C, D	Bit value copied from the corresponding incoming bit.								
~A, ~B, ~C, ~D	Inverted bit value related to the corresponding incoming bit.								
0	Bit value is always 0.								
1	Bit value is always 1.								
BUSY	Used to select the incoming pattern to be interpreted internally as the busy state. The pattern is specified by a hexadecimal digit (0 to 9, A to F), which when converted to binary format yields the ABCD sequence. <p><b>Example:</b> if the busy state is indicated by the incoming sequence 1000, select 8.</p> <p><b>Default:</b> F</p>								

Parameter	Description
<b>IDLE</b>	Used to select the incoming signaling bit pattern to be interpreted internally as the idle state.  The pattern is specified by a hexadecimal digit (0 to 9, A to F), which when converted to binary format yields the ABCD sequence.  <b>Default: 0</b>

- After marking the desired selections in the receive section, press **<Enter>** to display the transmit section (TX TRANSLATION).

A typical display is shown below.

Tx Translation				
-----				
ABCD INT:	A	B	C	D
-----				
ABCD OUT:	A	A	A	A

The transmit section includes one field for each internal signaling bit. For each bit, the user can select the corresponding value of the translated signaling bit, that will be sent through the link. The available selections are explained in [Table 5-8](#).

## Use – Configuring R2 Signaling Profiles

An R2 signaling profile comprises the following sections:

- General parameters section
- Timeslot (channel) parameters section
- Manual parameter selection section (displayed only when the manual configuration mode is selected).

To help you select the proper values for the R2 protocol parameters, the following section describes the call setup procedures under the R2 protocol.

## Basic Call Setup Process using R2 Protocol

[Figure 5-1](#) shows the flow of signaling information during a basic call setup process. The time flows downward from the top.

The following conventions are used:

- The side originating the call is also referred to as the *outgoing side*, and its signaling are called *forward signals*
- The side receiving (terminating) the call is also referred to as the *incoming side*, and its signaling is called *backward signals*.

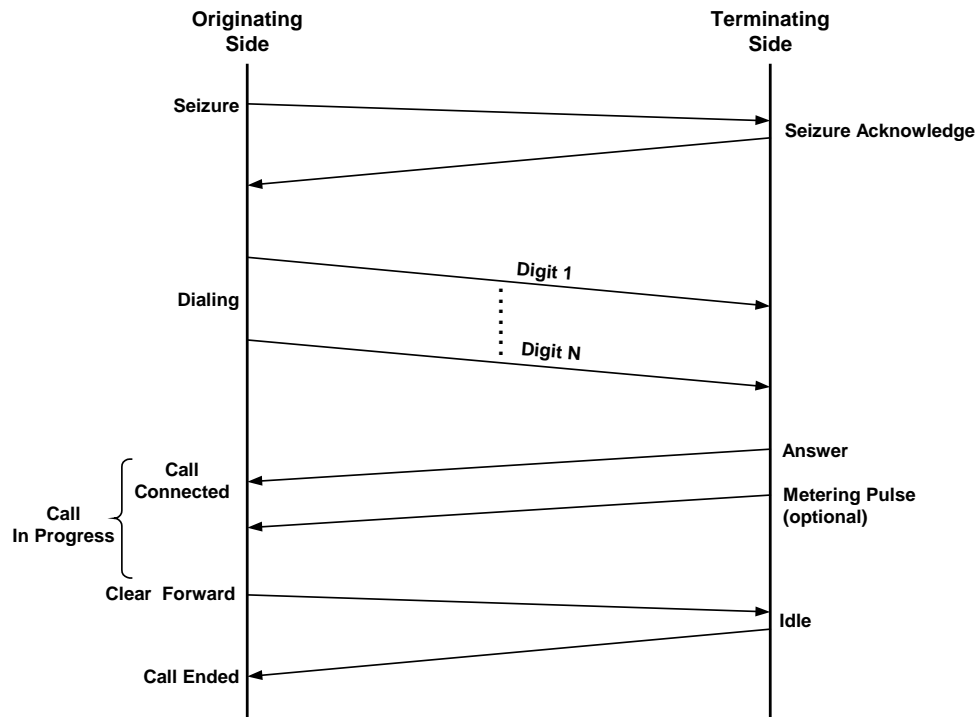


Figure 5-1. Basic R2 Call Setup Process

The basic process includes the following main steps:

1. **Seizure:** the originating side goes off-hook, and seizes the line at the local end. This state is reported to the terminating side.
2. **Seizure acknowledge:** in response to the seize request, the terminating side sends an acknowledgment to the originating side, to indicate that it is ready to continue the call setup process.
3. **Dialing:** the originating side dials the digits of the desired destination.
4. **Answer:** after the path to the destination is connected, the terminating side enables the destination to answer. At this stage, a call is in progress. When necessary, metering pulses may be generated and sent to the originating side, for taxing purposes.
5. **Clear Forward:** when the call is over and the originating side returns on-hook, a clear-forward request is sent. After the terminating side acknowledges the request and returns to the idle state, the call is ended.

The call setup process uses various timers, to ensure that the steps performed during this process are completed within a reasonable time. If a timer expires, the call setup process is aborted, to release network resources.

The signaling necessary to implement the call setup process is carried by the four signaling bits (A, B, C and D) of the channel, which are multiplexed in timeslot 16 of the E1 frame (this requires G.704 multiframe (G.732S) framing).

---

**Note** *Since the R2 protocol requires bidirectional exchange of information, it cannot be used for channels configured for the unidirectional broadcast mode.*

---

To prevent call attempts over channels connected to inoperative links, e.g., over a link which is in a loss of signal or loss of frame synchronization state, the channel can enter an additional state, **Blocked**.

► **To configure an R2 signaling profile:**

1. After selecting R2 CAS for the **Signaling Type**, you will see the general parameters section of the selected R2 profile.

A typical display is shown below.

Country	R2 Mode	R2 Delay	Metering Indication	Uniform
-----	-----	-----	-----	-----
ITU-T	MANUAL	TERRESTRIAL	C BIT	NO

*Table 5-9* explains the parameters appearing in this section.

*Table 5-9. R2 Protocol, General Parameters*

Parameter	Function	Values
<b>R2 Mode</b>	Selects the R2 parameter selection method	<b>AUTO</b> – Parameter values are selected in accordance with the default values corresponding to the selected country. <b>MANUAL</b> – Parameter values are selected by the user, within the range of values corresponding to the selected country. <b>Default: AUTO</b>
<b>Country</b>	Selects a specific (national) implementation of the R2 protocol	<b>ITU-T</b> – In accordance with ITU-T Rec. Q.421. <b>KOREA</b> – Korean national standards. <b>INDIA</b> – Indian national standards. <b>BRASIL</b> – Brazilian national standards. <b>Continuous</b> – applicable to continuous signaling. <b>BRASIL Pulsed</b> – Brazilian national standards applicable to pulsed signaling. <b>ARGENTINA</b> – Argentinian national standards. <b>COUNTRY 7 to COUNTRY 10</b> – User-selectable values. <b>Default: ITU-T</b>
<b>R2 Delay</b>	Selects the delay expected on the E1 trunk	<b>TERRESTRIAL</b> – Relatively short delay, typical of terrestrial links. <b>SATELLITE</b> – Long delay, typical of satellite links. <b>Default: TERRESTRIAL</b>
<b>Metering Indication</b>	Selects the channel signaling bit used for carrying the metering indication	<b>C BIT</b> – Metering indication carried by signaling bit C. <b>B BIT</b> – Metering indication carried by signaling bit B. <b>Default: C BIT</b>

2. After configuring the parameters in the general section, press **<Enter>**. You will see the first line of the timeslot map used to select the call parameters. After making the desired selections in the first line, press **<Enter>** to continue to the next line.

- Repeat until the call parameters for all the timeslots are configured. A typical timeslot map, as seen after all the lines have been displayed, is shown below.

	TS 01	TS 02	TS 03	TS 04	TS 05	TS 06
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO
	TS 07	TS 08	TS 09	TS 10	TS 11	TS 12
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO
	TS 13	TS 14	TS 15	TS 17	TS 18	TS 19
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO
	TS 13	TS 14	TS 15	TS 17	TS 18	TS 19
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO
	TS 20	TS 21	TS 22	TS 23	TS 24	TS 25
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO
	TS 26	TS 27	TS 28	TS 29	TS 30	TS 31
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH
Metering	NO	NO	NO	NO	NO	NO

*Table 5-10* explains the parameters appearing in this section.

*Table 5-10. Timeslot Call Parameters*

Parameter	Function	Values
Call En	Selects the type of calls that are accepted by the channel routed to the corresponding timeslot	<p><b>INCOMING</b> – The channel accepts only incoming calls.</p> <p><b>OUTGOING</b> – The channel initiates only outgoing calls.</p> <p><b>BOTH</b> – The channel supports both outgoing and incoming calls.</p> <p><b>Default: BOTH</b></p>
Metering	Controls the use of the metering function for the channel routed to the corresponding timeslot	<p><b>C BIT</b> – Metering function enabled, and uses signaling bit C.</p> <p><b>B BIT</b> – Metering function enabled, and uses signaling bit B.</p> <p><b>Default: C BIT</b></p>

- If the **R2 Mode** is AUTO, pressing **<Enter>** ends the command.

If the **R2 Mode** is MANUAL, pressing **<Enter>** displays the first R2 protocol parameter. After making the desired selection in the first line, press **<Enter>** to continue to the next line. Repeat until the R2 parameters for all the timeslots are configured.

A typical display, as seen after all the R2 parameters have been displayed, is shown below. The numbers in the brackets specify the allowed range of values, which depends on the selected country (see *Table 5-10*).

*Table 5-11* explains the parameters appearing in this section. *Table 5-12* and *Table 5-13* present the allowed range and the default parameter values for the various countries.

Break duration	: 64 ms (56 - 80)
Release guard timing (T2)	: 600 ms (16 - 2000)
Regret timer duration	: 14 sec (1 - 1200)
Seize detect	: 64 ms (24 - 200)
Seize Ack. delay	: 8 ms (8 - 304)
Clear Back detect	: 24 ms (24 - 104)
Clear Forward detect	: 304 ms (200 - 504)
Fault detect	: 24 ms (16 - 104)
Fault removal detect	: 24 ms (16 - 104)
Meter pulse duration	: 152 ms (152 - 304)
Seize Ack. wait	: 400 ms (104 - 1200)
Seize Ack. detect	: 48 ms (48 - 600)
Answer detect	: 144 ms (136 - 400)
Block removal detect	: 16 ms (16 - 96)
Metering pulse detect	: 144 ms (96 - 440)
Forced disconnect detect	: 0 ms (0 - 0)
Disconnect acknowledge detect	: 0 ms (0 - 0)
Release guard timing (T1)	: 600 ms (16 - 2000)

*Table 5-11. R2 Protocol Parameters*

Parameter	Function
<b>Break Duration</b>	Selects the break duration, in msec. This effectively selects the make/break ratio for pulse dialing
<b>Release Guard Timing (T2)</b>	Release guard time for the incoming side, in msec
<b>Regret Timer Duration</b>	Regret timer, in sec. This timer is used to delay the sending of a clear forward request after the originating side goes on-hook. If the originating side returns to the off-hook state before this timer expires, the call is not disconnected
<b>Seize Detect</b>	Selects the minimum duration, in msec, an off-hook state must persist before a valid seizure is declared
<b>Seize Ack. Delay</b>	Selects the delay, in msec, before sending a valid seizure acknowledge signal
<b>Clear-Back Detect</b>	Selects the minimum duration, in msec, a clear back signal must persist to be identified as a valid signal
<b>Clear Forward Detect</b>	Selects the minimum duration, in msec, a clear forward signal must persist to be identified as a valid signal
<b>Fault Detect</b>	Selects the minimum duration, in msec, a fault signal must persist to be identified as a valid signal
<b>Fault Removal Detect</b>	Selects the minimum duration, in msec, a fault-removed signal must persist to be identified as a valid signal

Parameter	Function
<b>Meter Pulse Duration</b>	Selects the duration, in msec, of the metering pulse
<b>Seizure Ack Wait</b>	Selects the maximum time, in msec, to wait for a seizure acknowledge signal
<b>Seizure Ack Detect</b>	Selects the minimum duration, in msec, a seizure acknowledge signal must persist to be identified as a valid signal
<b>Answer Detect</b>	Selects the minimum duration, in msec, an answer signal must persist to be identified as a valid signal
<b>Block Removal Detect</b>	Selects the minimum duration, in msec, a block-removal signal must persist to be identified as a valid signal
<b>Metering Pulse Detect</b>	Selects the minimum duration, in msec, a metering pulse must persist to be identified as a valid signal
<b>Forced Disconnect Detect</b>	Selects the minimum duration, in msec, a forced-disconnect signal must persist to be identified as a valid signal
<b>Disconnect Acknowledge Detect</b>	Selects the minimum duration, in msec, a disconnect acknowledge signal must persist to be identified as a valid signal
<b>Release Guard Timing (T1)</b>	Release guard time for the outgoing side, in msec

*Table 5-12. Default R2 Protocol Values for India, Korea, and ITU-T Implementations*

Type	Parameter	Range of Values	Default
<b>Incoming</b>	<b>Seize Detect</b>	24 to 200 msec in 8-msec steps	64 msec
	<b>Seize Acknowledge Delay</b>	8 to 304 msec in 8-msec steps	8 msec
	<b>Clear Back Detect</b>	24 to 104 msec in 8-msec steps	24 msec
	<b>Clear Forward Detect</b>	200 to 504 msec in 8-msec steps	304 msec
	<b>Fault Detect</b>	16 to 104 msec in 8-msec steps	24 msec
	<b>Fault Removal Detect</b>	16 to 104 msec in 8-msec steps	24 msec
	<b>Metering Pulse Duration</b>	152 to 304 msec in 8-msec steps	152 msec
	<b>Release Guard Timer T2</b>	16 to 2000 msec in 8-msec steps	600 msec
	<b>Regret Timing</b>	1 to 1200 sec in 8-sec steps	14 sec
<b>Outgoing</b>	<b>Seize Ack Wait</b>	104 to 1200 msec in 8-msec steps	400 msec
	<b>Seizure Ack Detect</b>	48 to 600 msec in 8-msec steps	48 msec
	<b>Answer Detect</b>	136 to 400 msec in 8-msec steps	144 msec
	<b>Block Removal Duration</b>	16 to 96 msec in 8-msec steps	16 msec
	<b>Metering Pulse Detect</b>	96 to 440 msec in 8-msec steps	144 msec
	<b>Forced Disconnect Detect</b>	Ignored	
	<b>Disconnect Ack Detect</b>		

Type	Parameter	Range of Values	Default
	Release Guard T1 Timer	16 to 2000 msec in 8-msec steps	600 msec

*Table 5-13. Default R2 Protocol Values for Brazil Implementations*

Type	Parameter	Range of Values	Default
Incoming	Seize Detect	64 to 448 msec in 8-msec steps	64 msec
	Seize Acknowledge Delay	8 to 304 msec in 8-msec steps	8 msec
	Clear Back Detect	24 to 448 msec in 8-msec steps	24 msec
	Clear Forward Detect	200 to 448 msec in 8-msec steps	304 msec
	Fault Detect	16 to 104 msec in 8-msec steps	24 msec
	Fault Removal Detect	16 to 104 msec in 8-msec steps	24 msec
	Metering Pulse Duration	120 to 184 msec in 8-msec steps	152 msec
	Release Guard Timer T2	16 to 2000 msec in 8-msec steps	600 msec
	Regret Timing	1 to 1200 sec in 8-sec steps	14 sec
Outgoing	Seize Ack Wait	104 to 1200 msec in 8-msec steps	696 msec
	Seizure Ack Detect	48 to 600 msec in 8-msec steps	48 msec
	Answer Detect	64 to 448 msec in 8-msec steps	144 msec
	Block Removal Duration	16 to 96 msec in 8-msec steps	16 msec
	Metering Pulse Detect	64 to 448 msec in 8-msec steps	376 msec
	Forced Disconnect Detect	304 to 448 msec in 8-msec steps	376 msec
	Disconnect Ack Detect	304 to 448 msec in 8-msec steps	376 msec
	Release Guard T1 Timer	16 to 2000 msec in 8-msec steps	600 msec

## DEF PROFILE TS

### Purpose

Define signaling profiles per timeslot on the main E1/T1 link. This feature is useful when Megaplex is working opposite channel banks from various vendors and a link coming into the Megaplex contains timeslots with various signaling behaviors.

Each main link timeslot (excluding TS16 for E1 main links) can use a different signaling profile. The total number of profiles that can be defined is up to 5. This command is not available for profiles configured as R2.

### Syntax

```
DEF PROFILE TS SS CC
```



## Use

### ► To specify a profile per timeslot on a specific main link:

1. Use DEF CH SS CC command to define **Profile/Ts** in the **Sig. Profile** field.
2. Type DEF PROFILE TS, followed by the number of the slot in which the module is installed and the port number:

**DEF PROFILE TS SS CC <Enter>.**

A typical display is shown below.

TS 01	TS 02	TS 03	TS 04	TS 05	TS 06
(1)	(1)	(1)	(1)	(1)	(1)
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12
(1)	(1)	(1)	(1)	(1)	(1)
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18
(1)	(1)	(1)	---	(1)	(1)
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24
(1)	(1)	(1)	(1)	(1)	(1)
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30
(1)	(1)	(1)	(1)	(1)	(1)
TS 31					
(1)					

Change the profile numbers if needed, using <F> and <B> keys.

### **Note**

If two ML modules are configured as redundant, their Profile per timeslot configuration must be identical.

## DEF PROMPT

### Purpose

Define the working prompt displayed by the Megaplex. This command is identical to the DEF MMI command.

For a description of the command fields, refer to the DEF MMI command above.

## DEF PSW

### Purpose

Define a new user password.

### Syntax

DEF PSW

## Use

1. To define the user password, type:

```
DEF PSW<Enter>
```

You are prompted to enter the new password.

2. Type the required password (four to eight alphanumeric characters; spaces are not allowed). After entering the password, press **<Enter>**.

You are prompted to enter the password again. A typical data entry form is shown below:

```
Enter New Password (Up to 8 Characters): 'password'  
Re-enter Password :
```

where 'password' is the new password entered by the user.

3. Carefully check that the specified password has been indeed typed in, and then press **<Enter>**.

---

**Note** *A password is always required for Telnet sessions.*

---

## DEF PWD

### Purpose

Define a new user password. This command is identical to the DEF PSW command.

For a description of the command, refer to the DEF PSW command above.

## DEF RDN ST

### Purpose

Enable the user to control the redundancy state of a port (enabled, disabled, flip), which is a member of a redundancy pair.

This command is relevant only to main link modules with E1 and T1 interfaces (including ML-20N).

When module ports are operated as a redundancy pair and both ports operate normally, the redundancy mechanism automatically selects one of the ports as the active one, and the other port is switched to standby. When both ports operate normally, it does not matter which port is selected, because both can provide good service. However, when it is necessary to remove the active module from the chassis or disconnect the cables connected to a port, for example, for maintenance or test purposes, you should be able to switch to the other port without affecting the traffic flow (simply removing the module with the active port or disconnecting the port will also cause switching, but this action will also cause a short disruption in traffic flow).

This command enables you to switch the traffic to the other module port.

All of the following conditions must be fulfilled for this command to work:

- The command must specify the numbers of installed and programmed module and port, and the specified port must be connected
- The target port must be defined as a member of a redundancy pair, and the other port of this pair must be located on a different module

This means that it is not possible to change the redundancy state of a module which is not installed or not programmed in the I/O slot specified in the command; neither is it possible to change the redundancy state of unconnected port.

**Note** *Changing the redundancy state of a port to **DISABLE** by this command is reported by a major alarm.*

## Syntax

```
DEF RDN ST A B
```

## Use

1. To change the redundancy state of a specific port, type:

```
DEF RDN ST SS CC<Enter>
```

where SS is the I/O slot number of the corresponding module, and CC is the port number.

You will see the port state selection data form. A typical data form is shown below:

Port 1	
Redundancy State	Online State
-----	-----
<b>ENABLE</b>	<b>ACTIVE</b>

2. To change the redundancy state, press F or B and then press **<Enter>**. In addition to enabling or disabling the port, you can use the FLIP command to momentarily set the current port to be active. It is relevant only when performing the command on the standby port and when both ports are enabled.

The change actually takes place after performing database update, using the DB UPD command.

**Note** *It is illegal to perform this command on a main link port when defining redundancy in the same module, since the redundancy mechanism in the same module is software-controlled.*

## DEF RDN ST BND

### Purpose

Enable the user to control the redundancy state (enabled or disabled) of a bundle, which is a member of a redundancy pair. This command is relevant only to ML-IP.

This command enables you to switch the traffic to the other module port. Moreover, if this command is executed on a bundle which serves as a clock source, the Megaplex will change its timing source to match the new situation: for example, if a bundle serves as the main clock source and its redundancy state is changed to **DISABLE**, the Megaplex will switch to the fallback clock source.

## Syntax

```
DEF RDN ST BND A
```

## Use

- To change the redundancy state of a specific bundle, type:

```
DEF RDN ST A<Enter>
```

where A is the number of the corresponding bundle.

You will see the bundle state selection data form. A typical data form is shown below:

BND 1	
Redundancy State	Online State
-----	-----
<b>ENABLE</b>	<b>ACTIVE</b>

- To change the redundancy state, press F or B and then press **<Enter>**. In addition to enabling or disabling the bundle, you can use the FLIP command to momentarily set the current bundle to be active. It is relevant only when performing the command on the standby bundle and when both bundles are enabled.

---

**Note** *It is illegal to perform this command on a bundle when defining redundancy in the same module, since the redundancy mechanism in the same module is software-controlled.*

---

## DEF ROUTE

### Purpose

Modify an existing static entry to the Megaplex routing table. The routes defined in this table are sent to the ML-IP and HS-ETH/SW modules installed in the enclosure.

This command is similar to the ADD ROUTE command, except that it applies only to existing routes. To find the index number of the desired route, use the DSP ROUTE command.

### Syntax & Use

```
DEF ROUTE R<Enter>
```

For a description of the display fields, refer to the ADD ROUTE command.

## DEF SP

### Purpose

Configure the parameters of the specified supervisory port.

### Syntax

DEF SP [CON#]

### Use

- To define the parameters of the CONTROL-DCE port (port 1), type:
 

```
DEF SP CON1<Enter>    Or    DEF SP<Enter>
```
- To define the parameters of port 2, designated CONTROL-ETH , type:
 

```
DEF SP CON2<Enter>
```

The first line of the supervisory port parameters data form is displayed.  
The data form contents depend on the port interface: serial or Ethernet.

### Command Fields for Serial Supervisory Port

A typical data form for a serial supervisory port is shown below. The form presents the current parameter values as defaults.

Baud Rate	Parity	Data Bits	Stop Bits	Auxiliary Device
9.6 KBPS	NONE	8	1	SLIP NMS
Routing Protocol				
NONE				

Change parameters as required, and then press **<Enter>** to end.

The fields appearing on the data form are explained in [Table 5-14](#).

*Table 5-14. Serial Supervisory Port Parameters*

Parameter	Function	Values
<b>Baud Rate</b>	Port data rate. The rate can be separately selected for each port	0.3, 1.2, 2.4, 4.8, 9.6, 19.2, 38.4, and 57.6 kbps
<b>Parity</b>	Controls the use of parity	<b>ODD</b> – Odd parity. <b>EVEN</b> – Even parity. <b>NONE</b> – Parity disabled
<b>Data Bits</b>	Selects the number of data bits in the word frame	7 or 8 data bits
<b>Stop Bits</b>	Selects the number of stop bits in the word frame	1, 1.5, or 2 bits

Parameter	Function	Values
<b>Auxiliary Device</b>	Selects the management mode supported by the corresponding CONTROL port	<p><b>TERMINAL</b> – The corresponding CONTROL port supports only management by means of a supervision terminal.</p> <p><b>SLIP NMS</b> – The corresponding CONTROL port supports out-of-band SNMP and/or Telnet management, using the SLIP protocol.</p> <p><b>SLIP AGENT</b> – The corresponding CONTROL port is connected to another RAD agent using the SLIP protocol.</p> <p><b>PPP NMS</b> – Same as SLIP NMS, except that the PPP protocol is used.</p> <p><b>PPP AGENT</b> – Same as SLIP AGENT, except that the PPP protocol is used.</p> <p><b>UNDEFINED</b> – The function of the corresponding CONTROL port is not yet defined</p>
<b>Routing Protocol</b>	<p>Controls the transmission of RIP2 routing tables, to enable the use of the RIP2 routing protocol for management traffic carried through the corresponding CONTROL port.</p> <p>This field is displayed only when the management mode is <b>PPP NMS</b> or <b>SLIP NMS</b>. Refer to Chapter 4 for additional details</p>	<p><b>RIP2</b> – Enables the transmission of RIP2 routing tables. This enables the routing of management traffic by means of any router which supports the RIP2 protocol.</p> <p><b>PROPRIETY RIP</b> – Use of RAD proprietary routing only.</p> <p><b>NONE</b> – No routing information is used</p>

### Command Fields for Ethernet Supervisory Port

A typical data form for a Ethernet supervisory port is shown below. The form presents the current parameter values as defaults.

<b>Routing Protocol</b>	<b>Direct LAN Connection</b>
- - - - -	- - - - -
<b>NONE</b>	<b>YES</b>

The data form includes two fields:

<b>Routing Protocol</b>	See description in <a href="#">Table 5-14</a> .
<b>Direct LAN Connection</b>	<p>Controls the operation of the Ethernet port:</p> <p><b>YES</b> The CL module uses its Ethernet port for management communication.</p> <p>This is the default selection.</p>

- NO** The external Ethernet port of the CL module is disabled. The CONTROL-DCE port can still be used for management the SLIP protocol.
- If the Megaplex module includes an ML-IP or HS-ETH/SW module that has been configured to carry management traffic, the management communication normally directed through the CL Ethernet port is directed to that module.

## DEF SPLIT TS

### Purpose

Define the assignment of individual bits in a selected timeslot. You can assign pairs of consecutive bits to different channels.

Currently, the I/O modules which can use the split timeslot feature are HS-U-6, HS-U-12, HS-S, HS-RN, HS-DP/3, HS-DP/6, VC-4A, VC-8A, VC-16A, LS-12 and LS-6N.

Split timeslot assignment increases the utilization efficiency of main link bandwidth for TDM modules or channels that do not require a full timeslot (eight bits, equivalent to 64 kbps of bandwidth), because it enables the allocation of main link bandwidth in smaller units (16 kbps). IP main link modules also support split timeslot assignment to bundles.

Split timeslot assignment can be defined for any timeslot. Before starting, make sure the desired timeslot is not yet assigned, or select a split timeslot in which some of the bits have not yet been assigned.

You can display the current assignment of timeslots and identify the timeslots with split assignment by means of the DSP TS command.

Note that split timeslot assignment can be performed only when the selected modules (both user's I/O modules and main link modules) are configured as *connected*. For guidelines regarding split timeslot assignment, refer to the *Special Considerations section* below. You may also find additional information in *Chapter 1*.

For information on the number of timeslots required by the various I/O modules, refer to the corresponding module Installation and Operation Manual.

### Syntax

```
DEF SPLIT TS SS :CC:TT
```

### Use

- To define the bit-level assignment for a specific timeslot, type the command DEF SPLIT TS and include the desired slot, channel, and timeslot number:

```
DEF SPLIT TS SS:CC:TT<Enter>
```

### Note

*To identify a timeslot connected to an ML-IP bundle, use the channel number (CC) of the ML-IP internal TDM port, for example, IN1.*

- Following the DEF SPLIT TS command, the Megaplex checks that the requested timeslot is not already assigned as a full timeslot. If it is, an error message is displayed.
- If the selected timeslot is valid, Megaplex displays the bit-level assignment data form for requested timeslot. A typical data form is shown below. The data form identifies the module type, the slot in which the module is installed, the required timeslot bit level assignment, and the current bit level assignment.

The following example shows a data form displayed in response to the command DEF SPLIT TS 1:1:7.

For your orientation, in the example given below, the configured timeslot is associated with the first port of an E1 main link module installed in slot 1; an HS-U-6 module is installed in slot 5, and an HS-S module is installed in slot 7.

```

DEF SPLIT TS 1:1:7
Module : ML-2E1
Required Split Timeslot Bits For IO-01 :
CH 01:
      IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01  - - - - - 4 - - 2 - - - - -
Channel 02  - - - - - - - - - - - - - - -
Channel 03  - - - - - - - - - - 2 - - - - -
Channel 04  - - - - - - - - - - - - - - -
Channel 05  - - - - - - - - - - - - - - -
Channel 06  - - - - - - - - - - - - - - -
Channel 07  - - - - - - - - - - - - - - -
Channel 08  - - - - - - - - - - - - - - -
Channel 09  - - - - - - - - - - - - - - -
Channel 10  - - - - - - - - - - - - - - -
Channel 11  - - - - - - - - - - - - - - -
Channel 12  - - - - - - - - - - - - - - -
Channel 13  - - - - - - - - - - - - - - -

      Bit1   Bit2   Bit3   Bit4   Bit5   Bit6   Bit7   Bit8
TS 01  05:IN01 05:IN01 05:IN01 05:IN01 07:IN01 07:IN01 07:IN03 07:IN03

```

### Note

The maximum number of channels appearing in the required timeslots section is equal to the number of channels available on the connected module with most channels, and therefore changes in accordance with the types of modules configured in the database.

If inband management using a dedicated timeslot is configured on the selected port, you will see an additional line, which reminds you that a timeslot is required for management.

For your convenience, the data form includes two sections:



- The top section defines the current bit-level assignment requirements for all the I/O slots available in the corresponding configuration. The number of required bits is automatically derived from the current configuration of the relevant modules, and is separately given for each channel which requires main link timeslot bit level assignments.

- - indicates that bit-level assignment is not required.

In the example given above, channel 1 of the module installed in slot 5 needs 32 kbps (4 bits), and each of the channels 1 and 3 of the module installed in slot 7 require 16 kbps (2 bits). Note that none of the channels which require a full timeslot appears on this data form.

- The other section is used to specify the assignment of bits in the selected timeslot. For each bit position, it either shows - - - to indicate that the timeslot bit is not connected, or lists the channel to which it is currently connected in the format **slot** -[**channel**].

#### ► To assign a bit, or to change its current assignment

1. Move the cursor to the desired position using the spacebar.
2. Press the F or B key until the desired assignment is displayed (only valid assignment requirements will be displayed: any other combinations will be skipped).
3. After the desired bit assignments are made, press **<Enter>** to end. The Megaplex display a message that reminds you that it is necessary to use the DB UPD command to activate the changed parameters, followed by the Megaplex prompt.

---

**Note** *When you press <Enter> to end, the timeslot assignment is automatically checked for validity. If errors are detected, a detailed list of errors is displayed. The list identifies omissions, double assignments and incorrect assignment, for example, when the channel requires more or less bits. If the assignment is not correct, it is not possible to update the database.*

---

## Special Considerations

When assigning the bits in a selected timeslot, observe the following:

- Always assign a group of consecutive bits to a channel.
- Bit assignment for channels which require quarter-timeslot assignment (2 bits, or 16 kbps) must start at an odd bit (1-2, 3-4, 5-6, 7-8).
- Channels which require half-timeslot assignment (4 bits, or 32 kbps) must be assigned either bits 1-4, or 5-8.
- When timeslots with split assignment are bypassed, make sure to have identical splitting assignments at all the relevant Megaplex units. Note that it is not possible to bypass individual bits: only the whole timeslot can be bypassed.

## DEF SYS

### Purpose

Define the system configuration and timing sources.

## Syntax

DEF SYS

## Use

- To define the system configuration, type:  
**DEF SYS<Enter>**
- You will see the first part of the system parameters data form. This part is used to configure the modules to be included in the Megaplex database. You can include in the Megaplex database a module that is not physically installed in the chassis: this will enable you to preprogram the module parameters so that when the module is installed, it will start immediately to operate in the desired mode.
- After making the desired selections in the first part of the system parameters data form, press **<Enter>** to continue to the second part, used to control the use of the V5.2 protocol. Since this feature is not supported in the current version, press **<Enter>** to continue to the third part, used to specify the Megaplex timing sources.
- After all the desired parameter values are selected, press **<Enter>** to end.

The three parts of the system parameters data form are explained below.

## Selection of System Configuration

A typical first part of the system parameters data form for a Megaplex-2100 chassis, as seen after all the lines have been displayed, is shown below.

SLOT:	PS-A	PS-B	CL-A	CL-B	
TYPE:	PS+FAN	PS+FAN	MCL-2ETH	MCL-2ETH	
SLOT:	IO-01	IO-02	IO-03	IO-04	IO-05
TYPE:	ML-2/E1	HS-Q	VC-8/E&M	VC-4/FXS	ML-2/E1
SLOT:	IO-06	IO-07	IO-08	IO-09	IO-10
TYPE:	VC-8/FXS	VC-6A	HS-S	LS-12	VC-8/FXS
SLOT:	IO-11	IO-12			
TYPE:	HS-U-6	HS-S			

The first part consists of several lines:

- The first line is used to define the common modules installed in the unit, that is, the PS and CL modules.
- The following lines are used to define the I/O modules.

The number of common and I/O module slots displayed on this part depends on the enclosure type (Megaplex-2100 or Megaplex-2104).

### ► To change the displayed module types

- Bring the cursor to the desired field.
- Press F or B to change the module types as required.

3. If you want to remove the currently displayed module without scrolling through the list, press I.
4. After making the desired selections in the current line, press **<Enter>** to display the next line.

### Selecting the Timing Sources

The first row of the timing source selection part contains the master and fallback clock source selection fields.

► **To use an internal or external clock source:**

1. In the **Mode** row, select RX CLOCK or INTERNAL under the **Master** and **Fallback** columns, in accordance with the prescribed timing source.
2. If INTERNAL has been selected for both the **Master** and **Fallback** columns, pressing **<Enter>** finishes the command.

However, if RX CLOCK is selected in at least one of these columns, pressing **<Enter>** displays the new row, used to select the I/O slot of the module which provides the timing reference signal:

- To use an external (station) clock source, select the I/O slot of the TDM main link module to which the station clock is connected, and then select, in the **Ch** row, the number of the external clock port (for example, EX3 for an ML-2E1 module).
- To use loopback timing, select the I/O slot of a TDM main link module connected to the link providing the timing reference, and then select, in the **Ch** row, the number of the desired external port, for example, EX1 or EX2 for an ML-2E1 module.
- To lock the timing to an external clock source supplied to a high-speed data channel or to an ISDN channel, select the I/O slot of the prescribed module, and then select, in the **Ch** row, the number of the desired module port.

A typical display, as seen after making the desired selections, is shown below.

	<b>Master</b>	<b>Fallback</b>
<b>Mode:</b>	<b>RX CLOCK</b>	<b>INTERNAL</b>
<b>Slot:</b>	<b>IO-1</b>	<b>N/A</b>
<b>Ch :</b>	<b>EX1</b>	<b>N/A</b>

3. To finish, press **<Enter>**.

► **To use the adaptive timing mode:**

**Note** *The adaptive timing mode is available only when an ML-IP module is configured in the system configuration part of the data form.*

1. Make sure that the bundle (or bundles) that will serve as timing sources have already been defined.

**Note** *If you are preparing the configuration of a new system, first use the ADD BND command to define the prescribed bundles. You can define the desired bundles*

*even without first using the DEF SYS command to define the corresponding ML-IP modules in the system.*

2. In the **Mode** row of the timing source selection part of the DEF SYS data form, select ADAPTIVE under the **Main** and/or **Fallback** columns, in accordance with the clock signal to be locked to a timeslot bundle, and then press **<Enter>**.
3. The parameter appearing in the next row depends on the clock:
  - If both **Main** and **Fallback** are set to ADAPTIVE, the next row displays BND together with the default bundle selections for both columns, which is N.C. (not connected). In this case, press F or B to scroll among the currently defined bundles until the desired bundle is displayed.  
Perform this procedure for both the **Main** and **Fallback** columns.
  - The second row will also display BND when one clock signal (either **Main** or **Fallback**) is set to ADAPTIVE, and the other is set to Internal. However, in this case, you can select a bundle only under the ADAPTIVE column.
  - If one clock signal is set to ADAPTIVE and the other is set to RX CLOCK, the next two rows are used to select the I/O slot and channel of the RX CLOCK source as explained above. The fourth row is then used to select the desired bundle.

A typical data form showing the RX CLOCK option as a fallback for adaptive timing is shown below.

	<b>Master</b>	<b>Fallback</b>
<b>MODE</b>	<b>ADAPTIVE</b>	<b>RX CLOCK</b>
<b>Slot</b>	<b>N/A</b>	<b>I/O-5</b>
<b>Ch</b>	<b>N/A</b>	<b>EX2</b>
<b>BND:</b>	<b>003</b>	<b>N.C.</b>

4. To finish, press **<Enter>**.

## DEF TERM

### Purpose

Define the control sequences to be sent to the supervision terminal to perform the following terminal control functions:

- Clear screen.
- Move cursor to screen home position.
- Move cursor to the right by one position.

This command enables you to specify a terminal type, and the Megaplex will automatically configure itself for using the corresponding control sequences.

The terminal types supported by this command are: generic ANSI, VT-52, VT-100, TV-920, FREEDOM-100, FREEDOM-110, FREEDOM-220, or a terminal which is compatible with one of the terminals listed above. However, you can also enter manually the required sequences.

The codes used by the supported terminals are listed in [Table 5-15](#).

Table 5-15. Terminal Control Sequences

Function	Terminal Type					
	TV- 920	VT-52	VT-100	Freedom-100 Freedom-110	Freedom-220	ANSI
Clear Screen	1B2A0000	N/A	1B5B324A	1B2A0000	1B5B324A	1B5B324A
Cursor Home	1E000000	1B480000	1B5B4800	1E000000	1B5B4800	1B5B3B66
Cursor Right	0C000000	1B430000	1B5B3143	0C000000	1B5B0143	1B5B3143

## Syntax

```
DEF TERM ['terminal']
```

## Use

- To configure the Megaplex for using the control sequences corresponding to a supported terminal, type:

```
DEF TERM 'terminal'<Enter>
```

where 'terminal' stands for one of the types listed in the table above. You will see the new control sequences, in the format shown below:

```
New Control Sequences:
CLEAR SCREEN    = hhhhhhhh
CURSOR HOME     = hhhhhhhh
CURSOR RIGHT    = hhhhhhhh
```

where h indicates hexadecimal digits.

- To configure the Megaplex for using different control sequences, type:

```
DEF TERM<Enter>
```

- The terminal control sequences data form is displayed. The top section lists the current control sequences, and is followed by a section which provides entry fields for each sequence. The entry section is displayed line by line by pressing <Enter>. A typical screen, as seen after filling all the lines, is shown below:

```
Current Control Sequences:
CLEAR SCREEN    = hhhhhhhh
CURSOR HOME     = hhhhhhhh
CURSOR RIGHT    = hhhhhhhh
Enter New Control Sequences:
CLEAR SCREEN    = hhhhhhhh
CURSOR HOME     = hhhhhhhh
CURSOR RIGHT    = hhhhhhhh
```

where h indicates hexadecimal digits.

- Enter the control sequence. After the desired values are selected, press <Enter> to end.

Note that if the selected control sequences are not correct, the cursor position will be incorrect. To recover from this situation, type the DEF TERM command again, and then correct as necessary.

## DEF TERMINAL ACCESS

### Purpose

Disable or enable terminal access.

### Syntax

DEF TERMINAL ACCESS

### Use

1. Type:

**DEF TERMINAL ACCESS<Enter>**

```

>DEF TERMINAL ACCESS

Terminal Access
-----
ENABLE
```

2. Use <B> or <F> key to disable or enable the terminal access.

## DEF TEST

### Purpose

Control the test and diagnostic functions that can be performed on a selected Megaplex module and/or module channel.

Megaplex equipment supports test and diagnostic functions at two basic levels:

- System level. At the system level, the user can use the test subsystem of a main link module to check internal signal paths. These checks can include:
  - Local and remote loopbacks on user-selected internal and external ports and channels
  - BER tests toward the local and/or remote sides
  - Tone injection toward local and/or remote voice channels
  - When ML-IP modules are programmed: loopbacks on timeslot bundles.

Refer to [Chapter 6](#) for a description of the Megaplex test and diagnostic functions.

- I/O module level. Each Megaplex module has integral test and diagnostic functions, which enable checking its proper operation. These functions are described in the module Installation and Operation Manual.

Because of the many test and diagnostic options, the functions that can be performed by the DEF TEST command depend on the type of target module. This section explains both the general form of this command, and the particular command forms.

## Syntax

```
DEF TEST {[BND:B] [SS] [SS:CC]}
```

## Use

1. To display the control screen for the tests available on a module installed in the desired slot, type:

```
DEF TEST SS<Enter>
```

2. To display the control screen for the tests available on a desired module channel or internal port, type:

```
DEF TEST SS CC<Enter>
```

3. To display the control screen for the tests available on a desired timeslot bundle (available only when an ML-IP module is programmed in the Megaplex), type:

```
DEF TEST BND B<Enter>
```

4. You will see the corresponding test control screen.

## General Command Form – Regular I/O Modules

A typical test control screen for regular I/O modules is shown below.

Slot	Module	Channel	Test	Time-Out
IO-2	ML-2/E1	EX1	NONE	INFINITE

The screen includes the following fields:

- The first three fields (**Slot**, **Module**, **Channel**) identify the slot, module type, and module channel. The channel can be an internal port (e.g., the module interface to the TDM bus), or an external port (e.g., user channel).
- A **Test** field that displays the test function to be performed: NONE for normal operation, or one of the loopbacks or tests available for the selected module or module channel, e.g., BERT, tone injection, local loopback, remote loopback, etc.
- An additional column, **Time-Out**, provides you with the option to limit the duration of the selected test function:
  - INFINITE – the loopback or test continues until it is disabled by a specific command (either by entering again the DEF TEST command and selecting NONE, or with the CLR TEST command).
  - Predetermined test duration: the test duration can be selected in the range of 1 to 30 minutes. After the specified interval expires, the loopback or test is automatically deactivated, without operator intervention. However, you can always deactivate a test loopback activated on the local Megaplex before this time-out expires using either of the methods listed above.
- Change to the required state of the loopback or test, and then press **<Enter>**.

## Command Form for Main Link Modules

A typical test control screen for a main link module is shown below.

Slot	Module	Channel	Test	Time-Out				
IO-5	ML-2E1	02	LOOP/BERT PER TIMESLOT	INFINITE				
Bert Pattern		Inject Error Rate	Bert Run/Stop					
QRSS (0.151)		SINGLE	STOP					
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06			
- - -	3:1	4:2	5:6	5:6	- - -			
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12			
--- --	--- --	--- --	--- --	--- --	--- --			
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18			
--- --	--- --	--- --	--- --	--- --	--- --			
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24			
--- --	--- --	--- --	--- --	--- --	--- --			
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30			
--- --	--- --	--- --	--- --	--- --	--- --			
TS 31								
--- --					---			
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06			
NO	LOCAL	REMOTE	SPLIT	NO	NO			
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12			
NO	NO	NO	NO	NO	NO			
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18			
NO	NO	NO	NO	NO	NO			
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24			
NO	NO	NO	NO	NO	NO			
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30			
NO	NO	NO	NO	NO	NO			
TS 31								
NO					---			
	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7	Bit8
TS4	L. Bert	L. Bert	No	No	No	No	L. Bert	L. Bert

The first line of the test control screen is similar to the general command data form described above. The only difference is the list of tests that can be selected in the **Test** column includes additional options, related to the use of the test subsystem located on the selected main link module. The list depends on the type of main link module, however in general the following types of tests are available:

- Local loopback on the selected channel
- Remote loopback on the selected channel
- Local BER test on the selected channel
- Remote BER test on the selected channel
- BER tests and loopbacks on individual timeslots of the selected channel. For a split timeslot, it is also possible to perform local and remote BER tests on selected bits within the timeslot.



---

**Note** For ML-1E1/ML-2E1 and MLF-1E1/MLF-2E1 ports configured to use an R2 signaling profile, the user has an additional test option, **BLOCK**. This option enables to simulate the R2 block condition for the channels routed through the tested main link port. Enabling the **BLOCK** option does not cause the **TEST** indicators to turn on.

---

When you select, NONE, LOCAL LOOP or REMOTE LOOP in the **Test** column, pressing **<Enter>** after the **Time-Out** field ends the command.

However, when any of the BERT options is selected, the second line is displayed, to enable selecting the BER test characteristics. The fields appearing in the BER test control line are as follows:

<b>BERT Pattern</b>	<ul style="list-style-type: none"> <li>• QRSS test sequence per ITU-T Rec. O.151</li> <li>• Pseudo-random sequences per ITU-T Rec. O.151: 215-1, 220-1, 223-1</li> <li>• 2047-bit long pseudo-random sequence per ITU-T Rec. O.152/3</li> <li>• 511-bit long pseudo-random sequence per ITU-T Rec. O.153</li> <li>• 63-bit long pseudo-random sequence</li> <li>• Repetitive patterns of one mark ("1") followed by seven spaces ("0") (1M-7S); one space followed by seven marks (1S-7M); alternating marks and spaces (ALT); continuous mark (MARK), or continuous space (SPACE).</li> </ul>
<b>Inject Error Rate</b>	<p>Used to control the injection of errors in the transmitted sequence. The injected errors should be reflected in the BER test results.</p> <p>You can inject a single error, or inject errors at a calibrated rate: <math>10^{-1}</math>, <math>10^{-2}</math>, <math>10^{-3}</math>, <math>10^{-4}</math>, <math>10^{-5}</math>, <math>10^{-6}</math> or <math>10^{-7}</math>.</p> <p>When errors are injected, errors accumulate in proportion to the BER test duration. For example, when testing a channel assigned 15 timeslots (960 kbps), and using an error injection rate of <math>10^{-6}</math>, errors accumulate at a rate of approx. 1 per second of testing time. Errors in excess of this rate are due to actual transmission errors.</p>
<b>BERT Run/Stop</b>	<p>You can use this field to start and stop the on-going BER test, without resetting the BER counters.</p> <p>Use the F or B keys to change between RUN and STOP. The command is executed when you press <b>&lt;Enter&gt;</b> to end the command entry.</p>

---

**Note** Since the main link modules can perform only one BER test at a time, if you have already activated a BER test on this module, the next time you scroll through the options appearing in the **Test** column you will not see the **LOCAL BERT**, **REMOTE BERT** and **LOOP/BERT PER TIMESLOT** options.

---

To perform tests on individual timeslots of the selected channel or internal port, select the LOOP/BERT PER TIMESLOT option.

In this case, when you press <Enter> after the **BERT Run/Stop** field, the timeslot map of the selected channel or internal port is displayed, line by line. For each timeslot, you can scroll, using the F and B key, among the following options:

- - - -	No test.
<b>LOCAL LOOP</b>	Local loopback on the selected timeslot.
<b>REMOTE LOOP</b>	Remote loopback on the selected timeslot.
<b>LOCAL BERT</b>	BER test toward the local side in the selected timeslot. You can select this option for only one timeslot.
<b>REMOTE BERT</b>	BER test toward the remote side in the selected timeslot. You can select this option for only one timeslot.
<b>LOCAL TONE INJ</b>	Injection of digital test tone toward the local side in the selected timeslot. You can select this option for only one timeslot.
<b>REMOTE TONE INJ</b>	Injection of digital test tone toward the remote side in the selected timeslot. You can select this option for only one timeslot.
<b>SPLIT</b>	Enables activation of tests on individual bits in the corresponding timeslot. You can select this option for only one timeslot.

- 
- Notes**
1. Only one BER test can be active within the module. Therefore, if you have already activated a BER test on this module, the next time you scroll through the options appearing for any timeslot, you will not see the LOCAL BERT and REMOTE BERT options for any timeslot.
  2. Tone injection can also be activated on only one timeslot within the module. Therefore, if you have already activated tone injection on one timeslot, the LOCAL TONE INJ and REMOTE TONE INJ will no longer appear.
  3. To expedite the activation of a test or loopback on a group of timeslots which form a service bundle, it is sufficient to activate it on the timeslot with the highest number (the last timeslot of that bundle): the CL module then automatically activates the loopback on all the other timeslots in the same group (bundle). Similarly, when the user chooses not to use the command that clears all the tests and loopbacks on the corresponding port, the deactivation can also be initiated by changing the state of the last timeslot in that service bundle.
  4. When the test or loopback is activated on timeslots of a bundle which is part of a bundle redundancy pair, the CL module automatically activates the loopback on the same timeslots of the other bundle of the pair. This convenience feature is also available for loopback deactivation: the deactivation command can be issued to either one of the bundles of the

*redundancy pair (even if it has been activated by a command to the other bundle).*

If you selected SPLIT for one of the timeslots, then after pressing **<Enter>** for the last timeslot available on the selected channel or port (timeslot 31 for ML-IP and E1 ports, timeslot 24 for T1 ports) you will see the bit map of the corresponding timeslot. The default value for each bit is NO. If no BER test is currently active within the module, you can select L. BERT (local BERT) or R. BERT (remote BERT) by pressing the F or B key.

Pay attention to the following points:

- You can select only one type of test within the timeslot.
- Make sure to select pairs of consecutive bits, for example: 1-2, 3-4, 5-6, 7-8.

Pressing **<Enter>** after this line ends the command and executes the selections.

### Command Form for Timeslot Bundles

When an ML-IP module is installed in the Megaplex, you can also activate local loopbacks on timeslot bundles.

A typical test control screen for a timeslot bundle, displayed in response to the DEF TEST BND 1 command, is shown below.

Bundle	Test
- - - -	- - - - -
BND1	LOCAL LOOP

The control screen displays the designation of the selected bundle in the **Bundle** column.

Use the F or B keys to display the desired test designation in the **Test** column:

- To activate the local loopback, select LOCAL LOOP.
- To deactivate the local loopback, select NONE.

**Note** *If the specified bundle is part of a redundancy pair, the same action is automatically performed on the other bundle of the pair.*

## DEF TS

### Purpose

Define the assignment of timeslots for a selected channel or port. The command can be used to assign timeslots on any module that has internal or external ports with E1 or T1 interface, for example, for main link modules. When an ML-IP module is programmed in the chassis, this command is also used for timeslot bundles.

The DEF TS command is used for payload routing within the Megaplex. The general approach to payload routing is described in the [Internal Routing Parameters](#) section of the DEF CH command.

As explained in the [Internal Routing Parameters](#) section, the DEF TS (or DEF SPLIT TS) command is always used to assign timeslots, the only exception being channels configured to operate in the unidirectional or bidirectional broadcast

receive mode: in these modes, supported by some of the Megaplex I/O modules, several channels can be connected to the same main link timeslot. Therefore, it is necessary to use the DEF CH command to select the main link timeslots from which the channel receives its payload.

---

**Note**

*For a detailed description of the various modes, refer to Section 2.3.*

---

There are two basic types of timeslot assignment operations:

- Connection of an I/O channel to the port specified by the user. You can route any I/O channel to any timeslot of any legacy main link internal or external port installed in the chassis.

When ML-IP modules are programmed in the Megaplex chassis, you can also connect to a timeslot bundle.

- Bypassing of timeslots between main link ports. You can route any main link timeslot to any desired timeslot of another main link (free bypassing).

When ML-IP modules are programmed in the Megaplex chassis, you can also bypass timeslots between bundles.

When using channel-associated signaling, the signaling information associated with each channel is routed in parallel with the channel data.

In addition to the regular (duplex) bidirectional mode, the timeslot assignment function supports the unidirectional and bidirectional broadcast modes:

- The unidirectional broadcast modes can be used with all the I/O modules.
- The bidirectional broadcast modes can be used with the following I/O modules: VC-6 (E&M, FXS only), VC-6A (E&M, FXS only), HS-RN, HS-2, HS-Q/N, LS-12, LS-6N, HS-12N, HS-6N.

The main link modules also support split (bit-level) timeslot assignment: this assignment is performed by means of the DEF SPLIT TS command. For your convenience, the DEF TS command enables you to find the timeslots for which split timeslot assignment has been performed, and identify the module channels which require such assignment. Moreover, you can also reserve timeslots for split timeslot assignments.

For information on the number timeslots required by the various modules, refer to the module Installation and Operation Manuals.

Timeslot assignment can be performed only when the selected modules (both user's I/O modules and main link modules) are configured as **connected**. For special considerations regarding timeslot assignment, refer to the *Special Considerations Regarding Timeslot Assignment* section below. You may also find additional information in *Chapter 1*.

---

**Note** *When using redundancy, you can avoid the need to configure twice the same timeslot assignment for the two ports by first configuring the two ports as a redundant pair. In this case, when you complete timeslot assignment on one port and press <Enter> to end the DEF TS command, the timeslot assignment is automatically copied to the other port in the redundant pair.*

*This procedure does not work in the reverse direction: if you first perform timeslot assignment on a port, and then define the redundancy relationship, you have to repeat the timeslot assignment for the redundant port.*

---

## Syntax

DEF TS SS CC

## Use

1. To define the timeslot assignment on a specific main link, type DEF TS, followed by the number of the slot in which the main link module connected to that bus is installed and the number of the desired port:

**DEF TS SS CC<Enter>**

To define the timeslot assignment for any other module with E1 or T1 interface, type the command DEF TS with the number of the slot in which the desired module is installed.

To define the timeslot assignment for an ML-IP bundle, enter the number of the internal TDM port on which the bundle is defined.

After the DEF TS command, the Megaplex performs a partial sanity check that does not include the checking of the current timeslot assignment. This sanity check ensures that the existing configuration is correct, before starting the assignment of the timeslots. If errors are detected, you are prompted to correct them.

Once the partial sanity check finished, Megaplex displays the requested timeslot assignment data form. The fields appearing in the data form depend on the module type: TDM or IP.

## Timeslot Assignment Data Form for TDM Module

A typical data form for a TDM module is shown below. The data form identifies the module type, and the slot in which the module is installed.

```

Module : ML-2E1
Required Timeslots For IO-01:
CH-01:
      IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01  - - - - - - - - SP - - - - - - - -
Channel 02  - - - - B1 - - - - 01 - - 03 - - - - 01
Channel 03  - - - - - - - - 01 - - - - - - - - 02
Channel 04  - - - - - - - - 01 - - - - - - - - 05
Channel 05  - - - - - - - - 01 - - - - - - - - - -
Channel 06  - - - - - - - - - - - - - - - - - - - -
Channel 07  - - - - - 01 01 - - - - - - - - - - - -
Channel 08  - - - - - 01 - - - - - - - - - - - - - -
Channel 09  - - - - - 01 - - - - - - - - - - - - - -
Channel 10  - - - - - 01 - - - - - - - - - - - - - -
Channel 11  - - - - - - - - - - - - - - - - - - - -
Channel 12  - - - - - - - - - - - - - - 2 - - - - -
Channel 13  - - - - - - - - - - - - - - - - - - - -
      * Additional timeslot is required for management.
TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
03:02      04:07      04:08      04:09      04:10      - - -
UNI BRD D  DATA      DATA      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
05:05      05:07      06:IN02   06:IN03   06:IN04   08:02
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
08:02      08:02      12:02      12:03      12:03      12:04
DATA      DATA      DATA      DATA      MNG       DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
12:04      12:04      12:04      12:04      Split     - - -
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
- - -      - - -      - - -      - - -      - - -      - - -
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
- - -
DATA

```

For your orientation, in the example given above:

- An E1 main link module is installed in slot 1, and the data form is used to assign timeslots on port 1 of that module
- HS-Q/N modules are installed in slots 3 and 8 (note that channel 2 of the HS-Q/N module installed in slot 3 is configured for the unidirectional broadcast mode)
- VC-6 modules are installed in slots 4, 5
- A HS-U-6/1 module is installed in slot 6 (with channel 1 requiring split timeslot assignment)
- A HS-Q/N module is installed in slot 12.

For you convenience, the data form includes two sections:

- The top section defines the current timeslot requirements for all the I/O slots available in the corresponding configuration. The number of required timeslots is automatically derived from the current configuration of the relevant modules.

The symbols appearing in this section are as follows:

- B1** indicates a channel using unidirectional or bidirectional routing.
- BP** indicates that bypassing may be used.
- SP** indicates a module channel that requires split timeslot assignment.
- -** indicates that no timeslot is required.

- The other section is used to specify timeslot assignment and the timeslot type. The information presented for each timeslot of the selected module is as follows:

- - - -** Indicates that the timeslot is not connected.
- SPLIT** Indicates split timeslot assignment (refer to the DEF SPLIT TS command for details).
- [Slot]:[Channel]** The timeslot is assigned to the listed I/O module channel.
- [Slot]:[Timeslot]** The timeslot is routed (bypassed) to the listed timeslot of another E1 or T1 port.

---

**Note** *The maximum number of channels appearing in the required timeslots section is equal to the number of channels available on the connected module with the greatest number of channels, and therefore changes in accordance with the types of modules configured in the database. If inband management using a dedicated timeslot is configured on the selected port, you will see an additional line, which reminds you that a timeslot is required for management.*

---

- The lower part is displayed line by line:
  - To assign a timeslot, or to change its current assignment, move the cursor to the desired position using the spacebar, and then press the **F** or **B** key until the desired assignment is displayed (only valid assignment requirements will be displayed: any other combinations will be skipped).
  - To reserve a timeslot for split timeslot assignment, press the **F** or **B** key until **SPLIT** is displayed.
  - To remove the current assignment, press **I**.
  - To move the cursor directly to the next available port, press **J**.
- 2. After the timeslots in the first line are properly assigned, press **<Enter>** to continue to the next line, used to select the timeslot type:

- DATA** Data timeslot. This is the default timeslot type.
- VOICE** Voice timeslot.
- MNG** Timeslot dedicated to inband management. If the corresponding main link module port is configured for inband management, you must select one timeslot as management timeslot. Note that only one timeslot of any main link port can be defined as management timeslot.
- UNI BRD D** Unidirectional broadcast timeslot carrying data.
- UNI BRD V** Unidirectional broadcast timeslot carrying voice.

- |                  |  |
|------------------|--|
| <b>BID BRD D</b> | Bidirectional broadcast timeslot carrying data.  |
| <b>BID BRD V</b> | Bidirectional broadcast timeslot carrying voice.   |
| <b>D-CH</b>      | Timeslot carrying bypassed D-channel information (use only for the special option of ISDN port <b>connected to V5.1 link or V5.2</b> interface, not relevant for the current version). |
3. After selecting the types for the timeslots in the first line, press **<Enter>** to display the next timeslot line. Repeat the assignment procedure described in *Steps 1, 2* above for the remaining timeslots. The total number of timeslots is 24 for T1 interfaces, and 31 for E1 interfaces.
  4. After the desired timeslot assignments are made, press **<Enter>** to end. Megaplex reminds you that it is necessary to use the DB UPD command to activate the changed parameters, followed by the Megaplex prompt.

---

**Note** *When you press **<Enter>** to end, the timeslot assignment is automatically checked for validity. If errors are detected, a detailed list of errors is displayed. The list identifies omissions, double assignments and incorrect assignment, for example, channels which require more timeslots. If the assignment is not correct, it is not possible to update the database.*

---

### Timeslot Assignment Data Form for IP Module

The bundles serve as virtual internal ports, to which one or more I/O channels are routed for transmission to the network through the ML-IP module. The only difference is that bundles are defined on the internal TDM ports of the module, and therefore timeslots are routed to a bundle through the mediation of the internal port.

The following data form shows the response to a DEF TS command issued to internal port IN1 of the ML-IP module installed in I/O slot 2.

The Megaplex chassis covered by this example includes the following modules:

- Two ML-IP modules installed in I/O slots 1 and 2
- One VC-16 module installed in I/O slot 10.

The upper section of the data form shows the following timeslot routing requirements:

- Two channels (1 and 2) are bypassed between the two ML-IP modules
- Three voice channels (1, 2, and 3) of the VC-16 are to be routed to the ML-IP module in I/O slot 1.

The lower section of the data form shows the timeslot routing made in response to these requirements. For each of the 31 timeslots available on the ML-IP internal port, the data form includes the following 4 subfields (listed from top to bottom):

- Timeslot number, in the range of TS01 through TS31.
- The I/O module and channel to be connected to the corresponding bundle timeslot, in the format SS CC, where SS is the module slot number, and CC is the desired external port number.



By scrolling with the F or B keys, you can display any of the desired channels appearing in the upper section of the data form that are waiting for assignment.

**Note** *When a port requires several timeslots, all its timeslots must be connected to the same bundle (for example, the two timeslots data channel operating at 128 kbps must be connected to the same bundle).*

- The destination bundle, in the format BND:B, where B is the bundle number. You can scroll only among the bundles currently defined on this port.
- The timeslot type, in accordance with the standard types explained above.

```

Module : ML-IP
Required Timeslots For IO-02:
CH-01:
      IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01    BP BP - - - - - - - - - - 01 - - - -
Channel 02    BP BP - - - - - - - - - - 01 - - - -
Channel 03    - - - - - - - - - - - - 01 - - - -
Channel 04    - - - - - - - - - - - - - - - - - -
Channel 05    - - - - - - - - - - - - - - - - - -
Channel 06    - - - - - - - - - - - - - - - - - -
Channel 07    - - - - - - - - - - - - - - - - - -
Channel 08    - - - - - - - - - - - - - - - - - -
Channel 09    - - - - - - - - - - - - - - - - - -
Channel 10    - - - - - - - - - - - - - - - - - -
Channel 11    - - - - - - - - - - - - - - - - - -
Channel 12    - - - - - - - - - - - - - - - - - -
Channel 13    - - - - - - - - - - - - - - - - - -
Channel 14    - - - - - - - - - - - - - - - - - -
Channel 15    - - - - - - - - - - - - - - - - - -
Channel 16    - - - - - - - - - - - - - - - - - -

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
10:01      10:02      10:03      -----      -----      -----
BND:003    BND:003    BND:003    -----      -----      -----
VOICE      VOICE      VOICE      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
-----      -----      -----      -----      -----      -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----      -----      -----      -----      -----      -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----      -----      -----      -----      -----      -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----      -----      -----      -----      -----      -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
-----
DATA
    
```

Note that timeslot 16 cannot be assigned when the internal TDM port is configured to support CAS signaling.

## Special Considerations Regarding Timeslot Assignment

The connection between I/O modules and main link modules (both TDM and IP modules) is performed by means of TDM buses. Therefore, the timeslot assignment actually assigns timeslots on the TDM buses. The main link module then places the timeslots in the frame type selected by the user, for transmission over the selected port. The total number of user timeslots that can be assigned to the user's I/O modules is determined by the frame type:

- For TDM modules with E1 interfaces or internal ports, the total number is maximum 31 for basic G.704 (G.732N) frames, and maximum 30 for G.704 multiframe (G.732S) frames.
- For IP modules, the total number of timeslots for each internal TDM port is 31 when CAS support is disabled, and 30 when CAS support is enabled.
- For TDM modules with T1 interfaces or internal ports, the total number is maximum 24.

Since the timeslot assignment is actually performed for the TDM buses, user timeslots may be routed only to a main link module which is already configured as *connected* to a TDM bus.

The timeslot assignment for a given module is valid only when the total number of timeslots that has been assigned is equal to the number of timeslots required to carry the module payload.

Additional rules apply when preparing the timeslot assignment for bypassing:

- Timeslots to be bypassed must be routed between main link module ports, or between ML-IP timeslot bundles.
- When channel-associated signaling information must be bypassed between TDM module ports, it is necessary to configure as follows:
  - The framing mode of both main link module ports must be G.704 multiframe (G.732S) with or without CRC-4.
  - Timeslot 16 of one main link module port must be routed to timeslot 16 of the other port.

## Additional Timeslot Assignment Rules for Bundles

- A bundle can include timeslots from only one internal TDM port.
- The maximum number of timeslots per bundle is 31. However, as listed above, the maximum number of timeslots decreases to 30 when CAS support is enabled on the corresponding internal port, because in this case timeslot 16 is reserved and cannot be assigned.
- For convenience, when two bundles are defined as a redundancy pair, you need assign timeslots only to one of these two bundles: the assignment is automatically copied to the other bundle of the redundancy pair.

## Configuration Guidelines for Unidirectional and Broadcast Modes

When configuring the routing of timeslots assigned to channels operating in the unidirectional and bidirectional broadcast modes, it is necessary to configure the timeslot parameters at two ends:

- At the channel end: this is performed using the DEF CH command
- At the main link port end: this is performed using the DEF TS command.

### Timeslot Selection Method

The selection of timeslots must be made in accordance with the transmission direction of the timeslot:

- Several channels configured for unidirectional receive, or broadcast receive, can be connected to the same main link or bundle timeslot. Therefore, for each channel you must use the DEF CH command to select the main link or bundle timeslots from which the channel receives its payload.

To prevent conflicts in timeslot assignments, any main link or bundle timeslot to which the timeslot selection is made at the channel level must be left unconnected in the timeslot map of the main link port, displayed by means of the DEF TS command. Nevertheless, you must define the correct type for the corresponding timeslot: UNI BRD D or BID BRD D for data channels, or UNI BRD V or BID BRD V for voice channels.

- Several main link ports can be connected to a channel configured for unidirectional transmit. Therefore, for each main link port you must use the DEF TS command to select the timeslots that will transmit the channel payload.

### Number of Timeslots Needed

The number of timeslots needed by a channel depends on its data rate. However, when using the broadcast mode, even if the channel split timeslot assignment, you must allocate it a full timeslot.

To help you determine the number of timeslots needed by a channel operating in the UNI-BRD TX mode, a special identifier, B1, appears in the requirements timeslot map of the main link port.

For timeslot assignments made at the channel level, pay attention to the following points when completing the timeslot assignment at the main link port level:

- Always make sure to select the number of main link port timeslots that matches the channel data rate (e.g., for a channel operating at 128 kbps, you must select two timeslots).
- When using the **USER** mapping mode, you can select any free timeslot.
- When using the **SEQUENCE** mapping mode, consecutive main link timeslots must be selected, starting with the timeslot selected by means of the START TS parameter of the channel.

## DEL AI

## Purpose

Cancel the inversion of an alarm. You can use the DSP AI command to view the currently inverted alarms.

## Syntax

```
DEL AI A[:SS[:CC]]
```

## Use

- To cancel the inversion of an alarm only with respect to a specific module port, type:

```
DEL AI A SS CC<Enter>
```

where A is the alarm number.

To cancel the inversion of an alarm with respect to all the ports of a specific module port, type:

```
DEL AI A SS *<Enter>
```

- To cancel the inversion of an alarm with respect to a specific slot, type:

```
DEL AI A SS<Enter>
```

- To cancel the inversion of an alarm with respect to all the slots, type:

```
DEL AI A *<Enter>
```

- To cancel the inversion of an alarm with respect to the Megaplex system, type:

```
DEL AI A<Enter>
```

## DEL AM

### Purpose

Cancel the temporary masking of an alarm. To cancel permanent masks, use the DEL PERMANENT AM command.

You can use the DSP AM command to view the currently masked alarms.

### Syntax

```
DEL AM A[:SS[:CC]]
```

### Use

- To cancel the masking of an alarm only with respect to a specific module port, type:

```
DEL AM A SS CC<Enter>
```

where A is the alarm number.

- To cancel the masking of an alarm with respect to all the ports of a specific module, type:

```
DEL AM A SS *<Enter>
```

- To cancel the masking of an alarm with respect to a specific slot, type:  
`DEL AM A SS<Enter>`
- To cancel the masking of an alarm with respect to all the slots, type:  
`DEL AM A *<Enter>`
- To cancel the masking of an alarm with respect to the Megaplex system, type:  
`DEL AM A<Enter>`

## DEL AT

### Purpose

Delete the threshold values defined for a selected type of event alarm. You can use the DSP AT command to view the alarms for which threshold values have been defined.

### Syntax

DEL AT A

### Use

To delete the threshold values defined for an alarm, type:

```
DEL AT A<Enter>
```

where A is the alarm number.

## DEL BND

### Purpose

Delete an existing bundle. You can use the DSP BND command to view the parameters of the bundle before it is deleted.

### Syntax

DEL BND B

### Use

To delete a bundle, type:

```
DEL BND B<Enter>
```

where B is the number of the desired bundle.

## DEL DB

### Purpose

Erase a selected database from the non-volatile memory of the Megaplex. You can only erase an existing database which is not used in any of the flip database entries. To check, use the DSP DB LIST command to display the list of existing databases, and then compare the list with the databases specified by the flip database entries (displayed by means of the DSP FLIP ENTRY command).

In addition, you must not erase the default database (use the DSP DEFAULT DB command to see the database currently selected as the default).

### Syntax & Use

```
DEL DB D<Enter>
```

where D is the desired database number (1 through 10).

## DEL FLIP ENTRY

### Purpose

Delete a selected entry from the flip database. To check the current entries, use the DSP FLIP ENTRY command. After deleting an entry from the flip database, use the FLIP UPD command to update.

### Syntax

```
DEL FLIP ENTRY E
```

### Use

- To delete an entry from the flip database, type:

```
DEL FLIP ENTRY E<Enter>
```

where E is the desired entry, in the range of 1 through 10.

You will see the entry contents, followed by a request for confirmation. A typical display is shown below:

Entry No	Logical Expression	DB No	Discard Eligible
03	1	01	N/A

- To cancel the request, type N. To confirm, type Y.

## DEL FLIP EVENT

### Purpose

Delete a selected event from the flip database. To check the current events, use the DSP FLIP EVENT command.

After deleting an event from the flip database, use the FLIP UPD command to update.

### Syntax

DEL FLIP EVENT V

### Use

- To delete an event from the flip database, type:

```
DEL FLIP EVENT V<Enter>
```

where V is the desired event, in the range of 1 through 10.

You will see the event data form, followed by a request for confirmation. A typical display is shown below:

No	Event Type	Bit No	Day Agenda	Start Time	End Time
01	TIME	001	FULL	06:00:00	20:00:00
Delete (Y/N)?					

- To cancel the request, type N. To confirm, type Y.

## DEL MANAGER LIST

### Purpose

Delete an existing network management station.

### Syntax

DEL MANAGER LIST

### Use

- To delete an existing management station, type:
 

```
DEL MANAGER LIST<Enter>
```
- You will see the data form of the first management station. To select another station, scroll within the list by pressing F or B when the cursor is in the **No.** column.
- When the desired management station is displayed, press **<Enter>** to delete it.

## DEL NET ENTRY

### Purpose

Delete an existing net entry (refer to the ADD NET ENTRY command for details). You can use the DSP NET ENTRY command to see the existing net entries.

### Syntax

DEL NET ENTRY N

### Use

- To delete an existing net entry, type:

```
DEL NET ENTRY N<Enter>
```

where N is the net entry number, in the range of 1 through 10.

You will see the entry contents, followed by a request for confirmation. A typical display is shown below:

ENTRY NO	NET IP	NET MASK
02	190.205.000.000	255.255.000.000
DELETE (Y/N)?		

- To cancel the request, type N. To confirm, type Y.

## DEL PERMANENT AM

### Purpose

Cancel the permanent masking of an alarm. This command also erases the definition of the mask from the configuration database.

You can use the DSP AM command to view the currently masked alarms.

To cancel temporary masks, use the DEL AM command.

### Syntax

DEL PERMANENT AM A[:SS[:CC]]

### Use

- To cancel the permanent masking of an alarm only with respect to a specific module port, type:

```
DEL PERMANENT AM A:SS:CC<Enter>
```

where A is the alarm number.

- To cancel the permanent masking of an alarm only with respect to all the ports of a specific module, type:

```
DEL PERMANENT AM A:SS:*<Enter>
```

- To cancel the permanent masking of an alarm to a specific slot, type:



**DEL PERMANENT AM A:SS<Enter>**

- To cancel the permanent masking of an alarm to all the slots, type:

**DEL PERMANENT AM A:\*<Enter>**

- To cancel the permanent masking of an alarm with respect to the whole Megaplex system, type:

**DEL PERMANENT AM A<Enter>**

## DEL RIP2 AGENT

### Purpose

Delete a selected entry from the RIP2 agents table.

### Syntax

DEL RIP2 AGENT

### Use

- To delete an entry, type:

**DEL RIP2 AGENT <Enter>**

You will see the first entry in the RIP2 agents table. A typical display is shown below:

No	IP Address
--	-----
01	192.188.000.001

- To confirm the deletion of the first entry, press **<Enter>**.

To delete a different entry, press the F and B keys until the desired entry is displayed, and then press **<Enter>**.

## DEL ROUTE

### Purpose

Delete a static entry from the routing table sent to ML-IP and HS-ETH/SW modules.

You can view the parameters of the route to be deleted by means of the DSP ROUTE command.

### Syntax

DEL ROUTE R

### Use

To delete a route, type:

**DEL ROUTE R<Enter>**

where R is the index number of the route within the IP routing table.

## DSP AF

### Purpose

Display the current filtering values for a selected type of state alarm.

### Syntax

DSP AF A

### Use

- To display the filtering parameters, type:

**DSP AF A<Enter>**

where A is the event alarm number.

You will see the filtering parameters screen. A typical screen is shown below:

ALARM: 001			
SET VALUE	RESET VALUE	SLOT	CHANNEL
- - - - -	- - - - -	- - -	- - - - -
50	20	IO-1	IN1

Refer to the DEF AF command above for an explanation of the information displayed on this screen.

## DSP AGENDA

### Purpose

Display the classification of week days from the edited database.

To display the classification in the current (active) database, use the DSP ST AGENDA command.

### Syntax

DSP AGENDA

### Use

- Type:

**DSP AGENDA<Enter>**

You will see the classification of week days from the edited database. A typical data form is shown below.

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
-----	-----	-----	-----	-----	-----	-----
FULL	FULL	FULL	FULL	PARTIAL	PARTIAL	WEEKEND

## DSP AGENT

### Purpose

Display the SNMP agent parameters.

### Syntax

DSP AGENT

### Use

- To display the Megaplex SNMP parameters, type:

```
DSP AGENT<Enter>
```

You will see the SNMP agent data form. A typical form is shown below:

```
The Mux Name: Megaplex
The IP Address: 192.112.11.24
The Sub Net Mask: 255.255.255.000
Default Gateway: 0.0.0.0
Net Id: 010
SNMP Read Community: public
SNMP Write Community: private
SNMP Trap Community: public
The MAC Address: 00-20-D2-16-89-85
```

The data displayed on the data form includes the fields defined by means of the DEF AGENT command, except for the last field; displayed only for CL.2 modules with CONTROL-ETH port:

**The MAC Address** Displays the MAC address of the Ethernet port.

Refer to the DEF AGENT command for a description of the other command fields.

## DSP AI

### Purpose

Display the current list of inverted alarms.

### Syntax

DSP AI [SS:[CC]]

### Use

- To display the inverted alarms for a specific module port, type:
 

```
DSP AI SS:CC<Enter>
```
- To display the inverted alarms for all the ports of a specific module, type:

**DSP AI SS:\*<Enter>**

3. To display the inverted alarms for a specific slot, type:

**DSP AI SS<Enter>**

4. To display the inverted alarms for all the slots, type:

**DSP AI :\*<Enter>**

5. To display the inverted alarms for the Megaplex system, type:

**DSP AI<Enter>**

where A is the alarm number.

## DSP ALM

### Purpose

Display the contents of the history alarm buffer.

### Syntax

DSP ALM [HISTORY] [/C] [/A]

### Use

- To display the Megaplex alarm history buffer, type:

**DSP ALM<Enter>** OR **DSP ALM HISTORY<Enter>**

- To display the Megaplex alarm history buffer and then clear the displayed alarms, type:

**DSP ALM /C<Enter>** OR **DSP ALM HISTORY /C<Enter>**

- To display again all the Megaplex alarms (including the alarms previously cleared by you), type:

**DSP ALM /A<Enter>** OR **DSP ALM HISTORY /A<Enter>**

### Display Syntax

The contents of the alarm buffer are displayed as a table with the alarm source at the left, followed by the alarm message, and the date and time the alarm occurred in accordance with the internal clock of the Megaplex.

<b>(A)(076) IO-12 EX1 BUFFER OVERFLOW/UNDERFLOW EVENT 07/01/97 11:30:00</b>
---

When the number of alarms exceeds the maximum number of lines that fits on one screen, the display stops at the end of the screen. To see the next page of alarms, press any key. At the end of the list, you will see the Megaplex prompt.

## DSP ALM ST

### Purpose

Display and optionally clear, the status alarms. You can specify a specific module or module channel to display.

### Syntax

```
DSP ALM ST {[SS] [SS:CC]} {/C}
```

### Use

- To display all the Megaplex status alarms, type:  
`DSP AS<Enter>`
- To display all the Megaplex status alarms and then clear them, type:  
`DSP AS /C<Enter>`
- To display the status alarms for a specific module, type:  
`DSP AS SS<Enter>`
- To display the status alarms for a specific module and then clear these alarms, type:  
`DSP AS SS /C<Enter>`
- To display the status alarms for a specific module channel, type:  
`DSP AS SS:CC<Enter>`
- To display the status alarms for a specific module channel and then clear these alarms, type:  
`DSP AS SS:CC /C<Enter>`

#### Note

*You cannot clear from the status alarms buffer an alarm that is in the ON state, but only events or alarms that are in the OFF state.*

### Display Syntax

The alarm status is displayed as a table with the alarm number at the left, followed by the alarm source, the alarm message, the current status of the alarm, the number of times the alarm occurred, and an indicator for special conditions.

A typical section of an alarm display is shown below.

(A)	(126)	IO-1	EX1	LOC SYNC LOSS	MAJOR	2	I
-----	-------	------	-----	---------------	-------	---	---

#### Note

*You cannot clear from the status alarms buffer an alarm that is in the ON state, but only events or alarms that are in the OFF state.*

The indicator letters have the following meaning:

- I** Inverted alarm
- M** Masked alarm

- T Event alarm with threshold
- F State alarm with filtering

When the number of alarms exceeds the maximum number of lines that fits on one screen, the display stops at the end of the screen. To see the next page of alarms, press any key. At the end of the list you will see the Megaplex prompt.

## DSP AM

### Purpose

Display the current list of masked alarms.

### Syntax

DSP AM [SS:[CC]]

### Use

- To display the masked alarms for a specific module port, type:  
`DSP AM SS:CC<Enter>`
- To display the masked alarms for all the ports of a specific module, type:  
`DSP AM SS:*<Enter>`
- To display the masked alarms for a specific slot, type:  
`DSP AM SS<Enter>`
- To display the masked alarms for all the slots, type:  
`DSP AM SS:*<Enter>`
- To display the masked alarms for the Megaplex system, type:  
`DSP AM<Enter>`

## DSP AP

### Purpose

Display the priority level of a specific alarm.

### Syntax

DSP AP [A]

### Use

- To display the priority level of a specific alarm, type:  
`DSP AP A<Enter>`
- To display all the alarm priorities, type:  
`DSP AP<Enter>`

## DSP AQ

### Purpose

Display, and optionally clear, the contents of the history alarm buffer.

This command is identical to the DSP ALM command. For a description of the display fields, refer to the DSP ALM command above.

## DSP AR

### Purpose

Display the current selections for the alarm reporting method, and the alarm indications.

### Syntax

DSP AR

### Use

- To display the current alarm reporting and indications, type:

**DSP AR<Enter>**

You will see the alarm data form. A typical data form is shown below:

ALARM	REPORT	LOG	RELAY1	RELAY2	MINOR LED	MAJOR LED
CRITICAL ON	YES	YES	YES	YES	YES	YES
CRITICAL OFF	YES	YES	N/A	N/A	N/A	N/A
MAJOR ON	YES	YES	YES	YES	YES	YES
MAJOR OFF	YES	YES	N/A	N/A	N/A	N/A
MINOR ON	YES	YES	NO	YES	YES	NO
MINOR OFF	YES	YES	N/A	N/A	N/A	N/A
WARNING ON	YES	YES	NO	NO	YES	NO
WARNING OFF	YES	YES	N/A	N/A	N/A	N/A
EVENT	YES	YES	NO	NO	YES	NO

Refer to the DEF AR command above for an explanation of the information displayed on this screen.

## DSP AS

### Purpose

Display, and optionally clear, the status alarms. You can specify a specific module or module channel to display.

This command is identical to the DSP ALM ST command. For a description of the display fields, refer to the DSP ALM ST command above.

## DSP ASP

### Purpose

Display the alarms with priority equal to, or higher than, a specified priority level. The priority levels are as follows:

- 1 – events
- 2 – warnings
- 3 – minor alarms
- 4 – major alarms
- 5 – critical alarms.

### Syntax

DSP ASP 'priority' {/C}

### Use

- To display all the Megaplex status alarms having priorities equal to, and higher than a specified priority, type:

```
DSP ASP 'priority'<Enter>
```

- To display all the Megaplex status alarms and then clear them, type:

```
DSP ASP 'priority' /C<Enter>
```

For a description of the display fields, refer to the DSP AS command.

## DSP AT

### Purpose

Display the threshold values defined for a specified type of event alarm.

### Syntax

DSP AT A [SS[:CC]]

### Use

- To display the filtering threshold data for the desired alarm, type:

```
DSP AT A<Enter>
```

where A is the event alarm number.

- To display the filtering threshold data as defined for a specific module, type:

```
DSP AT A SS<Enter>
```

- To display the filtering threshold data as defined for a specific port of a module, type:

```
DSP AT A SS:CC<Enter>
```

You will see the filtering window data form. A typical data form is shown below:



ALARM	SLOT	PORT	SET VALUE	RESET VALUE
---	---	---	---	---
031	IO-1	EX-1	020	010

For a description of the various fields, refer to the DEF AT command.

## DSP AT&T

### Purpose

Display performance statistics collected in accordance with AT&T Pub. 54016 (T1 statistics), or RAD proprietary statistics (for E1 links). You can select between the display of the statistics for the current 15-minute interval and the display of the 24-hour (long-term) statistics supported by the Megaplex. You can also clear the long-term statistics after displaying them. This action restarts the collection intervals.

**Note** *AT&T statistics are available only for T1 interfaces which use the ESF framing mode, and for E1 interfaces using the CRC-4 mode.*

### Syntax

DSP AT&T SS:CC {24H} [/C]

### Use

- To display the current 15-minute statistics for the desired module port, type:

**DSP AT&T SS:CC 15M<Enter>**

A typical display is shown below.

```

ESF ERROR EVENTS = 0 or CRC ERROR PER SECOND = 0
CRC AVERAGE ERROR PER SECOND = 0

CURRENT ES = 0 CURRENT UAS = 0 CURRENT SES = 0
CURRENT BES = 0 CURRENT LOFC = 0 CURRENT CSS = 0
CURRENT TIMER = 0

```

- To display the last 24-hour statistics for the desired module port, type:

**DSP AT&T SS:CC 24H<Enter> OR DSP AT&T SS:CC<Enter>**

- To display the last 24-hour statistics for the desired module port, and then clear the statistics, type:

**DSP AT&T SS:CC 24H /C<Enter> OR DSP AT&T SS:CC /C<Enter>**

A typical first page of the display is shown below. To see the other pages, press any key.

```

ESF ERROR EVENTS = 0 or CRC ERROR PER SECOND = 0
CRC AVERAGE ERROR PER SECOND = 0
CURRENT ES = 0 CURRENT UAS = 0 CURRENT SES = 0
CURRENT BES = 0 CURRENT LOFC = 0 CURRENT CSS = 0
CURRENT TIMER = 0
24 HOUR ES = 0 24 HOUR UAS = 0 24 HOUR SES = 0
24 HOUR BES = 0 24 HOUR LOFC = 0 24 HOUR CSS = 0
CURRENT 24 HOUR DEGRADED MINUTES = 0
LAST 24 HOUR DEGRADED MINUTES = 0
CURRENT INTERVAL NUMBER = 0
INTERVAL 00 : ES = 0 UAS = 0 BES = 0 SES = 0 LOFC = 0 CSS = 0
INTERVAL 01 : ES = 0 UAS = 0 BES = 0 SES = 0 LOFC = 0 CSS = 0

```

## Display Fields

<b>ESF error events</b>	An ESF error event is any extended super-frame containing a CRC error and/or OOF event. The number of events is collected in a current ESF error events register. Available only for T1 links.
<b>CRC error per second</b>	A CRC error is any CRC error detected by the CRC-4 function. This register collects the total number of CRC errors detected in the current second. Available only for E1 links.
<b>CRC average error per second</b>	The average number of CRC errors per second detected in the current measurement interval. Available only for E1 links.
<b>Current timer (SECS)</b>	The number of seconds in the current measurement interval. A measurement interval has 900 seconds (15 minutes).
<b>Current errored seconds (ES)</b>	An errored second is any second containing one or more CRC error events, or one or more OOF events, or one or more controlled slip events. The data is collected for the current 15-minute interval.
<b>Current unavailable seconds (UAS)</b>	An unavailable second is any second in which a failed signal state exists. A failed signal state is declared when 10 consecutive severely errored seconds (SES) occur, and is cleared after 10 consecutive seconds of data are processed without a SES.
<b>Current severely errored seconds (SES)</b>	A SES is a second with 320 or more CRC error events, or one or more OOF events. The data is collected for the current 15-minute interval.
<b>Current bursty errored seconds (BES)</b>	A BES is a second with 2 to 319 CRC error events. The data is collected for the current 15-minute interval.
<b>Current loss of frame counter (LOFC)</b>	The loss of frame (LOF) counter counts the loss of frame alignment events. The data is collected for the current 15-minute interval.
<b>Current slip second counter (CSS)</b>	A CSS is a second with one or more controlled slip events. The data is collected for the current 15-minute interval.
<b>Long-term errored seconds (ES)</b>	The total number of ES in the current 24-hour interval.

<b>Long-term fail seconds (UAS)</b>	The total number of UAS in the current 24-hour interval.
<b>Long-term severely errored seconds (SES)</b>	The total number of SES in the current 24-hour interval.
<b>Long-term loss of frame counter (LOFC)</b>	The total number of LOF events in the current 24-hour interval.
<b>Long-term slip second counter (CSS)</b>	The total number of CSS in the current 24-hour interval.
<b>Long-term BES</b>	The total number of BES in the current 24-hour interval.
<b>Long-term interval</b>	The number of valid 15-minute intervals in the previous 24 hour period.
<b>Current degraded minutes</b>	The total number of degraded minutes in the current 24-hour interval. A degraded minute is a minute in which the bit error rate (BER) exceeded $1 \times 10^{-6}$ . This number is updated every minute.
<b>Last degraded minutes</b>	The total number of degraded minutes in the last 24-hour interval. This number is updated every 24 hours.

## DSP AW

### Purpose

Display the filtering window duration (in seconds).

### Syntax

DSP AW

### Use

- To display the filtering window, type:

```
DEF AW<Enter>
```

You will see the filtering window data form. A typical display is shown below:

```
TIME WINDOW VALUE (1 TO 255): 20
```

## DSP BERT

### Purpose

Display the results of the BER tests currently running on the Megaplex or on a selected module. You can also clear (reset to 0) the BER counters after displaying the current counts. This restarts the collection interval without stopping the BER test.

### Syntax

DSP BERT [SS] [/C]

## Use

- To display the current results of all the BER tests running on the Megaplex, type:

```
DSP BERT<Enter>
```

- To display the current values of the BER counters, and then reset all the counters to 0, type:

```
DSP BERT /C<Enter>
```

The terminal displays a table listing the current values of the BERT counters for all the modules on which BER tests are running.

The BERT count range is 0 through 65535. If the maximum value is reached, the counter holds this value until cleared. A typical screen is shown below.

Slot	Module	Channel	Error Count
IO-01	HS-2	EX1	2134
IO-03	HS-Q	EX2	10

- To display the current result of the BER test running on a selected module, type:

```
DSP BERT SS<Enter>
```

- To display the current result of the BER test running on a selected module, and then reset that BER counter to 0, type:

```
DSP BERT SS /C<Enter>
```

## DSP BND

### Purpose

Display the parameters of a selected timeslot bundle.

### Syntax

```
DSP BND B
```

### Use

- To display the parameters of a bundle, type:

```
DSP BND B<Enter>
```

where B is the desired bundle number.

You will see the first line of the bundle parameters data form. The bundle number is identified in a separate line.

To display the next line, press <Enter>. Repeat until all the lines have been displayed. A typical data form, as seen after all the lines have been displayed, is shown below.

Bundle 3 Parameters				
Connect	ML-IP Slot	ML-IP TDM	Destination IP	Next Hop IP
ENABLE	I/O-2	IN1	172.17.171.20	0.0.0.0
IP TOS	Ext Eth	Dest Bundle	Jitter Buffer	Name
0	AUTO	BND3	3 msec	
TDM Bytes In Frame	Voice OOS	Data OOS	Far End Type	
48	00	00	E1	
OAM Connectivity	VLAN Tagging	VLAN Id	VLAN Priority	Redundancy
DISABLE	NO	N/A	N/A	NO

The data form fields are similar to those of the ADD BND command. For a description of the display fields, refer to the ADD BND command.

## DSP DB LIST

### Purpose

Display the list of configuration databases stored in the non-volatile memory of the Megaplex.

### Syntax

DSP DB LIST

### Use

- Type:

**DSP DB LIST<Enter>**

You will see a table with 10 rows, one for each database that can be stored. For each row, you will see YES if the database exists, or NO if the corresponding database is not stored in the non-volatile memory. A typical display is shown below:

DB No	Exists
01	YES
02	YES
03	NO
04	NO
05	NO
06	NO
07	NO
08	NO
09	NO
10	NO

## DSP DEFAULT DB

### Purpose

Display, from the edited database, the number of the configuration database to be used as a default for “normal operation”.

“Normal operation” means that none of the flip conditions defined in the flip database is present, and therefore none of databases specified in the **DB No.** field of the ADD FLIP ENTRY commands is in use.

To see the current default database, use the DSP ST DEFAULT DB command.

### Syntax

DSP DEFAULT DB

### Use

- To display the default database, type:

```
DSP DEFAULT DB D<Enter>
```

You will see the default database number in the following format:

```
Default Database No
- - - - -
06
```

## DSP FLIP BROADCAST

### Purpose

Display the flip event broadcasting parameters defined for this Megaplex in the edited database.

To display the information from the current (active) database, use the DSP ST FLIP BROADCAST command.

### Syntax

DSP FLIP BROADCAST

### Use

- To display the current flip broadcasting parameters, type:

```
DSP FLIP BROADCAST<Enter>
```

You will see the flip broadcast data form. A typical data form is shown below:

FLIP BROADCAST	BROADCAST INTERVAL [sec]
---	-----
OFF	060

For a description of the display fields, refer to the DEF FLIP BROADCAST command.

## DSP FLIP ENTRY

### Purpose

Display information on a selected flip entry (or on all the entries) in the edited flip database. To display the information from the current flip (active) database, use the DSP ST FLIP ENTRY command.

### Syntax

DSP FLIP ENTRY [E]

### Use

- To display information on all the flip entries in the edited database, type:

```
DSP FLIP ENTRY<Enter>
```

To display information on a selected entry, type:

```
DSP FLIP ENTRY E<Enter>
```

where E is the entry number (1 through 10).

You will see the requested data form. A typical display is shown below:

Entry No	Logical Expression	DB No	Discard Eligible
02	1&2	01	N/A
Entry No	Logical Expression	DB No	Discard Eligible
03	1	01	N/A

For a description of the fields, refer to the ADD FLIP ENTRY command.

## DSP FLIP EVENT

### Purpose

Display information on a selected flip event (or on all the events) in the edited flip database.

To display the information from the current flip (active) database, use the DSP ST FLIP EVENT command.

### Syntax

DSP FLIP EVENT [V]

### Use

- To display information on all the flip events in the edited database, type:

**DSP FLIP EVENT<Enter>**

To display information on a selected event, type:

**DSP FLIP EVENT V<Enter>**

where V is the event number (1 through 10).

- You will see the requested data form. A typical display is shown below:

No	Event Type	Bit No	Day Agenda	Start Time	End Time	
01	TIME	001	FULL	06:00:00	20:00:00	
No	Event Type	Bit No	Slot	Port	In-Service Delay	Out-Of-Service Delay
02	LINK DOWN	100	IO-1	EX1	10 sec	20 sec

For a description of the fields, refer to the ADD FLIP EVENT command.

## DSP MANAGER LIST

### Purpose

Display the current list of network management stations that receive traps from this Megaplex.

### Syntax

DSP MANAGER LIST



### Use

- To display the list, type:

**DSP MANAGER LIST<Enter>**

You will see the network management stations data form. A typical form is shown below:

No	IP Address	IP mask	Alarm	Trap Masking		
				Sanity	Cnfg DB	Flip DB
01	192.114.029.001	255.255.255.252	YES	NO	NO	NO
02	192.114.029.013	255.255.255.000	NO	NO	NO	NO
03	168.110.010.001	255.000.000.000	NO	NO	NO	NO
04	193.114.029.075	255.255.254.000	NO	NO	NO	NO
05	001.001.001.001	255.000.000.000	NO	NO	NO	NO
06	002.003.004.007	255.255.255.000	NO	NO	NO	NO
07	110.001.001.001	200.000.000.000	NO	NO	NO	NO
08	100.004.005.001	255.000.000.000	NO	NO	NO	NO
09	004.001.001.001	255.000.000.000	NO	NO	NO	NO
10	005.005.005.005	255.000.000.000	NO	NO	NO	NO

The data form is similar to the data form used to define a new management station. Refer to the ADD MANAGER LIST command for a description of the data form.

## DSP MMI

### Purpose

Display the user prompt.

### Syntax

DSP MMI

### Use

- To display the current Megaplex user's prompt, type:

**DSP MMI<Enter>**

You will see the user's prompt data form. A typical form is shown below:

Alarm Status	Database	Mux Name	User Prompt	Time Stamp	Logoff Time
NO	NO	NO	NO	NO	3 MINUTES
Date Format	Pop Alarm				
DD-MM-YYYY	OFF				

Refer to the DEF MMI command above for an explanation of the information displayed by this command.

## DSP NAME

### Purpose

Display the parameters of the Megaplex SNMP agent.

This command is identical to the DSP AGENT command. For a description of the display fields, refer to the DSP AGENT command above.

## DSP NET DELAY

### Purpose

Display the current net delay from the edited flip database.

To display the information from the current flip (active) database, use the DSP ST NET DELAY command.

### Syntax

DSP NET DELAY

### Use

- To display the current net delay, type:

```
DSP NET DELAY<Enter>
```

You will see the current net delay, in seconds. A typical display is shown below:

```
Net Delay sec
- - - - -
060
```

## DSP NET ENTRY

### Purpose

Display the existing net entries defined for filtering the incoming routing tables.

### Syntax

DSP NET ENTRY

### Use

- To display the current net entries, type:

```
DSP NET ENTRY<Enter>
```

You will see the current net entries table. A typical display is shown below:

ENTRY NO	NET IP	NET MASK
01	192.114.029.007	255.255.255.000
02	192.114.229.111	255.255.255.000

Refer to the DEF NET ENTRY command above for an explanation of the information displayed by this command.

## DSP PING

### Purpose

Display the results of a ping command. Correct results are displayed only after the last DEF PING command for the same I/O slot is successfully completed.

If the command failed, that is, no response has been received from the specified destination, you will see a **Request Timed Out** message.

### Syntax

DSP PING

### Use

- To display the ping results, type:

**DSP PING SS<Enter>**

where SS is the number of the slot in which the desired HS-ETH/SW module is installed.

You will see the ping results data form. [Table 5-16](#) explains the displayed ping results.

*Table 5-16. DSP PING Parameters*

Parameter	Description
<b>Final Result</b>	Qualifies the information presented in the data form displayed by the command entered by you <ul style="list-style-type: none"> <li><b>Not Updated</b> – the results have not yet been updated, and should be ignored.</li> <li><b>Not Final Result</b> – the command is still being executed, and therefore you should repeat the command later to read meaningful results.</li> <li><b>Final Result</b> – the displayed results are valid</li> </ul>
<b>Packets Sent</b>	Displays the total number of ping request packets that have been sent (maximum 255)
<b>Packets Received</b>	Displays the total number of ping response packets that have been received (maximum 255, however it cannot exceed the number of sent requests)
<b>Packets Lost</b>	Displays the total number of lost packets (the difference between <b>Packets Sent</b> and <b>Packets Received</b> )
<b>Min Round Trip Time (ms)</b>	Displays the minimum measured time between the transmission and reception of a ping, in milliseconds (the supported range is 0 to 65535)
<b>Max Round Trip Time (ms)</b>	Displays the maximum measured time between the transmission and reception of a ping, in milliseconds (the supported range is 0 to 65535)

---

<b>Average Round Trip Time (ms)</b>	Displays the average time calculated for all the successfully received ping responses, in milliseconds (the supported range is 0 to 65535)
-------------------------------------	--

---

## DSP PROFILE

### Purpose

Display the contents of a signaling profile.

### Syntax

DSP PROFILE S

### Use

- To display the contents of a profile, type:

```
DSP PROFILE S<Enter>
```

where S is the number of the desired signaling profile, 1 through 5.

You will see the profile data form. The profile contents depend on the signaling protocol defined in the profile.

- A typical data form for a legacy profile shown below.

Signaling Type	Profile Name					
-----	-----					
LEGACY	STANDARD					
Rx Translation						
-----						
ABCD INT:	A	B	C	D	BUSY	IDLE
-----	-----					
ABCD IN:	A	A	A	A	F	0
Tx Translation						
-----						
ABCD INT:	A	B	C	D	D	
-----	-----					
ABCD IN:	A	A	A	A	A	

- A typical R2 profile data form is shown below. Note that the data form displays the timer data, even when the profile parameters selection mode is AUTOMATIC.

Signaling Type	Profile Name						
-----	-----						
R2 CAS	STANDARD						
Country	R2 Mode		R2 Delay		Metering Indication		Uniform
-----	-----		-----		-----		-----
ITU-T	MANUAL		TERRESTRIAL		C BIT		NO
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06		
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
	TS 07	TS 08	TS 09	TS 10	TS 11	TS 12	
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
	TS 13	TS 14	TS 15	TS 17	TS 18	TS 19	
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
	TS 13	TS 14	TS 15	TS 17	TS 18	TS 19	
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
	TS 20	TS 21	TS 22	TS 23	TS 24	TS 25	
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
	TS 26	TS 27	TS 28	TS 29	TS 30	TS 31	
Call En	BOTH	BOTH	BOTH	BOTH	BOTH	BOTH	
Metering	NO	NO	NO	NO	NO	NO	
Break duration							: 64 ms (56 - 80)
Release guard timing (T2)							: 600 ms (16 - 2000)
Regret timer duration							: 14 ms (14 - 120)
Seize detect							: 64 ms (24 - 200)
Seize Ack. delay							: 8 ms (8 - 304)
Clear Back detect							: 24 ms (24 - 104)
Clear Forward detect							: 304 ms (200 - 504)
Fault detect							: 24 ms (16 - 104)
Fault removal detect							: 24 ms (16 - 104)
Meter pulse duration							: 152 ms (152 - 304)
Seize Ack. wait							: 400 ms (104 - 1200)
Seize Ack. detect							: 48 ms (48 - 600)
Answer detect							: 144 ms (136 - 400)
Block removal detect							: 16 ms (16 - 96)
Metering pulse detect							: 144 ms (96 - 440)
Forced disconnect detect							: 0 ms (0 - 0)
Disconnect acknowledge detect							: 0 ms (0 - 0)
Release guard timing (T1)							: 600 ms (16 - 2000)

The fields displayed by means of this command are similar to those displayed by the DEF PROFILE command. For a description of the display fields, refer to the DEF PROFILE command above.

## DSP PROMPT

### Purpose

Display the user prompt of the Megaplex. This command is identical to the DSP MMI command.

For a description of the display fields, refer to the DSP MMI command above.

## DSP RDN ST

### Purpose

Display information on the redundancy state of a port, which is a member of a redundancy pair.

### Syntax

DSP RDN ST A B

- To display the redundancy state of a specific port, type:

```
DSP RDN ST SS CC<Enter>
```

where SS is the I/O slot number of the corresponding module, and CC is the port number.

A typical display is shown below:

Port 1	
Redundancy State	Online State
-----	-----
ENABLE	ACTIVE

## DSP RDN ST BND

### Purpose

Display information on the redundancy state of a bundle, which is a member of a redundancy pair.

This command is relevant only to ML-IP.

### Syntax

DSP RDN ST BND A

### Use

- To display the redundancy state of a specific bundle, type:

```
DSP RDN ST A<Enter>
```

where A is the number of the corresponding bundle.

A typical display is shown below:

<b>BND 1</b>	
<b>Redundancy State</b>	<b>Online State</b>
-----	-----
<b>ENABLE</b>	<b>ACTIVE</b>

## DSP REM AGENT

### Purpose

Display information on the remote SNMP agents that are known to the IP router of the Megaplex, provided SNMP management is enabled.

### Syntax

DSP REM AGENT

### Use

- To display the remote agent information, type:

**DSP REM AGENT<Enter>**

If no agent is known, you will see a **(E)(030)NO MUX DEFINED IN NET** message. Otherwise, you will see a table listing the remote agents. A typical table is shown below:

<b>IP ADDRESS</b>	<b>MUX NAME</b>	<b>PHYSICAL DISTANCE</b>	<b>LOGICAL DISTANCE</b>
-----	-----	-----	-----
<b>192.114.50.2</b>	<b>New-York</b>	<b>001</b>	<b>006</b>

The fields displayed for each agent are as follows:

<b>IP ADDRESS</b>	The IP address of the remote agent.
<b>MUX NAME</b>	The logical name of the remote agent.
<b>PHYSICAL DISTANCE</b>	The physical distance is a metric that indicates the number of hops (through the management network) to the remote agent.
<b>LOGICAL DISTANCE</b>	Metric that indicates the logical distance (through the management network) to the remote agent, and is used, among other factors, in the selection of the optimal route to be used by the management traffic. The distance calculation also takes into account the quality of the line.

## DSP REM NAME

### Purpose

Display the remote SNMP agents parameters.

This command is identical to the DSP REM AGENT command. For a description of the display fields, refer to the DSP REM AGENT command above.

## DSP REV

### Purpose

Display the list of modules actually installed in the Megaplex slot, and the hardware revision and software version of each module.

In addition, the command also displays the modules currently programmed in the database.

### Syntax

DSP REV

### Use

- To display information on all the modules, type:

**DSP REV<Enter>**

The supervision terminal displays the list of slots for the corresponding Megaplex enclosure, the type of module installed in each slot, the module hardware and software revisions, the programmed module type, and the chassis revision.

A typical display for a Megaplex-2100 is illustrated below. The information displayed for your Megaplex unit may be different, because it depends on your software version, chassis version and module configuration.

System type : MP-2100 , System version : 6.05 , chassis revision : 1				
Slot	Installed Card	HW Revision	SW Version	Programmed Card
PS-A	PS220-200W	0		PS220-200W
PS-B	-----			-----
CL-A	MCL-2	1	11.0	CL.2
CL-B	MCL-2	1	11.0	CL.2
IO-1	ML-2E1	3	4.54	ML-2E1
IO-2	-----			ML-2E1
IO-3	LS-12	1	4.54	LS-12
IO-4	-----			HS-Q/N
IO-5	-----			HSU/I
IO-6	-----			VC-6/FXS(1)
IO-7	-----			-----
IO-8	-----			-----
IO-9	-----			-----
IO-10	-----			-----
IO-11	-----			-----
IO-12	-----			-----



## DSP RIP2 AGENT

### Purpose

Display the contents of the RIP2 agents table.

### Syntax

DSP RIP2 AGENT

### Use

- To display the RIP2 agents table, type:

```
DSP RIP2 AGENT <Enter>
```

If the RIP2 agents table is not empty, you will see a table listing the current RIP2 agents defined in the table. A typical table is shown below:

No	IP Address
01	192.168.19.001
07	162.188.50.122
23	172.168.22.99

## DSP ROUTE

### Purpose

Display the parameters of a static entry in the routing table, used by the ML-IP and HS-ETH/SW modules.

### Syntax

DSP ROUTE [R]

### Use

- To display the parameters of all the currently defined routes, type:

```
DSP ROUTE<Enter>
```

- To display the parameters of a specific route, type:

```
DSP ROUTE R<Enter>
```

where R is the index number of the route in the IP routing table.

You will see the desired route parameters. A typical display is shown below.

Route 3			
ENTRY Type			
-----			
SINGLE IP			
Destination IP	Next Hop IP	Subnet Mask	Metric
-----	-----	-----	-----
0.0.0.0	0.0.0.0	0.0.0.0	15

For a description of the data form fields, refer to the ADD ROUTE command.

## DSP SIG TS

### Purpose

Display the signaling information transmitted and received by a specific voice channel configured for CAS signaling. The voice channel is identified by the timeslot to which it is routed.

### Syntax

DSP SIG TS SS:CC:TT

### Use

- To display the signaling information of the desired channel, type:

**DSP SIG TS SS:CC:TT<Enter>**

where SS:CC indicates the I/O slot and port of the main link module to which the channel is routed, and TT identifies the desired timeslot.

**Note** For a voice channel routed to a timeslot bundle, enter the internal TDM port number.

You will see the signaling information collected at the instant the command has been executed. A typical data form is shown below.

<b>Tx to IO</b>				<b>Rx from Link</b>					
-----				-----					
<b>ABCD:</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>ABCD:</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
-----				-----					
<b>ABCD:</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>ABCD:</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>
<b>Rx from IO</b>				<b>Tx to Link</b>					
-----				-----					
<b>ABCD:</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>	<b>ABCD:</b>	<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
-----				-----					
<b>ABCD:</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>ABCD:</b>	<b>1</b>	<b>1</b>	<b>1</b>	<b>1</b>

- To update the display, enter again the command (for convenience, may also use the CTRL A shortcut).

### Display Fields

The data form includes two parts:

<b>Rx from Link</b>	Displays the states of the four signaling bits, received from the link, after being processed by the main link module is the selected profile. The bits are identified in accordance with the standards as A, B, C and D.
<b>Tx to Link</b>	Displays the state of the signaling bits sent by the voice channel to the main link. The bits actually sent to the remote side depend on the selected profile.

The interpretation of the signaling information depends upon the signaling protocol being used.

## DSP SP

### Purpose

Display the parameters of the specified supervisory port.

### Syntax

DSP SP [CON#]

### Use

- To display the parameters of the CONTROL-DCE port (port 1), type:  
`DSP SP CON1<Enter>` OR `DSP SP<Enter>`
- To display the parameters of the ETHERNET port (port 2), type:  
`DSP SP CON2<Enter>`
- The supervisory port parameters data form is displayed.
  - A typical data form for a serial supervisory port is shown below.

Baud Rate	Parity	Data Bits	Stop Bits	Auxiliary Device
9.6 KBPS	NONE	8	1	SLIP NMS
Routing Protocol				
NONE				

- A typical data form for an Ethernet port is shown below.

Routing Protocol	Direct Lan Connection
NONE	YES
RIP2	NO
PROPRIETARY RIP	

For a description of the display fields, refer to the DEF SP command above.

## DSP ST AGENDA

### Purpose

Display the classification of weekdays from the current (active) flip database. To display the classification in the edited flip database, use the DSP AGENDA command.

### Syntax

DSP ST AGENDA

### Use

- Type:

**DSP ST AGENDA<Enter>**

You will see the classification of weekdays from the current (active) flip database. Refer to the DSP AGENDA command for a description of the display.

## DSP ST CH

### Purpose

Read information about the status of a selected module or module channel. The displayed information depends on the module type.

This section explains the general procedure for using this command. For descriptions of the specific parameters available for each type of module, refer to the corresponding module Installation and Operation Manual.

### Syntax

DSP ST CH {[SS] [SS:CC]}

### Use

- To display the complete status information for a selected module, type:

**DSP ST CH SS:\*<Enter>**

This will result in the display of the status of all the module channels, and the status of the module itself.

The information is shown on two pages, one displaying the hardware status (when available), and the other – the software (configuration) data. After displaying the first part, the terminal pauses and prompts you to display the second part.

- To display status information for a selected module, type:

**DSP ST CH SS<Enter>**

This will result in a similar display, but this time the status of the module channels will be omitted.

- To display status information for a selected module channel, type:

**DSP ST CH SS:CC<Enter>**

## DSP ST DEFAULT DB

### Purpose

Display the number of the configuration database currently used as a default for “normal operation”. To see the default database defined in the edited database, use the DSP DEFAULT DB command.

### Syntax

DSP ST DEFAULT DB

### Use

- To display the current default database, type:

```
DSP ST DEFAULT DB D<Enter>
```

You will see the default database number in the following format:

<pre>Default Database No - - - - - 06</pre>
---

## DSP ST FLIP BROADCAST

### Purpose

Display the flip event broadcasting parameters defined for this Megaplex in the current (active) database.

To display the information from the edited database, use the DSP FLIP BROADCAST command.

### Syntax

DSP FLIP BROADCAST

### Use

- To display the current flip broadcasting parameters, type:

```
DSP FLIP BROADCAST<Enter>
```

You will see the flip broadcast data form. A typical data form is shown below:

<pre>FLIP BROADCAST      BROADCAST INTERVAL [sec] - - - - - OFF                  060</pre>
--

For a description of display fields, refer to the DEF FLIP BROADCAST command.

## DSP ST FLIP ENTRY

### Purpose

Display information on a selected flip entry (or on all the entries) in the current flip database. To display the information from the edited flip database, use the DSP FLIP ENTRY command.

### Syntax

DSP ST FLIP ENTRY [E]

### Use

- To display information on all the flip entries in the current database, type:

```
DSP ST FLIP ENTRY<Enter>
```

- To display information on a selected entry, type:

```
DSP ST FLIP ENTRY E<Enter>
```

where E is the entry number (1 through 10).

You will see the entry data form. Refer to the DSP FLIP ENTRY command for a description of the display.

## DSP ST FLIP EVENT

### Purpose

Display information on a selected flip event (or on all the events) in the current flip database.

To display the information from the edited flip database, use the DSP FLIP EVENT command.

### Syntax

DSP ST FLIP EVENT [V]

### Use

- To display information on all the flip events in the current database, type:

```
DSP ST FLIP EVENT<Enter>
```

- To display information on a selected event, type:

```
DSP ST FLIP EVENT V<Enter>
```

where V is the event number (1 through 10).

You will see the event data form. Refer to the DSP FLIP EVENT command for a description of the display.

## DSP ST SPLIT TS

### Purpose

Display the current assignment of individual bits in a selected timeslot.

### Syntax

DSP SPLIT TS SS:CC:TT

### Use

- To display the bit-level assignment for a specific timeslot, type the command with the desired slot, channel, and timeslot number:

**DSP SPLIT TS SS:CC:TT<Enter>**

### Note

To identify a timeslot connected to an ML-IP bundle, use the channel number (CC) of the ML-IP internal TDM port, for example, IN1.

You will see the bit-level assignment data form.

The display fields are similar to the fields on the data form displayed in response to the DEF SPLIT TS command, except that no change can be made.

Refer to the DEF SPLIT TS command for a description of the display.

## DSP ST SYS

### Purpose

Display system status information.

### Syntax

DSP ST SYS

### Use

- To view the current system status, type:

**DSP ST SYS<Enter>**

A typical system status display for a system with two CL modules is shown below.

System Clock	: INTERNAL	
Clock Mode	: INTERNAL	
Clock Source	: MCL-2 CL-A	
TDM Master	: NONE	
Active DB	: 1	
	CL-A	CL-B
	-----	-----
Activity	: ON LINE	OFF LINE
Test	: OFF	OFF
Alarm	: OFF	OFF
NVRAM Capacity	: 05%	06%

<b>NVRAM Checksum</b>	<b>: 01FE</b>	<b>0200</b>
<b>Last DB Update</b>	<b>: 04/12/1999 14:42:12</b>	<b>03/05/1999 10:20:00</b>

## Display Fields

The display shows the following information:

<b>System Clock</b>	Displays the system clock mode (master, fallback, internal).
<b>Clock Mode</b>	Displays the system timing source (internal, receive clock or adaptive).
<b>Clock Source</b>	Displays the module and port that provides the system clock. When the adaptive mode is used, this field displays the bundle providing the timing reference.
<b>TDM Master</b>	Displays the main module and port that provides the system timing.

### Note

*The **System Clock**, **Clock Mode** and **Clock Source** fields are not relevant when the **TDM Master** is **NONE**.*

<b>Active DB</b>	Displays the database number currently in use.
<b>Activity</b>	Displays the state of each CL module used by the system: <ul style="list-style-type: none"> <li>• ON LINE indicates the active (master) module.</li> <li>• OFF LINE indicates the standby (slave) module.</li> </ul>
<b>Test</b>	Indicates whether tests are present in the system.
<b>Alarm</b>	Indicates the type of the most severe alarm that exists in the system.
<b>NVRAM Capacity</b>	Indicates the percentage of non-volatile memory capacity used to store user's parameters.
<b>NVRAM Checksum</b>	Indicates the checksum of the data stored in the non-volatile memory.
<b>Last DB Update</b>	Indicates the date and time of the last database update.

## DSP ST TS

### Purpose

Display the current timeslot assignment of a module port with E1 or T1 interface operating in the legacy mode. You can also use this command for the ML-IP internal TDM ports.

### Syntax

DSP ST TS

### Use

- To display the timeslot assignment for the desired module port, type:

**DSP ST TS SS:CC<Enter>**

Megaplex displays the timeslot assignment data form. The data form is identical to the timeslot assignment data form displayed in response to the DEF TS command, except that the whole data form is displayed



immediately, and it displays the active timeslot assignment, not the edited assignments.

## DSP STAT CH

### Purpose

Display the statistics collected for a specified port.

Currently, this command is supported only by the HS-ETH/SW, VFS-24, VFS-30, VFS-48 and VFS-60 modules.

### Syntax

DSP STAT CH SS:CC

- To display the statistics collected for a specified port, type:

```
DSP STAT CH SS:CC<Enter>
```

where SS is the number of the I/O slot and CC is the number of the port.

You will see the statistics data form, correct for the instant the command has been received by the Megaplex unit. For a description of the performance statistics, refer to the corresponding module Installation and Operation Manual.

## DSP STAT BND

### Purpose

Display the performance statistics of a timeslot bundle.

### Syntax

DSP STAT BND B

### Use

- To display the performance statistics of a desired timeslot bundle, type:

```
DSP STAT BND B<Enter>
```

You will see the bundle performance statistics. A typical display is shown below.

```
BUNDLE 3 STATISTICS
- - - - -
RECEIVE CORRECT FRAMES = 179756
SEQUENCE ERRORS        = 0
JITTER BUFFER OVERFLOW = 0
JITTER BUFFER UNDERFLOW = 0
TRANSMITTED FRAMES     = 179756
RUNNING TIME SINCE LAST CLEAR = 0 days 00:05:37
```

### Display Fields

The performance parameters are as follows:

<b>Receive Correct Frames</b>	Number of packets correctly received from the IP network.
<b>Sequence Errors</b>	Number of instances in which packets were received out-of-order from the IP network.  Events of this type are counted only when the bundle is synchronized.
<b>Jitter Buffer Overflow</b>	The number of times packets were lost because the bundle receive buffer overflowed.
<b>Jitter Buffer Underflow</b>	The number of times packets were lost because the bundle receive buffer was in an underflow state.  The buffer may enter the underflow state in the following cases: <ul style="list-style-type: none"> <li>• As a result of packet sequence errors</li> <li>• When packets arrive with a delay exceeding the maximum allowed delay variation</li> <li>• When packets are lost in the network and thus do not reach the buffer in time.</li> </ul>
<b>Transmitted Frames</b>	Number of packets transmitted to the network.
<b>Running Time Since Last Clear</b>	Time (in seconds) since the corresponding set of counters were last cleared. This is the total time over which the current values of this set of bundle performance parameters have been collected.  If no clear command has yet been issued, this parameter indicates the time since the Megaplex has been last restarted, or since this bundle has been configured.

## DSP STAT LAN

### Purpose

Display the performance statistics collected for an ML-IP Ethernet port.

### Syntax

DSP STAT LAN SS:CC

### Use

1. To display the performance statistics collected for an ML-IP Ethernet port, type:  
**DSP STAT LAN SS:CC<Enter>**
2. You will see the performance statistics for the specified port. A typical display is shown below.

```

EXTERNAL 1 LAN STATISTICS
-----
RECEIVED FRAMES
-----
RCV CORRECT FRAMES = 1284487          RCV CORRECT OCTETS
RCV UNICAST FRAMES = 1284416          RCV MULTICAST FRAMES = 0
RCV BRDCAST FRAMES = 71
RCV FCS ERRORS      = 0                RCV_ERRORS              = 0
RCV DISCARD FRAMES = 0

TRANSMITTED FRAMES
-----
TRANSMIT CORRECT FRAMES = 383232      TRANSMIT CORRECT OCTETS  = 35991032
TRANSMIT UNICAST FRAMES = 383228      TRANSMIT MULTICAST FRAMES = 0
TRANSMIT BRDCAST FRAMES = 4
TRANS SINGLE COLLISION = 0            TRANSMIT LATE COLLISION  = 0
RUNNING TIME SINCE LAST CLEAR = 0 days 02:52:48

```

## Display Fields

The performance parameters are as follows:

<b>RCV Correct Frames</b>	The total number of frames that have been correctly received at the corresponding ML-IP interface (parameter defined in RFC 1493).
<b>RCV Unicast Frames</b>	The total number of unicast frames that have been received at the corresponding ML-IP interface.
<b>RCV Brdcast Frames</b>	The total number of broadcast frames that have been received at the corresponding ML-IP interface.
<b>RCV FCS Errors</b>	The total number of frames received at the corresponding ML-IP interface that do not pass the frame checksum (FCS) check (parameter defined in RFC 2665).
<b>RCV Discard Frames</b>	The total number of frames received at the corresponding ML-IP interface that have been discarded for various reasons (including filtering).
<b>RCV Correct Octets</b>	The total number of correct octets received at the corresponding ML-IP interface (parameter defined in RFC 2233).
<b>RCV Multicast Frames</b>	The total number of multicast frames that have been received at the corresponding ML-IP interface.
<b>RCV Errors</b>	The total number of frames received at the corresponding ML-IP interface having a length that is not an integer number of octets (parameter defined in RFC 2665).

## DSP TERM

### Purpose

Display the terminal control sequences.

### Syntax

DSP TERM

### Use

- To display the terminal control sequences, type:  
**DSP TERM <Enter>**
- You will see the control sequences. A typical display is shown below.

```
Current Control Sequences :
CLEAR SCREEN = 1B5B324A
CURSOR HOME  = 1B5B3B66
CURSOR RIGHT = 1B5B3143
```

## DSP TEST

### Purpose

Display the loopbacks and tests activated on the Megaplex.

### Syntax

DSP TEST

### Use

- To display the loopbacks and tests activated on the Megaplex, type:

**DSP TEST <Enter>**

If at least one loopback or test is now active, the table contains one line for each module and channel on which a loopback or test is active. When an ML-IP module is installed in the Megaplex, the data form will also include information tests activated on bundles.

A typical display is shown below.

Slot	Module	Channel	Test	Time-Out
IO-3	HS-Q	EX1	BERT	INFINITE
IO-4	VC12/E&M	EX1	TONE INJECTION	INFINITE

If no loopback or test is active, the terminal displays the message **No test in progress**.

## DSP TS

### Purpose

Display the last edited assignment of timeslots for a module with E1 or T1 interface operating in the legacy mode. You can also use this command for the ML-IP internal TDM ports.

Refer to the DSP ST TS section for an explanation of the display fields.

## F

### Purpose

Define the control sequences sent to the supervision terminal.

This command is identical to the DEF F command. For a description of the display fields, refer to the DEF F command above.

## FLIP [DB] CHK

### Purpose

Perform a sanity check on the flip database being edited. It is recommended to perform this action while editing the flip database, to check for consistency and complete definition of parameters.

Note that the flip database sanity check will not report conflicting parameters related to the remote equipment unit.

### Syntax

FLIP [DB] CHK

### Use

- To initiate the flip database sanity check, type:

```
FLIP [DB] CHK<Enter>
```

If errors are found, the terminal will display a list of error messages.

## FLIP [DB] NET GO

### Purpose

Broadcast a command to all the Megaplex in the network, to activate the flip database previously loaded in the non-volatile memory by means of a FLIP [DB] NET UPD command.

### Syntax & Use

```
FLIP [DB] NET GO<Enter>
```

## FLIP [DB] NET UPD

### Purpose

Copy the flip database from the edit buffer to the non-volatile memory, without activating it.

Before any update, a sanity check is automatically performed, and the database update is performed only if no errors are detected.

Errors are displayed in the same format used with the FLIP [DB] CHK command.

The flip database can be activated on all the Megaplex units in the network by means of the DB NET GO command.

### Syntax

```
FLIP [DB] NET UPD
```

### Use

To copy the flip database to the non-volatile memory, type:

```
FLIP [DB] NET UPD<Enter>
```

## FLIP [DB] UNDO [CHANGES]

### Purpose

Cancel all the changes made to the flip database being edited since the start of this editing session. This action actually retrieves the contents of the edited flip database from the active database.

Changes can be canceled only if the flip database has not yet been activated by an FLIP [DB] UPD or FLIP [DB] NET UPD command.

### Syntax

```
FLIP [DB] UNDO [CHANGES]
```

### Use

To undo the changes, type:

```
FLIP [DB] UNDO CHANGES<Enter> Or FLIP [DB] UNDO<Enter>
```

## FLIP [DB] UPD

### Purpose

Activate the edited flip database. The edited flip database is copied to the current flip database, and is also stored in the non-volatile memory of the local Megaplex.

Before any update, a sanity check is automatically performed, and the database update is performed only if no errors are detected. Errors are displayed in the same format used with the FLIP [DB] CHK command.

## Syntax

FLIP [DB] UPD

## Use

- To activate the edited flip database, type:  
**FLIP [DB] UPD<Enter>**
- If errors are found, the terminal display a list of error messages.

## H

### Purpose

Display an index of the supervisory port commands and the options available for each command. The index is organized in command groups. The following command groups are displayed:

- MMI commands
- Edit configuration database commands
- Edit flip database commands
- Diagnostic commands
- Status commands
- Alarm operation commands
- Other commands, which do not fit in the previous groups
- Menu navigation commands.

The index of commands begins with a list of the notational conventions used by the HELP function.

### Syntax

H

### Use

- To enter the help system, type:  
**H<Enter>**
- You will see the first HELP page. Press any key to display the next page.

## HELP

### Purpose

Display an index of the supervisory port commands and the options available for each command.

This command is identical to the H command. For a description of the display fields, refer to the H command above.

## INIT AP

### Purpose

Return the alarm priorities to the default values.

### Syntax & Use

```
INIT AP<Enter>
```

## INIT DB

### Purpose

Load the default parameters in the database being edited. This command is identical to the DB INIT command.

For a description of the display fields, refer to the DB INIT command above.

## INJER

### Purpose

Inject one error in the test sequence during BER testing of a selected HS-Q/N module.

Since the test subsystem of the HS-Q/N module can perform only one BER test at any given time, it is not necessary to specify the exact target (for example, channel) on which the test is being performed.

### Syntax & Use

Type:

```
INJER SS<Enter>
```

where SS is the slot number of the desired module.

## LOAD DB

### Purpose

Copy a selected database from the non-volatile memory to the edit buffer. You can display the databases stored in the non-volatile memory using the DSP DB LIST command.

### Syntax & Use

Type:

```
LOAD DB D<Enter>
```

where D is the desired database number, in the range of 1 through 10.



## RESET

### Purpose

Reset a module installed in a specified slot.

### Syntax & Use

1. To reset a module, type:

```
RESET SS<Enter>
```

where SS is the slot number of the desired module.

2. You are requested to confirm the operation:
  - Type N to cancel
  - Type Y to confirm.

## TIME

### Purpose

Set the time for the Megaplex internal real time clock.

### Syntax

```
TIME
```

### Use

- To set the time, type:

```
TIME<Enter>
```

- The Megaplex sends the time entry form:

```
HOUR    = 12  
MINUTE  = 25  
SECOND  = 16
```

- Bring the cursor to the first field to be changed by pressing <Enter>.
- To change the selected field, press F to increase and B to decrease the displayed values. When done, press <Enter> to move to the next field.
- Set the time about one minute beyond the current time, and then press <Enter> at the correct instant.



# Chapter 6

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## Monitoring and Diagnostics

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### 6.1 Alarm Messages

*Table 6-1* lists the alarm messages generated by the Megaplex software version 12 and higher and explains their interpretation. The alarm messages are listed in ascending order of their codes.

**Note**

*A state alarm is an alarm that is in the ON state while a certain condition is present, and automatically changes to OFF when the condition is no longer present. This type of alarm cannot be cleared (removed from the alarm buffer) while it is in the ON state.*

*An event alarm is an alarm that records the occurrence of an event. This type of alarm can be cleared at any time.*

For each alarm, *Table 6-1* also specifies the type (event or state), and lists the default severity level for state alarms. The severity level can be modified in accordance with the specific customer's requirements using the DEF AP command.

*Table 6-1. Alarm Messages*

Code	Message	Default Severity	Interpretation
<b>SNMP Agent Alarms</b>			
001	DB CONTROL WAS TAKEN BY TERM MMI	Event	The Megaplex database is being edited by an SNMP-based network management station, e.g., RADview, while it is also being edited using an ASCII terminal. It is user's responsibility to prevent possible conflicts by stopping the editing from either the terminal or the management station
002	Reserved	N/A	N/A
003	SWITCH OF DB OCCURRED	Event	The active database of the Megaplex has been changed
004	LOSS OF ALMS FROM HISTORY BUFFER	Event	More than 256 alarms have occurred since the Megaplex alarm buffer was last read. The alarm buffer of the Megaplex has been filled up and the new alarms are overwriting the oldest alarms (the first alarms stored in the alarm buffer)

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
005	NO MEM LEFT FOR TRACING NEW ALMS	Major	No additional memory space can be allocated for tracing new alarms in the Megaplex. New alarms will be lost
006	Reserved	N/A	N/A
007	CL-A & CL-B HAVE DIFF SW/HW PROGRAM	Major	Different software versions are stored by the two CL modules installed in the Megaplex. Ignore this message if it appears during the downloading of a new software version
008	Reserved	N/A	N/A
009	CLK IS DIFFERENT FROM MASTER CLK SRC	Major	The Megaplex has switched to the fallback clock source, or to the internal oscillator. This indicates a major failure in the source which provided the master clock source
010	CLK CHANGED TO MASTER CLK SRC	Event	The clock source has been changed to the specified source
011	CLK CHANGED TO FALLBACK CLK SRC		
012	CLK CHANGED TO INTERNAL CLK SRC		
013	AGENT WITH SAME IP IN NET	Major	Another RAD IP entity in the network uses the IP address configured on the Megaplex SNMP agent. Check and correct the IP address
014	AGENT WITH SAME NAME IN NET	Minor	Another IP entity in the network used for SNMP management uses the logical name configured on the SNMP agent of the Megaplex. Check and correct the logical name
015	BAD EXTERNAL TDM CLOCK	Major	The external clock source which has been selected as a master or fallback source, is missing or failed
016	INVALID CHASSIS TYPE	Major	The CL module installed in the Megaplex is not of the correct CL type. Replace the CL module
017	Reserved	N/A	N/A
018	DB UPDATE OCCURRED	Event	The Megaplex has stored the edited database in the non-volatile memory (appears after executing a DB UPD command)
019	DB CONTROL WAS TAKEN BY SNMP MMI	Event	The Megaplex database is being edited from an ASCII terminal, while it is also being edited by an SNMP-based network management station. It is user's responsibility to prevent possible conflicts by stopping the editing from either the terminal or the management station
<b>General Module Alarms</b>			
020	INTERNAL MESSAGE	Event	The module reports an internal RAD message used for SW tracking. Report the internal message number to RAD technical support personnel
021	MODULE WAS REMOVED	Event	A module has been removed from the specified slot
022	MODULE WAS INSERTED	Event	A module has been inserted in the specified slot

Code	Message	Default Severity	Interpretation				
023	RESET OCCURRED	Event	The module installed in the specified slot has been reset automatically				
024	HARDWARE/INIT FAILURE	Major	An error has been detected during the power-up self-test and/or during the module initialization process. In case the alarm remains in the ON state, remove the module, and then reinsert it in its slot. If problem recurs, replace the module				
025	NOT PROGRAMMED MODULE	Minor	The module identified by the CL module as being installed in the specified slot is not programmed in the active database				
026	MODULE TYPE MISMATCH	Major	The module identified by the CL module as being installed in the specified slot is not of the type programmed in the active database				
027	MODULE SEMI ID MISMATCH	Major	The modules that have been read from the Megaplex unit do not fully match the modules programmed in the active database				
028	HARDWARE/SOFTWARE MISMATCH	Major	The selected configuration parameters are not supported by the software and/or hardware version of the installed module. The meaning of this alarm depends on the module type, as explained below:				
			<table border="1"> <thead> <tr> <th>Module</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>ML-20N</td> <td> <ol style="list-style-type: none"> <li>The module has AMI interfaces, and you selected a data rate lower than 512 kbps for a connected interface.</li> <li>The module has AMI interfaces, and you selected <b>CALL IN</b> or <b>CALL OUT</b> for <b>DIAL PROCESS</b>.</li> <li>You selected <b>YES</b> for <b>ERROR CORRECTION</b> on a connected channel of a module without AMI interfaces.</li> <li>When <b>DIAL PROCESS</b> is <b>NO</b>, you are trying to connect a channel whose interface type cannot be determined (in this case, replace the ML-20N module)</li> <li>You are trying to configure n timeslots while the module rate is n x 56/64 kbps and your CL version is 11x or lower (for these versions only n-1 timeslots can be configured). This is possible starting from CL ver 12 and provided "Signaling &amp; Management" is not set (thus, TS0 can be used for 56K data). This feature is neither supported for ML-20N with SW version &lt; 1.10.</li> </ol> </td> </tr> </tbody> </table>	Module	Meaning	ML-20N	<ol style="list-style-type: none"> <li>The module has AMI interfaces, and you selected a data rate lower than 512 kbps for a connected interface.</li> <li>The module has AMI interfaces, and you selected <b>CALL IN</b> or <b>CALL OUT</b> for <b>DIAL PROCESS</b>.</li> <li>You selected <b>YES</b> for <b>ERROR CORRECTION</b> on a connected channel of a module without AMI interfaces.</li> <li>When <b>DIAL PROCESS</b> is <b>NO</b>, you are trying to connect a channel whose interface type cannot be determined (in this case, replace the ML-20N module)</li> <li>You are trying to configure n timeslots while the module rate is n x 56/64 kbps and your CL version is 11x or lower (for these versions only n-1 timeslots can be configured). This is possible starting from CL ver 12 and provided "Signaling &amp; Management" is not set (thus, TS0 can be used for 56K data). This feature is neither supported for ML-20N with SW version &lt; 1.10.</li> </ol>
Module	Meaning						
ML-20N	<ol style="list-style-type: none"> <li>The module has AMI interfaces, and you selected a data rate lower than 512 kbps for a connected interface.</li> <li>The module has AMI interfaces, and you selected <b>CALL IN</b> or <b>CALL OUT</b> for <b>DIAL PROCESS</b>.</li> <li>You selected <b>YES</b> for <b>ERROR CORRECTION</b> on a connected channel of a module without AMI interfaces.</li> <li>When <b>DIAL PROCESS</b> is <b>NO</b>, you are trying to connect a channel whose interface type cannot be determined (in this case, replace the ML-20N module)</li> <li>You are trying to configure n timeslots while the module rate is n x 56/64 kbps and your CL version is 11x or lower (for these versions only n-1 timeslots can be configured). This is possible starting from CL ver 12 and provided "Signaling &amp; Management" is not set (thus, TS0 can be used for 56K data). This feature is neither supported for ML-20N with SW version &lt; 1.10.</li> </ol>						

Code	Message	Default Severity	Interpretation
			<p>Main Link (ML/MLF-1/2) Modules</p> <ol style="list-style-type: none"> <li>1. You are trying to enable Y-cable redundancy for a module whose software version does not support this feature. This option is supported only starting with ML-2 software version 1.11, or ML-4 software version 11.11.</li> <li>2. You are trying to enable ring redundancy for a module whose software version does not support this feature. This option is supported only by software version 14 or higher.</li> <li>3. You are trying to configure <b>FDL = NONE</b> for a module whose software version does not support this feature. This option is supported only starting with ML-2 software version 1.13, or ML-4 software version 11.13.</li> <li>4. You are trying to select an R2 profile for a module whose software version does not support this feature. This option is supported only by software version 15.18 or higher.</li> </ol> <p>Contact RAD Technical Support Department for information on software upgrades</p>
			<p>HS-DP/3, HS-DP/6</p> <p>You are trying to connect a channel whose interface type cannot be determined (in this case, replace the module)</p>
			<p>HS-S</p> <ol style="list-style-type: none"> <li>1. You are trying to enable D-channel compression for a module whose version does not support this feature. Contact RAD Technical Support Department for information on upgrades.</li> <li>2. The interface type (TE or NT) does not match the module hardware. Check and if necessary replace the module.</li> <li>3. You are trying to configure the module for using all the four TDM buses in the chassis, but the module version does not support this feature. Contact RAD Technical Support Department for information on upgrades.</li> </ol>
			<p>HS-2, HS-Q/N</p> <p>You cannot connect a channel with V.35 interface when the clock mode is DCE.</p>
			<p>HS-ETH</p> <ol style="list-style-type: none"> <li>1. You cannot configure channels not supported by this module version (not relevant for the 4-channel version).</li> <li>2. You are trying to configure the bus connection parameters for a module not supporting this option (only the HS-ETH/B/CD version supports this option).</li> </ol>

Code	Message	Default Severity	Interpretation
		HS-U-6, HS-U-12	<ol style="list-style-type: none"> <li>1. You cannot enable RLB or LLB when using V.110 rate adaptation.</li> <li>2. It is not allowed to select 56 kbps or 128 kbps in the synchronous mode.</li> </ol>
		HS-R, HS-RN	<ul style="list-style-type: none"> <li>• You are trying to configure a HS-R module for using all the four TDM buses in the chassis, but this capability is supported only by HS-RN modules (that is, module hardware version 6 and higher).</li> <li>• You are trying to configure a HS-RN module for operation at 48 kbps, but this capability is supported only by HS-R modules (that is, module hardware version 5 or lower).</li> <li>• You are trying to configure an HS-R module for operation at 7.2, 14.4, or 28.8 kbps, but this capability is supported only by HS-RN modules (that is, module hardware version 6 and higher).</li> <li>• You are trying to configure a HS-RN/V.110 module for operation at 7.2, 14.4, or 28.8 kbps, but this capability is not supported.</li> <li>• You are trying to configure an HS-RN module for operation at Encapsulation mode=Latency Optimized in an HS-RN/V.110 module.</li> <li>• You are trying to configure a HS-RN module for operation at Encapsulation mode=Latency Optimized, but this capability is supported only by HS-RN modules with SW version higher than 50.</li> </ul>
		LS-6N, LS-12	<ul style="list-style-type: none"> <li>• In the synchronous mode, it is not allowed to select the DCE mode when the port hardware interface is DTE.</li> <li>• In the synchronous mode, it is not allowed to select the DTE mode when the port hardware interface is DCE.</li> <li>• The hardware version of the module does not support the selection of a 14.4 kbps rate. This option is supported only by hardware versions higher than 6.</li> </ul>

Code	Message	Default Severity	Interpretation
			<p>VC-4, VC-8, VC-16, VC-4A, VC-8A</p> <ul style="list-style-type: none"> <li>You are trying to enable signaling, but the hardware version of the module does not support metering pulses and reverse polarity signaling.</li> <li>The hardware version of a module with FXS or FXO interface does not support metering pulses and reverse polarity signaling, and you select the WINK START mode.</li> <li>You are trying to select ADPCM on a module does not include the additional hardware needed to support ADPCM.</li> <li>You are trying to select ADVANCED signaling services for a module whose software version does not support this feature. This option is supported only by software versions higher than 4. Contact RAD Technical Support Department for information on software upgrades.</li> <li>You are trying to select fault propagation on a module which is not VC-8/E&amp;M/RJ/POS/24.</li> </ul>
			<p>VC-6A</p> <ul style="list-style-type: none"> <li>You are trying to select ADPCM on a module does not include the additional hardware needed to support ADPCM.</li> <li>You are trying to select the 4-wire interface on a module which cannot support that selection.</li> <li>You cannot connect channels 5 and 6 on a VC-6/LB module which has only 4 channels</li> </ul>
			<p>VC-16A</p> <ol style="list-style-type: none"> <li>You are trying to select ADPCM for a module which supports the LINEAR mode.</li> <li>You are trying to select LINEAR encoding, but the hardware version of the module does not support this mode</li> </ol>
			<p>VF/VFS</p> <p>You are trying to select a specific fax rate when using a VF module with level 2.07 or earlier. Early hardware versions do not support this feature</p>
			<p>ML-IP</p> <p>Some of the ML-IP capabilities are supported only by ML-IP modules running software version 17.11 or higher, and daughter board versions 3.0 or higher (e.g., you may see this message if you are trying to use 1:1 redundancy for a module with previous software versions).</p> <p>Contact RAD Technical Support Department for information on software upgrades available for your specific ML-IP module</p>
029	NOT SUPPORTED SOFTWARE VER	Major	The module software version is not supported by the CL software



<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
030	BUS ERROR	Event	A temporary problem has been detected on the bus
031	COMMUNICATION FAILURE	Event	The CL module reported a temporary failure in the communication with I/O modules
032	LOOP ON MANAGEMENT PORT	Major	A test loopback has been activated on the management port, or the management port receives its own messages. Management of remote units is not possible while this condition is present
033	MANAGEMENT LINK IS DOWN	Major	The CL module cannot establish IP communication with the remote end. This may indicate incorrect set-up of the management port communication parameters, a disconnection along the communication path, or a hardware failure
034	NOT SUPPORTED HARDWARE VER	Major	The module hardware version is not supported by the CL software
035	Reserved for future use	Major	
036	SOFTWARE LOADING STARTED	Event	Informative message – indicates that software downloading using TFTP has been started
037	SOFTWARE LOADING COMPLETED	Event	Informative message – indicates that software downloading has been successfully completed
038	ABORT SOFTWARE LOADING	Event	Informative message – indicates that software downloading has been stopped before its successful completion
039	Reserved	N/A	N/A
<b>Power Supply Alarms</b>			
040	+5V POWER SUPPLY FAILURE	Major	The +5V voltage is missing. Turn the Megaplex off and then on again. If problem recurs, replace the power supply unit
041	-5V POWER SUPPLY FAILURE	Major	The -5V voltage is missing. Turn the Megaplex off and then on again. If problem recurs, replace the power supply unit
042	12V POWER SUPPLY FAILURE	Major	The 12V voltage is missing. Turn the Megaplex off and then on again. If problem recurs, replace the power supply unit
043	POWER SUPPLY'S FAN FAILURE	Major	The internal cooling fan of the power supply failed
044 to 049	Reserved for future use	N/A	N/A
<b>Additional SNMP Agent Alarms</b>			
050	CL FLIP OCCURRED	Event	Megaplex has switched to the other CL module
051	TERMINAL ACCESS WAS CHANGED	Event	This message is generated when TERMINAL access was changed (from disabled to enabled or vice versa).

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
052	DB SENT BY TFTP/SW VER MISMATCH	Event	This message is generated during the downloading of a database through TFTP, in case the CL software version indicated in the received data block differs from the software version installed in the local CL module
053	DB SENT BY TFTP IS CORRUPTED	Event	One or more blocks of the database file sent through TFTP is corrupted
054	TFTP FILE, AGENT IP/NAME MISMATCH	Event	This message may be generated only when downloading via TFTP a full NVRAM database file: it indicates that the <IP address and agent name> from which the file has been uploaded do not match the <IP address and agent name> to which you are trying to download the file.  The IP address and agent name of the CL modules installed in a given Megaplex chassis are both configured by means of the DEF AGENT command
055	DBS UPDATED BY TFTP	Event	This message is generated after receiving via TFTP a full NVRAM database file (containing all the 10 databases) and successfully updating all the local CL databases.  Informative message – no action required
056	TFTP FILE, CL TYPE/HW MISMATCH	Event	This message is generated during the downloading of a database through TFTP, in case the CL type and hardware version indicated in the received data block differs from the type and/or hardware version of the local CL module
057	DB LOADED BY TFTP	Event	This message is generated after receiving via TFTP a database file intended for loading into the edit buffer of the local CL: it indicates that the edit buffer contents have been successfully updated. After entering the DB UPD command, these contents update the active database.  Informative message – no action required
058	NOT MEGAPLEX SW VERSION	Event	This message is generated during the downloading of software through TFTP, in case the file received for downloading is not a CL version file.  Informative message – no action required
059	SW DOESN'T SUPPORT CL HW	Event	This message is generated during the downloading of software through TFTP, in case the software version indicated in the received data block differs from the type and/or hardware version of the local CL module.  Informative message – no action required
<b>CL Module Alarms</b>			
060	DEFAULT DB LOADED ON STARTUP	Event	During the power-up self-test it was found that the Megaplex database is missing or corrupted. The default database has been loaded
061	DATABASE CHECKSUM ERROR	Major	A checksum error has been detected when trying to send the database to the redundant CL module

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
062	CL-A AND CL-B HAVE DIFF DB CKSUM	Major	The checksums calculated by the system for the contents of the databases stored in the CL modules installed in the Megaplex chassis are different. Either database may be correct
063	Reserved	N/A	N/A
064	DIP SWITCH IS ON STATE	Major	Indicates that one of the sections 1 through 5 of the DIP switch located on the CL module is set to the ON position. Check and set to OFF
065	SAVE TO NVRAM FAIL	Event	The new or modified database could not be saved (written) to the non-volatile memory of the CL module.
066	NVRAM ALMOST FULL	Major	The remaining capacity of the CL non-volatile memory is low, and may not enable proper operation
067	COPY DB'S TO RDN CL IN PROCESS	Minor	The database of the active CL module is being copied to the slave CL module (relevant only when the Megaplex chassis includes two CL modules, for redundancy)
068	COPY DB'S TO RDN CL COMPLETED	Event	The database of the active CL module has been successfully transferred to the slave CL module (relevant only when the Megaplex chassis includes two CL modules, for redundancy)
069 to 079	Reserved for future use	N/A	N/A
<b>Main Link Alarms (see also alarms 591 and 598)</b>			
080	T1/E1 FRAME SLIP HAS OCCURRED	Event	A main link frame slip has occurred. This is usually caused by incorrect selection of clock sources
081	BPV ERROR HAS OCCURRED	Event	A bipolar violation error has been detected on the main link
082	EXCESSIVE BIPOLAR VIOLATION	Major	The number of coding errors detected in the main link signal received by the active main link module port is too high (the bipolar violation rate exceeds $1 \times 10^{-6}$ for 1000 consecutive seconds). This may indicate a fault in the link or in the link transmission equipment, or a failure in the active main link module port. This message is not available when the T1 main link operates with ESF framing
083	EXCESSIVE ERROR RATIO	Major	The error rate detected on the frame synchronization bits is high as defined by ITU-T Rec. G.732. This may indicate hardware problems or defective connections (appears only when an E1 main link is used)
084	ALARM INDICATION SIGNAL	Major	The Alarm Indication Signal (AIS), a framed "all ones" sequence, is received on the corresponding main link
085	AIS RED ALARM	Major	The local frame synchronization has been lost because of AIS reception
086	LOCAL SYNC LOSS	Major	Local main link module port lost synchronization to incoming data stream. May indicate a configuration error or a technical failure. For T1 links, this condition is the red alarm

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
087	REM SYNC LOSS	Major	Remote E1/T1 port lost synchronization to the incoming data stream. May indicate a configuration error or a technical failure. For T1 links, this condition is the yellow alarm.  This alarm may also appear in the VF and VFS modules when AIS is sent by the local equipment to the remote E1/T1 port. This may happen when the local VF or VFS internal port (bundle) loses synchronization with the remote port (bundle). In the VF modules, also a failure of E1/T1 link in the remote module may cause an AIS transmit to the remote E1/T1 port.
088	E1 MULTIFRAME LOCAL SYNC LOSS	Minor	On an E1 main link operating with G732S framing, the corresponding local main link module port has lost multiframe synchronization
089	E1 MULTIFRAME REMOTE SYNC LOSS	Minor	On an E1 main link operating with G732S framing, the corresponding remote main link module port has lost multiframe synchronization
090	LOST SIGNAL ON E1/T1 MODULE	Major	The corresponding main link module port does not receive the main link signal
091	T1/E1 DRIVER FAILURE	Major	Hardware failure on the corresponding main link module port (defective transmit line driver)
092	NETWORK LLB	Minor	A network-initiated line loopback has been activated on the corresponding module port. This loopback cannot be disconnected by the system management. This message may appear only for T1 main links
093	NETWORK PLB	Minor	A network-initiated payload loopback has been activated. This loopback cannot be disconnected by the system management. This message may appear only when using a T1 main link with ESF framing
094	CRC ERROR	Event	The corresponding main link module port reports the detection of a CRC error. This message may appear only for E1 links using the CRC-4 option
095	AIS WAS DETECTED	Major	The Alarm Indication Signal (AIS), a framed "all ones" sequence, is received on the corresponding main link port
096	FIFO BUFFER OVERFLOW/UNDERFLOW	Event	A FIFO overflow/underflow event has occurred. If the event recurs, it is usually caused by incorrect selection of the timing mode and/or user's equipment, or by technical problems (unstable clock) in the timing circuits of the external equipment
097	INTERNAL RATE GENERATOR FAILURE	Major	The internal rate generator of the module failed. If the message persists, the module must be repaired
098	LOCAL SWITCH FROM LBT TO INTERN CLK	Event	The Megaplex has switched to the internal clock source
099	FRAME/MULTIFRAME CLK RESYNC	Event	The corresponding main link module port reports a frame and/or multiframe resynchronization event
100	TCLK MON SYNC ERROR	Major	The corresponding main link module port reports problem with transmit clock synchronization

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
101	REDUNDANCY FLIP OCCURRED	Event	A switch to the other main link port has been performed by the redundancy function (applicable only for dual-link redundant configurations)
102	STATION CLOCK LOSS	Major	The station clock signal has been selected as source 1 or source 2, and is missing
103	LOOP ON MANAGEMENT PORT AT REM SITE	Major	A loopback has been activated at the remote end of the link, and therefore management through this port is not possible while this condition is present
104	INVALID RX CLOCK	Major	The receive clock of the selected port cannot be selected as timing reference source
105	TEST MODE (TM) IS ACTIVE	Minor	A loopback has been activated by external command on the corresponding port
106	Reserved for future use	N/A	N/A
107	USER USED/HW ML VERSION MISMATCH	Major	The hardware version of the corresponding ML module does not support the functions associated with the SET USER command setting (Normal = connected to all 4 TDM buses). An older ML module might support only 2 or 3 TDM buses. Consult with RAD
108	RING CLOCK FAILURE	Major	An E1 or T1 port participating in a ring topology lost its clock reference. This alarm is reported when a port whose receive clock has been configured as nodal clock source loses its receive signal
109	PORT DISABLED	Major	The specified port has been deactivated by administrative command
110	SLOT DEACTIVATED	Major	The specified module has been deactivated by administrative command. This will turn off all the activity alarms related to the deactivated slot
111	RING CONNECTION MISMATCH	Major	East-West mismatch indication in physical connections of primary or secondary ports of an E1 or T1 ring; the primary port of each ring node must be connected to the secondary port of the adjacent ring node
112	RING DOUBLE FAIL DETECT	Major	Two failures have been detected in the E1/T1 ring
113 to 119	Reserved for future use	N/A	N/A
<b>High-Speed Data Module Alarms</b>			
120	FIFO BUFFER OVERFLOW/UNDERFLOW	Event	The FIFO buffer of the specified HS-6N or HS-12N module channel overflowed or underflowed. If the event recurs, it is usually caused by incorrect selection of the timing mode on the module channels and/or user's equipment, or by technical problems (unstable clock) in the timing circuits of the user's equipment.  This message can appear only when the channel RTS line is active

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
121	INTERNAL RATE GENERATOR FAILURE	Major	The internal baud rate generator of the specified channel failed. The module must be repaired
122	RTS IS OFF	Minor	The RTS line (or the CI line for a channel with X.21 interface) is off
123	FT1 LB IS ACTIVE	Minor	A remote loopback has been activated on the specified channel by the reception of an FT1 inband loopback activation code
124	CARD/INTERFACE MISMATCH	Major	The selected interface type is not supported by the specified HS-6N or HS-12N module
125	ILLEGAL LINK RATE FOR RS232	Major	For RS-232 ports, you can select only a rate of 64 kbps
126 to 139	Reserved for future use	N/A	N/A
140 to 144	Reserved	N/A	N/A
145 to 159	Reserved for future use	N/A	N/A
<b>VC-6/VC-6A/VC-6AG Module Alarms</b>			
160	COMBO FAILURE ERROR	Major	The COMBO of the specified voice channel failed. This state is often reported because of a transient fault. If the fault state persists, the module must be repaired as soon as possible
161	CAS ALARM	Major	The state machine implementing the R2 protocol is currently in an alarm state
162	CAS FAULT	Major	The state machine implementing the R2 protocol is currently in a fault state
163	BLOCKED BY THE REMOTE UNIT	Major	The call has been blocked by the outgoing state machine (remote unit rejected the call set up request)
164	RINGER VOLTAGE NOT SUPPLIED	Major	The voice module reports that it does not receive the voltage needed to generate the ring voltage
165	Reserved	N/A	N/A
166	FAN FAILURE	Major	The internal cooling fan of the module does not operate. Replace the module immediately
167	ADPCM SYNC LOSS	Major	The ADPCM codec has lost synchronization. If the problem persist after module is reset, replace the module
168 to 179	Reserved for future use	N/A	N/A
<b>HS-S/HS-RN Module Alarms</b>			
210	SLIP HAS OCCURRED	Event	A frame slip has occurred at the specified port. This is usually caused by incorrect selection of timing mode
211	SYNC LOSS	Major	The specified channel reports loss of input signal or loss of synchronization

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
212	LOSS OF SIGNAL ERR	Major	Loss of input signal or loss of synchronization at the specified port
213	FIFO BUFFER OVERFLOW/UNDERFLOW	Event	The FIFO of the specified port has overflowed/underflowed
<b>HS-703 Module Alarms</b>			
250	MODULE LOSS OF INPUT SIGNAL ERR	Major	The input signal of the specified HS-703 channel is missing
251	LOC SYNC LOSS	Major	Loss of synchronization to the received data on the specified HS-703 channel
252	BIPOLAR VIOLATION ERROR	Major	The octet timing of the specified HS-703 channel (carried by bipolar violations) has been lost
253	Reserved	N/A	N/A
254, 255	Reserved for future use	N/A	N/A
256, 257	Reserved	N/A	N/A
258, 259	Reserved for future use	N/A	N/A
260 to 263	Reserved	N/A	N/A
264, 265	Reserved for future use	N/A	N/A
266, 267	Reserved	N/A	N/A
268 to 274	Reserved for future use	N/A	N/A
275 to 287	Reserved	N/A	N/A
288, 289	Reserved for future use	N/A	N/A
<b>LS-12, LS-6N Modules Alarms</b>			
290	LOC SYNC LOSS	Major	The specified internal port lost synchronization to incoming data stream
291	REM SYNC LOSS	Major	The specified internal port of the remote module reports loss of synchronization

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
292	BUFFER OVERFLOW	Event	An overflow/underflow event has occurred in the buffer of the specified channel. If the event recurs, it is usually caused by incorrect selection of the timing mode and/or user's equipment, or by technical problems (unstable clock) in the timing circuits of the external equipment
293	Reserved	N/A	N/A
294	INTERNAL RATE GENERATOR FAILURE	Major	The internal rate generator of the corresponding internal port failed. If the message persists, the module must be repaired
295	Reserved for future use	N/A	N/A
<b>HS-DP/3, HS-DP/6 Module Alarms</b>			
296	LOSS OF SIGNAL	Major	Loss of input signal of the corresponding external port. This may be caused by a problem in the connection to the user's equipment, in the user's equipment, or a module malfunction
297	OUT OF SERVICE CONDITION	Major	The corresponding port reports an out of service condition
298	NETWORK DSU LOOP IS ACTIVE	Minor	A DSU loopback has been activated on the corresponding port
299	NETWORK OSU LOOP IS ACTIVE	Minor	An OCU loopback has been activated on the corresponding port
300	NETWORK CSU LOOP IS ACTIVE	Minor	A CSU loopback has been activated on the corresponding port
301 to 309	Reserved for future use	N/A	N/A
310 to 379	Reserved	N/A	N/A
<b>HS-U-12 Module Alarms</b>			
380	COMPLETE LOOPBACK ON B1 B2 D	Minor	Loopbacks have been activated on all the channels (B1, B2, and D) of the specified ISDN port
381	LOOPBACK ON B1	Minor	A loopback has been activated on the B1 channel of the specified ISDN port
382	LOOPBACK ON B2	Minor	A loopback has been activated on the B2 channel of the specified ISDN port
383	PRIMARY POWER SUPPLY FAILURE	Major	The power supply installed in the PS-A slot has failed
384	SECONDARY POWER SUPPLY FAILURE	Major	The power supply installed in the PS-B slot has failed
385	NT DEVICE UNDER TEST	Major	A test has been activated on the NT or NT1 device connected to the specified ISDN port



<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
386	ASMi-31A CONFIG MISMATCH	Major	The ASMi-31 unit connected to the specified HS-U-12 port uses an incompatible configuration
387	ASMi-31B NVRAM FAILED	Major	The non-volatile memory of the ASMi-31 unit connected to the specified HS-U-12 port has failed
388	ASMi-31C NO INTERFACE	Major	No interface card is installed in the ASMi-31 unit connected to the specified HS-U-12 port
389	Reserved	N/A	N/A
390	ASMi-31 ILLEGAL CLOCK SOURCE	Major	The clock source selected for the ASMi-31 unit connected to the specified HS-U-12 port is not valid for the current operation mode
391	ASMi-31 LLB INITIATED BY DTE	Minor	A local loop has been activated by the corresponding HS-U-12 module port, in response to a request from ASMi-31 (applied through the LLB pin in the ASMi-31 user's connector)
392	Reserved	N/A	N/A
393	ASMi-31 RTS OFF	Minor	The user's equipment connected to the ASMi-31 dropped the RTS line
394 to 399	Reserved for future use	N/A	N/A

#### ACM Module Alarms

400 to 402	Reserved	N/A	N/A
403 to 410	Reserved for future use	N/A	N/A
411 to 528	Reserved	N/A	N/A
529	Reserved for future use	N/A	N/A

#### Additional HS-U-6, HS-U-12 Module Alarms - Full Duplex Support

530	NT DEVICE UNDER TEST	Minor	The NT device reports a test condition (indication provided only by a HS-U port configured for the /I mode)
531	ASMi-31 NO INTERFACE	Major	The ASMi-31 connected to the corresponding port reports that it does not include the user's interface board (this indication is generated only when the port is configured for operation in the synchronous mode)
532	ASMi-31 LLB INITIATED BY DTE	Minor	The ASMi-31 connected to the corresponding port reports that a local loopback has been activated in response to the control signal received from the user's equipment via the LLB pin in the user's interface connector
533	ASMi-31 RLB INITIATED BY DTE	Minor	A local loopback has been activated on the corresponding HS-U-12 module port in response to a command sent by the ASMi-31 (this command is sent when the user's equipment activates the RLB pin in the user's interface connector)

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
534	ASMi-31 RTS OFF	Minor	The user's equipment connected to the ASMi-31 dropped the RTS line
535	EXTERNAL UNIT MISMATCH	Minor	The modem connected to an HS-U-12 port configured for the /1 mode is not the modem type configured by the user.
536 to 569	Reserved for future use	N/A	N/A
<b>HS-ETH Module Alarms</b>			
570	LOSS OF INPUT SIGNAL	Major	The HS-ETH module reports loss of signal (indication available only when the CI line is active)
571	Reserved	N/A	N/A
572 to 579	Reserved for future use	N/A	N/A
<b>ML-IP Module Alarms</b>			
580	NO CARRIER SENSE	Major	The corresponding Ethernet port reports no-carrier-sense condition. Check port connections, replace the cable connected to the port, and make sure the port is connected to an active LAN or to another Ethernet port
581	SEQUENCE ERROR	Event	Packets have been received in incorrect order for the specified bundle
582	SYNC LOSS	Major	Loss of synchronization on the specified bundle. Check configuration and proper operation of the equipment at the remote end of the link. The bundle is the standby bundle in a 1:1 redundancy pair, and no OAM keep-alive messages are received
583	JITTER BUFFER OVERFLOW/UNDERFLOW	Event	Frames have been dropped because of a buffer overflow or underflow event (may appear only when the affected bundle is synchronized)
584	IN1 ALL BUNDLES SYNC LOSS	Major	Loss of synchronization on all the bundles carried by internal port IN1
585	IN2 ALL BUNDLES SYNC LOSS	Major	Loss of synchronization on all the bundles carried by internal port IN2
586	Reserved for future use	N/A	N/A
587	Reserved for future use	N/A	N/A
588	BND IS NOT CONNECTED TO TS	Major	The corresponding bundle is not connected to any internal port timeslot
589	TS IS NOT CONNECTED TO BND	Major	The corresponding internal port timeslot is not connected to any bundle
590	RING PORT IS DOWN	Major	The corresponding port (participating in a ring topology) is open
591	RING IS OPEN	Major	The E1/T1 or IP ring is open (the problem may have occurred in another chassis)

<b>Code</b>	<b>Message</b>	<b>Default Severity</b>	<b>Interpretation</b>
592	IN1 ECHO CANCELER NOT SUPPORTED	Major	The internal port IN1 is not equipped with an echo canceller, therefore you cannot enable echo canceling on this port
593	IN2 ECHO CANCELER NOT SUPPORTED	Major	The internal port IN2 is not equipped with an echo canceller, therefore you cannot enable echo canceling on this port
594	Reserved for future use	N/A	N/A
595	Reserved for future use	N/A	N/A
596	OAM SYNC LOSS	Major	OAM messages not received, or no reply to OAM echo message
597	OAM CONFIGURATION MISMATCH	Major	OAM is not configured at the far end equipment
598	MANUAL FLIP OCCURED	Event	This is to notify that you have performed the DEF RDN ST/DEF RDN BND ST command on the standby link/bundle and both ports are set to ENABLE
599	Reserved for future use	N/A	N/A
<b>Additional ML-20N Alarms</b>			
620	SATELLITE FIFO BUFFER OVERFLOW/UNDERFLOW	Major	An overflow or underflow of the satellite FIFO buffer of the corresponding port occurred. Check configuration of timing flow
621	RECEIVED RATE IS NOT SUPPORTED	Major	The data rate detected by a port using the automatic rate mode is not supported by the module
622	RCV RATE EXCEEDS ASSIGNED TS	Major	When using the automatic rate mode, the data rate detected by the corresponding port exceeds the number of timeslots configured for the port
623	ILLEGAL CLOCK SOURCE	Major	For ports with AMI interface, you must select the EXT DTE timing mode
624	BAUD RATE GENERATOR FAILURE	Event	A hardware failure occurred. If the problem persists after removing and reinserting the module, replace it
625	ERROR CORRECTION SYNC LOSS	Event	The error correction subsystem lost synchronization
626	RCV RATE LESS THAN ASSIGNED TS	Major	When using the automatic rate mode, the data rate detected by the corresponding port is less than the (total number of timeslots selected by user + 1) (for timeslot 0)
627	ILLEGAL CLOCK MODE	Major	For an ML-20N module with AMI interfaces, only the EXT DCE clock mode is allowed
628	LOSS OF RX CLOCK	Major	When Clock mode is Ext-DCE or DTE and no receive clock exists

Code	Message	Default Severity	Interpretation
629	Reserved for future use	N/A	N/A
<b>VF/VFS-24, VF/VFS-30, VF/VFS-48, VF/VFS-60 Alarms</b>			
630	INTERNAL PORT OUT OF SERVICE	Major	Alarm on internal port indicating that no correct frames received on this internal port:  Remote alarm indication - internal port reports an alarm as a result of a link failure in the remote unit.  Remote sync loss - internal port reports an alarm as a result of the remote receiver not receiving information.  Application ID alarm - internal port reports an alarm as a result of the remote side sending frames with application ID different from that configured on the local internal port
631	INTERNAL TS ASSIGNMENT FAILURE	Major	Failure of timeslot assignment on the corresponding internal port. Some timeslots may not carry data
632	REM INTERNAL PORT IS OUT OF SERVICE	Major	Remote sync loss on this internal port (bundle)
633 to 635	Reserved for future use	N/A	N/A
<b>HS-ETH/SW Module Alarms</b>			
636	HOST IP ADDRESS NOT ALLOCATED	Major	The module is configured to operate in the DHCP mode, and did not receive an IP address from the DHCP server
637	LAN LINK LOSS	Major	The module LAN port reports loss of link integrity. Check proper cable connection to a LAN with at least one active station
638 to 639	Reserved for future use	N/A	N/A
640	PORT IS DOWN	Major	WAN port (bundle) configured to use the PPP protocol is not synchronized
641 to 644	Reserved for future use	N/A	N/A

## 6.2 Configuration Error ("Sanity") Messages

*Table 6-2* lists the configuration error messages generated by Megaplex software version 11.2 and higher and explains their interpretation (such messages are often referred to as "sanity errors", because they are detected by the so-called *sanity check* automatically performed to confirm correct configuration of the equipment).

The messages are listed in ascending order of their codes.

Table 6-2. Error Messages

Code	Type	Syntax	Meaning
<b>Global Sanity Messages</b>			
000 to 099	N/A	Reserved	N/A
100	Error	AT LEAST ONE PS CARD MUST BE DEFINED	Check that at least one power supply module is defined in the system configuration
101	N/A	Reserved	N/A
102	Error	AT LEAST ONE CL CARD MUST BE DEFINED	At least one CL module must be defined in the system configuration
103	Error	AT LEAST ONE TDM TRUNK CARD MUST DEFINED	If one or more regular I/O modules are defined in the edited database: at least one main link module must be defined in the Megaplex
104	N/A	Reserved	N/A
105	Error	ILLEGAL CLOCK SOURCE FOR MASTER CLOCK	When configuring the master clock source to be locked to the receive clock of a module, the source module can only be a main link port with E1 or T1 interface
106	Error	ILLEGAL CLOCK SOURCE CHANNEL FOR MASTER CLOCK	Check 105 has been successfully passed, however the number of the source channel selected by you as the master clock source is not a valid number for the source module type
107	N/A	Reserved	N/A
108	Error	MASTER/FALLBACK CLOCK SOURCE MISMATCH	Checks 111 and 112 have been successfully passed, however the HS-Q modules do not support the selection of both master and fallback clock sources from different channels of the same module
109	Error	ILLEGAL MASTER CLOCK SOURCE MODE	Check 111 has been successfully passed, however when the master clock source is a main link module port, the clock mode of the module must be NODAL
110	Warning	CARD TYPE MISMATCH	Differences have been found between the modules actually installed in the equipment, and the modules programmed in the database
111	Error	MASTER CLOCK NOT CONNECTED	When configuring the master clock source to be locked to the receive clock of a module/channel, the source module/channel must be connected
112	Error	FALLBACK CLOCK NOT CONNECTED	When configuring the fallback clock source to be locked to the receive clock of a module/channel, the source module/channel must be connected
113	Error	ILLEGAL CLOCK SOURCE FOR FALLBACK CLOCK	When configuring the fallback clock source to be locked to the receive clock of a module, the source module can only be a main link port with E1 or T1 interface

Code	Type	Syntax	Meaning
114	Error	ILLEGAL CLOCK SOURCE CHANNEL FOR FALLBACK CLOCK	Check 113 has been successfully passed, however the number of the source channel selected by you as the fallback clock source is not a valid number for the source module type
115	Error	ILLEGAL FALLBACK CLOCK SOURCE MODE	Check 112 has been successfully passed, however when the fallback clock source is a main link module port, the clock mode of the module must be NODAL
116	Warning	UNKNOWN MODULE TYPE	The network management station is trying to configure a module which is not supported, by the Megaplex
117	Error	ILLEGAL MASTER CLOCK SOURCE INTERFACE	In HS-U-6/HS-U-12 modules, the interface of the ISDN channel selected as master clock reference cannot provide a reference clock. It must be configured as NT.
118	Error	ILLEGAL FALLBACK CLOCK SOURCE INTERFACE	In HS-U-6/HS-U-12 modules, the interface of the ISDN channel selected as fallback clock reference cannot provide a reference clock. It must be configured as NT.
119	N/A	Reserved for future use	N/A
120	N/A	Reserved	N/A
121	Warning	INTERFACE HW/SW MISMATCH	The interface type configured by the management system differs from the interface selected by means of jumpers

#### FLIP DB Sanity Messages

130	Error	DUPLICATE NET FLIP EVENT INDEX IN NET	The same index number is assigned to more than one net event within the same network
131	Error	TIME EV ALREADY EXIST FOR DAY CATEGORY	Only one time event is allowed for each day category
132	Error	REQUIRED FLIP DB NOT EXIST	One or more of the configuration databases specified in the FLIP DB command does not exist
133	Error	SLOT/EVENT TYPE MISMATCH	A LINK DOWN event can be defined only for a slot in which a main link module port is installed
134	Error	ILLEGAL FLIP CHAN ID	The specified channel is not valid for the requested slot
135	Error	ILLEGAL FLIP LOGICAL EXPRESSION	The logical expression cannot be solved
136	Error	ILLEGAL FLIP TIME RANGE	The end time specified in the command is before the start time
137	N/A	Reserved	N/A
138, 139	N/A	Reserved for future use	N/A

#### Global Module Sanity Messages

140 to 144	N/A	Reserved	N/A
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Code	Type	Syntax	Meaning
145	Error	CLOCK MODE/CLOCK SOURCE MISMATCH	The EXT-DCE clock mode cannot be selected when the port interface is configured as LT-1 (applicable only for HS-U-6 and HS-U-12 modules)
146, 147	N/A	Reserved	N/A
148	Error	PROTOCOL/RATE MISMATCH	Maximum data rate supported for inband management through the FDL or through timeslot 0, is 8 kbps
149 to 151	N/A	Reserved	N/A
152	Warning	RESTORATION TIME DOES NOT MATCH THE STANDARD	For T1 links, the restoration time should be 10 seconds, according to the standard. For E1 links, the restoration time should be in accordance with ITU-T recommendations
153	N/A	Reserved	N/A
154	Error	ILLEGAL NUMBER OF WIRES	Voice modules with /FXO and /FXS interfaces support only the two-wire interface.  For voice modules with /E&M interface, you can select between two-wire and four-wire interfaces  In VC-4/4A/8/8A/16 E&M modules, the same value must be defined for two adjacent channels (1&2, 3&4, etc)
155	Error	ILLEGAL MF SYNC SOURCE	Only a main link or high-speed module with E1 interface module can be selected as a multiframe synchronization source
156	N/A	Reserved	N/A
157	Error	MODULE CAN NOT BE MF SYNCHRONIZE TO ITSELF	A module can be multiframe synchronized only to a different module
158	Error	ASYMMETRIC MF SYNC CONNECTION	The multiframe synchronization source selected by you for the destination slot does not point to the correct source slot
159	Error	FRAME TYPE NOT SUPPORT MF SYNC	It is not allowed to bypass timeslots from a main link port using G732N or G732S-CRC4 to a port using G732N or G732N-CRC4 framing
160	N/A	Reserved	N/A
161	Error	ILLEGAL LINKS COMBINATION	When routing channels of VC-12 modules, the two channels of each pair (channels 1, 2 and channels 3, 4) must be routed to the same main link module port.  In addition, when three or more channels are in use and must be routed to different main links, you must route channels 1, 2 to TDM bus A, and channels 3, 4 to TDM bus B

Code	Type	Syntax	Meaning
162	Error	ROUTING PROTOCOL/ MANAGEMENT TYPE MISMATCH	The message appears when configuring the out-of-band port of the CL module: you can enable the RIP 2 protocol only when the supervisory port is configured for SLIP NMS or PPP NMS. When the message appears when configuring the external port of a main link module port: you can enable the RIP 2 protocol only when the inband management method is configured for DEDICATE PPP or DEDICATE FR
163	Error	FRAME TYPE/PROFILE MISMATCH	All the TX or RX bits are identical
164	Error	CARD DOES NOT SUPPORT BI BRD RX	Defining BI BRD RX for card which does not support this mode.  The cards supporting this mode are: VC-6 (E&M, FXS only), VC-6A (E&M, FXS only), LS-12, LS-6N, HS-RN, HS-2, HS-Q/N, HS-6N, HS-12N
165 to 179	N/A	Reserved for future use	N/A

#### Main Link (E1, T1) Sanity Messages

180	N/A	Reserved	N/A
181	Error	TDM ML NOT CONNECTED TO BUS	At least one main link module port must be connected to a TDM bus
182	Error	FRAME/INBAND MANAGEMENT TYPE MISMATCH	When using the SF framing mode, the inband management type must be OFF
183, 184	N/A	Reserved	N/A
185	Error	ILLEGAL REDUNDANCY ASSIGNMENT	The redundancy assignment of one main link module port does not point to another main link module port
186	Error	ASYMMETRIC REDUNDANCY ASSIGNMENT	The configuration of two main link module ports operating as a redundant pair must be identical
187	N/A	Reserved	N/A
188	N/A	Reserved for future use	N/A
189 to 192	N/A	Reserved	N/A
193	Error	Y CABLE ENABLE ONLY BETWEEN TWO CARDS	When using main link redundancy with Y-cable, the redundancy partner slot must be an external port of another main link module
194	Error	ILLEGAL IDLE CODE SELECTION	When configuring the idle code for a main link module with T1 interface, the second digit of the idle code must not be 0



Code	Type	Syntax	Meaning
195	Error	TEST/REDUNDANCY ASSIGNMENT MISMATCH	This message appears when a test is activated on the current master (active) main link port of a redundant pair
196	N/A	Reserved for future use	N/A
197	Error	LINE CODE/INBAND MANAGEMENT TYPE MISMATCH	For main link ports with T1 using the B7 line code, it is not allowed to use inband management
198	Error	R2 PROFILE DOESN'T WORK IN T1	R2 profiles are supported only by E1 module ports
199 to 239	N/A	Reserved for future use	N/A

#### HS-2/HS-6N/HS-12N Sanity Messages

260	Error	FIFO SIZE TOO SMALL	The manually-selected FIFO size must be equal or larger than the minimum required FIFO size, as required for operation on the currently active link (E1 or T1) and the selected rate
261	Error	ILLEGAL CHANNELS RATE COMBINATION	All the channel configured either for operation at multiples of 64 kbps or 56 kbps. It is not allowed to select a rate which is a multiple of 64 kbps in an odd channel, and a rate which is a multiple of 56 kbps in an even channel; in addition, the total rate of two adjacent channels (for example, 5 and 6) must not require more than 31 timeslots
262	Error	ILLEGAL CHANNELS LOOP	For HS-Q/M modules, it is not possible to activate external test loopbacks on a remote unit, or remote loopbacks on the remote unit, if the FT1 inband channel is not enabled
263	Error	MUST BE CTS VALUE FOR ALL CHANNELS	All the channels of the specified module must be configured with the same CTS mode
264	Error	ILLEGAL BRD SOURCE CHANNEL DEFINITION	For HS-6N or HS-12N card, if mismatch in defining special broadcast ring mode with primary/secondary source
265 to 269	N/A	Reserved for future use	N/A

#### HS-U/I Sanity Messages

270	Error	128/115.2 KBPS REQUIRES CONSECUTIVE TS ASSIGNMENT	The 115.2 and 128 kbps rates require consecutive timeslot assignment
271	Error	128/115.2 KBPS REQUIRES START ON EVEN TS	The 115.2 and 128 kbps rates require that the first timeslot assigned to the channel be even when using an E1 main link
272	Error	128/115.2 KBPS REQUIRES START ON ODD TS	The 115.2 and 128 kbps rates require that the first timeslot assigned to the channel be odd when using a T1 main link
273	Error	DIFFERENT CHANNEL INTERFACES	All the connected external ports (channels) must have the same interface (either NT or LT)

Code	Type	Syntax	Meaning
274	Error	EXTERNAL MODEM HARDWARE/SW CONFIG MISMATCH	For HS-U-6 or HS-U-12 port configured for operation in the /1 mode and connected to external modems, the following restrictions apply:  <b>ASMi-31 modems with V.110 rate adaptation:</b> in the asynchronous mode, the number of data bits can be only 7 or 8, and the supported data rates are 1.2 to 38.4 kbps <b>ASMi-31 modems without V.110 rate adaptation:</b> do not support the 56 kbps rate in the synchronous mode
275	Error	ILLEGAL ACTIVATION TYPE COMBINATION	The activation type of all the external ports configured as NT must use the same activation type (either TYPE ½ or TYPE 3)
276	Error	RATE IS NOT SUPPORTED BY V110	The data rates of 57.6 and 115.2 kbps cannot be used when V.110 rate adaptation is used (only the RAD proprietary protocol supports these rates)
277	Error	RATE IS NOT SUPPORTED BY ASYNC FORMAT	In the asynchronous mode, it is not possible to select channel data rates of 48, 56, and 64 kbps for HS-R and HS-RN modules
278, 279	N/A	Reserved for future use	N/A
280	N/A	Reserved for future use	N/A
281 to 299	N/A	Reserved for future use	N/A

#### VC Modules Sanity Messages

300	Error	ILLEGAL SIGNALING METHOD	You can select the channel associated signaling method only when an E1 main link module port with G732S framing is used.  You can select the ROBBED BIT MULTIFRAME signaling transfer method only for E1 links with G732S framing, or on T1 links.
301	Warning	VOICE CODING LAW STD (T1/E1) MISMATCH	The selected voice companding law differs from the companding law specified by the standards: the A-law is generally used for E1 main links, and the $\mu$ -law is generally used on T1 main links
302	Warning	PROPRIETARY SIGNALING METHOD	For E1 main links with G732S framing, it is not recommended to use the ROBBED BIT FRAME and the ROBBED BIT MULTIFRAME signaling transfer modes.  For T1 main links, it is not recommended to use the ROBBED BIT FRAME signaling transfer mode
303	Error	TX LEVEL/INTERFACE MISMATCH	The transmit gain selected for the specified channel is not within the supported range
304	Error	RX LEVEL/INTERFACE MISMATCH	The receive gain selected for the specified channel is not within the supported range

<b>Code</b>	<b>Type</b>	<b>Syntax</b>	<b>Meaning</b>
305	Error	OOS/INTERFACE MISMATCH	The selected OOS mode cannot be used on this type of interface
306	Error	SIGNALING PROFILE/INTERFACE MISMATCH	The selected profile cannot be used on this type of interface
307	Error	SIGNALING PROFILE/SIGNALING METHOD MISMATCH	The selected profile cannot be used with the selected signaling transfer method
308	Error	VOICE CODING/SIGNALING TYPE MISMATCH	A voice module configured to use ADPCM coding cannot use the ROBBED BIT FRAME signaling transfer mode. In the VC-4A and VC-8A modules, the RBF and RBMF signaling transfer modes are compatible with G.727 compression mode only (not compatible with G.726). For E1 main links with G732S framing, do not use the ROBBED BIT MULTIFRAME signaling transfer method
309	Error	SIG PROFILE/NUM OF SIG BITS MISMATCH	The selected signaling profile cannot be used with G732N or SF (D4) framing mode
310	N/A	Reserved for future use	N/A
311	N/A	Reserved for future use	N/A
312	Error	NO SIGNALING IS NOT LEGAL FOR THIS INTERFACE	The selected interface cannot be used with NO SIGNALING option
313	Error	ILLEGAL INTERFACE COMBINATION	All the voice channels must use the same interface type (either two-wire or four-wire)
314	Warning	MISMATCH BETWEEN TX SIGNALING BITS	The signaling conversion selected for the transmit direction is not allowed
315	Warning	MISMATCH BETWEEN RX SIGNALING BITS	The signaling conversion selected for the receive direction is not allowed
316	Error	WRONG CALL ENABLE/CAS STD/INTERFACE COMBINATION	The selected CAS signaling mode or interface cannot be used in the CALL ENABLE mode
317	Error	WRONG CODING MODE/CHANNEL COMBINATION	When configuring the channels of a VC-6A module operating with ADPCM coding, the channels must be connected in pairs: 1-2, 3-4, and/or 5-6
318	Error	CARD TYPE/INTERFACE MISMATCH	The VC-6A module cannot be configured to use the ground start mode: this mode is supported only by the VC-6AG module
319	Warning	MISSING ML PROFILE DEFINITION	For the VC-6A/FXS and VC-6A/FXO modules, it is not allowed to use profiles 3R and 3M

Code	Type	Syntax	Meaning
<b>Timeslot Sanity Messages</b>			
320	Error	ILLEGAL INTERNAL TS CONNECTION/ROUTING	<p>This message is usually displayed when one or more module channels are routed to an I/O slot not equipped with a main link module.</p> <p>For ML-IP modules, this message indicates that the bundle can be connected only when timeslots are routed to it</p>
321	Error	ILLEGAL TIMESLOT ASSIGNMENT	<p>Main Link modules: Check 320 has been successfully passed, but the number of timeslots requested does not match exactly the number of timeslots assigned on the relevant main link module port</p> <p>VFS modules: Timeslots from VC-4A or VC-8A modules cannot be routed to the VFS module ports</p>
322	N/A	Reserved	N/A
323	Error	ILLEGAL BYPASS CONNECTION	The number of timeslots routed between two main link module ports must be the same
324	Error	TS BYPASSING SHOULD BE IN ASCENDING ORDER	When bypassing timeslots between two main link modules, the timeslot mapping must be performed in ascending order (without any crossing)
325	Error	TS-16 IS RESERVED FOR CAS SIGNALING	<p>To enable the bypass of the signaling information between E1 ports on different modules, the following requirements must be met:</p> <ul style="list-style-type: none"> <li>• Both ports use G732S framing, with or without CRC-4 (G732S, G723S-CRC4).</li> <li>• Timeslot 16 of one module is routed to timeslot 16 on the other module.</li> </ul> <p>For ML-20N modules, when the SIGNALING &amp; MANAGEMENT parameter is YES, it is not necessary to reserve timeslot 16: the timeslot can be configured as either SPARE or DATA</p>
326	Warning	VOICE SIGNALING REQUIRES ONE TO ONE TS ASSIGNMENT	To enable bypassing of signaling information, one-to-one timeslot assignments must be made on the modules that perform the bypassing
327	Error	ILLEGAL POSITIONING OF TS BIT ASSIGNMENT	<p>When using split timeslot assignment:</p> <ul style="list-style-type: none"> <li>• 2-bit assignments must start at an odd bit (1, 3, 5 and/or 7).</li> <li>• 4-bit assignments must start at bit 1 and/or 5.</li> <li>• Consecutive bits must be assigned to any given channel</li> </ul>
328	Error	TS ASSIGNMENT/TS REQUEST MISMATCH	The timeslot bit assignment does not match the requirements for such timeslots
329	N/A	Reserved	N/A
330	N/A	Reserved	N/A
331	N/A	Reserved	N/A
332	Error	INCORRECT DATA TYPE	Check that the definition of the timeslot type corresponds to the type of information generated by the module using the

Code	Type	Syntax	Meaning
			<p>timeslot:</p> <ul style="list-style-type: none"> <li>• Timeslot routed to data I/O module: the type must be DATA (this also applies to timeslots routed to HSF modules).</li> <li>• Timeslot routed to voice I/O module: the type must be VOICE.</li> </ul> <p>In addition, check the following:</p> <ul style="list-style-type: none"> <li>• The types of timeslots bypassed between links must be identical.</li> <li>• No timeslot is assigned for management traffic when inband management uses timeslot 0 or the FDL, nor when inband management is disabled</li> </ul>
333	N/A	Reserved	N/A
334	Warning	TS DATA TYPE DOES NOT MATCH B7 LINE CODE	For T1 links, do not use the B7 line code when one or more timeslots are defined as data timeslots
335	Error	AB BUS OVERFLOW	<p>The timeslot assignment algorithm found that the number of timeslots to be assigned to channels that can be connected only to TDM buses A and B exceeds the available number of timeslots.</p> <ul style="list-style-type: none"> <li>• Check the total bandwidth needed by each channel and decrease it to the minimum that still meets the requirements.</li> <li>• Whenever possible, install modules that can use the additional TDM buses supported by software versions 7.0X and higher.</li> </ul> <p>Note however that this alarm may also appear when the Megaplex is configured to use a smaller number of buses, that is, less than 4. The number of buses is set by means of the SET USER command, and therefore whenever the chassis includes only modules that support all the 4 TDM buses, it is recommended to use the command SET USER NORMAL. Reduce the number of buses in use only when actually required for proper operation</p>
336	Error	BUS OVERFLOW	<p>The timeslot assignment algorithm found that the number of timeslots that must be assigned to the channels installed in this chassis exceeds the available number of timeslots.</p> <p>Check the total bandwidth needed by each channel and decrease it to the minimum that still meets the system requirements</p>
337	Warning	NEW TS ALLOCATION MAY CAUSE MOMENTARY DATA ERRORS	<p>The new timeslot assignment algorithm automatically changes the internal timeslot routing, when the current assignment of timeslots on the internal TDM buses cannot support the newly added channels. When the changes include the rerouting of timeslots from one TDM bus to another, the flow of data is momentarily disrupted.</p> <p>The purpose of this message is to warn you before you</p>

Code	Type	Syntax	Meaning
			confirm the database update, to enable you to postpone the database update, either to prepare for the disruption or to select a time at which the disruption has minimal effect on the traffic
338	Error	ILLEGAL BROADCAST DEFINITION	The timeslot assignment for the specified channel is not correct, or two split-timeslot channels are configured for broadcast in the same timeslot. Check the configuration and correct as required
339	Error	NOT COMPLETE BROADCAST DEFINITION	The timeslot assignment for the specified channel is not complete. Check the timeslot assignment at both the channel and the main link port level and correct as required
340	N/A	Reserved	N/A
341 to 349	N/A	Reserved for future use	N/A
<b>LS-6N, LS-12 Sanity Messages</b>			
350	Error	DIFFERENT PROTOCOLS IN SUB PORTS	The two ports of a pair of LS-6N/LS-12 channels (1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, or 11 and 12) must use the same protocol
351	Error	BANDWIDTH OVERFLOW	The bandwidth allocated to the internal port of the LS-6N/LS-12 module must be greater than, or equal to the sum of the following: <ul style="list-style-type: none"> <li>• The bandwidths allocated to the external ports.</li> <li>• Management channel, in case the remote unit is KM working in slave mode.</li> <li>• Frame synchronization.</li> <li>• Channel end-to-end control signals (one per pair)</li> </ul>
352	Error	ILLEGAL ADJACENT CARD CONFIGURATION	An LS-6N/LS-12 module configured as MASTER requires one of the following: <ul style="list-style-type: none"> <li>• The next/previous slot contains LS-6N/LS-12 module in SLAVE mode.</li> <li>• The next/previous slot contains the same type of LS-6N/LS-12 module</li> </ul>
353	Error	CONTROL SIGNALS MISMATCH	The two channels of a pair (1 and 2, 3 and 4, 5 and 6, 7 and 8, 9 and 10, or 11 and 12) must be configured for the same control signal mode for example, both must use DTR/RTS or RTS
354	Error	SUB PORTS NOT IN SAME RATE GROUP	The two supports of an LS-6N/LS-12 module pair of channels must operate in the same rate group
355	Warning	ADJACENT CARD CONFIGURATION WARNING	When an LS-6N/LS-12 module is configured as master, another LS-6N/LS-12 module must be configured as slave (the message is generated when another module is configured in the NO TANDEM mode, while a module is master without any slave)

Code	Type	Syntax	Meaning
356	Error	SUB PORTS NOT SAME INTERNAL	The two supports of an LS-6N/LS-12 module pair of channels must be connected to the same internal port
357	Error	MORE THAN ONE MASTER/SLAVE INTERNAL	More than one LS-6N/LS-12 internal port is configured as master
358	Error	EXT RATE IS NOT APPLICABLE WITH INT RATE	The external port rate is not compatible with the data rate allocated on the main link to the corresponding internal port
359	Error	NO EXTERNAL CHANNEL CONNECTED	The internal port is connected to the main link, but no external port is connected to it
360	Error	INTERNAL CHANNEL NOT CONNECTED	The internal channel is not connected to a main link
361	N/A	Reserved for future use	N/A
362	Error	TANDEM MODE VALUE IS ILLEGAL	It is not allowed to select the tandem mode
363 to 389	N/A	Reserved for future use	N/A
390 to 403	N/A	Reserved	N/A
404 to 409	N/A	Reserved for future use	N/A

#### HS-U-6, HS-U-12 Sanity Messages

410	Error	ILLEGAL D CHANNEL COMPRESS ASSIGNMENT	To connect an internal compression port, at least one internal D-channel port must be configured as connected to that port
412 to 419	N/A	Reserved for future use	N/A

#### Voice Module Sanity Messages

420	N/A	Reserved	N/A
421	Error	ILLEGAL E&M TYPE COMBINATION	This message, relevant only for E&M modules, is displayed when different signaling types have been selected for channels in a group of 4 consecutive channels (for example, 1, 2, 3, 4; 5, 6, 7, 8; etc.)
422	Error	ILLEGAL INTERFACE COMBINATION	This message, relevant only for VC modules with FXS and FXO interfaces, is displayed when you are trying to configure different signaling interfaces for channels within the same group of 8 consecutive channels (1 to 8 or 9 to 16)

Code	Type	Syntax	Meaning
423	Error	ILLEGAL SIGNAL FEEDBACK FXO COMBINATION	This message, relevant only for VC modules with FXO interfaces, is displayed when you are trying to configure different signaling feedback states for channels within the same group of 8 consecutive channels (1 to 8 or 9 to 16)
424	Error	LEVEL VALUE IS NOT SUPPORTED	The level specified for the corresponding channel is lower than the minimum level supported by the channel
425 to 429	N/A	Reserved for future use	N/A

#### Sanity Messages for Module with Ethernet Interfaces

430	Error	ILLEGAL SPEED COMBINATION	For HS-ETH modules, this message is displayed when channel 1 and/or 3 are configured to operate at a rate which is a multiple of 56 kbps, and the other channel (2 or 4) is configured to operate at a rate which is a multiple of 64 kbps.  This is not allowed: when channels of the same module operate at rates from different groups of rates (multiples of 64 kbps and multiples of 56 kbps), you must select multiples of 64 kbps for the odd channels.
431	Error	ILLEGAL BUS CONNECTION COMBINATION	All the module channels must be configured to use the same number of TDM buses: either partial (2 buses) or full (all the four buses)
432 to 434	N/A	Reserved for future use	N/A

#### Sanity Messages for ML-IP and VFS Modules

435	Error	ILLEGAL BND SLOT/CHAN CONNECTION	A bundle can only be connected to an internal port of an ML-IP module that is already connected
436	Error	ASYMMETRIC BND REDUNDANCY ASSIGNMENT	ML-IP bundles configured as redundancy partners must use the same values for the following parameters: <b>Connect, TDM Bytes in Frame, Voice OOS, Data OOS, Far End Type, Redundancy, Recovery Time</b>
437	Error	ILLEGAL IP ADDRESS	For the VFS modules: you specified an illegal IP address or Dest IP = 0 when working in the AAL2oMPLS mode.
438	N/A	Reserved	N/A
439	Error	NETWORK IP ADDRESS MISMATCH EXT/NEXT HOP	The next-hop IP address of the specified bundle must be within the subnet of the IP address assigned to the external port used by the corresponding internal route



Code	Type	Syntax	Meaning
440	Error	ILLEGAL BND ROUTE CHAN	This message will appear in the following cases: <ul style="list-style-type: none"> <li>When you are trying to connect a bundle to an ML-IP internal port not within the range supported by the corresponding module (IN1, IN2)</li> <li>When VLAN tagging is disabled or the specified VLAN ID is 0, and the selection mode for the external port is not AUTO</li> <li>When the selection mode for the external port is not AUTO, and the management VLAN tagging is enabled when using the ring topology (RING is ENABLE)</li> </ul>
441	Error	INCONSECUTIVE ONES IN SUBNET MASK	The binary representation of an IP subnet mask must start with a string of consecutive "1s" followed by the desired number of consecutive "0s"
442	N/A	Reserved	N/A
443	Warning	ILLEGAL TS BND ASSIGNMENT	Bundle must be configured with timeslots
444	N/A	Reserved	N/A
445	Warning	FAST REDUNDANCY/JITTER BUFFER MISMATCH	When two bundles defined on the same ML-IP module are defined as a redundancy pair, you may expect fast redundancy switching (within less than 50 msec). This message alerts you that fast redundancy is not available because the jitter buffer size is more than 50 msec
446	N/A	Reserved	N/A
447	Error	DEST IP IN STATIC ROUTE IN SAME NET	You are trying to define a static entry in the ML-IP IP routing table which specifies a destination IP address located in the same subnet as an ML-IP external port. This is neither needed, nor is it allowed
448	Error	BUNDLES OVERFLOW FOR IN1/IN2	The maximum number of bundles that can be defined for the internal ports 1 and 2 of the ML-IP module is as follows: <ul style="list-style-type: none"> <li>Without CAS support (that is, when no bundle defined on these ports carries timeslots which require transfer of signaling information): 24</li> <li>With CAS support: 14</li> </ul>
449	N/A	Reserved	N/A
450	Error	ILLEGAL PROTECTED IP ADDRESS	When ring redundancy is enabled, make sure that the IP addresses defined as protected addresses are different from the IP addresses assigned to ML-IP ports
451	Error	ILLEGAL OAM CONNECTION REDUNDANCY MODE	OAM must be selected in 1:1 mode. When using 1:1 redundancy, it is necessary to enable the OAM protocol
452	Error	MORE THAN ONE SOURCE FOR SERIAL FAR END TYPE	When the far-end type of the bundle is configured as serial port, only one data channel is supported. To perform bypass, make sure that only timeslots from the I/O module are included

Code	Type	Syntax	Meaning
453	Error	ILLEGAL FAR END TYPE FOR VOICE	The far-end type of the bundle is configured as serial port, and one or more of the bundle timeslots are configured to carry voice
454	N/A	Reserved for future use	N/A

#### Additional ML-20N Sanity Messages

480	Error	ILLEGAL CLOCK MODE	An AMI port can use only the EXT DCE timing mode
481	Error	ILLEGAL LINK RATE/ERROR CORRECTION MODE	Error correction can be enabled only for data rates of 256 to 1024 kbps (corresponding to link rates of 512 to 2048 kbps)
482	Error	RATE/TIME SLOT ASSIGNMENT MISMATCH	The number of timeslots assigned to the port does not match its data rate
483	Error	ILLEGAL CLOCK SOURCE	When the reference clock must be provided by a port with X.21 interface, only the RX clock source can be selected
484	Error	DIAL PROCESS IS NOT SUPPORTED	A module with AMI interfaces does not support dial-up

#### VFS Modules Sanity Messages

515	Error	DIFFERENT PARAMS FOR SAME DSP GROUP	Each group of 6 consecutive timeslots of the same internal port (for example, 1, 2, 3, 4, 5, 6, 7, ... 12; etc. ) of a VFS module must use the same fax rate and coder rate parameters
516	Error	INTERNAL PORT IS NOT CONNECTED	The corresponding internal port VFS module is not connected
518	Error	ILLEGAL CODER RATE CHANGE OPERATION	To change the coder rate, first disconnect the port. This operation cannot be performed when the port is connected
521	Error	ILLEGAL REMOTE TIMESLOT/ CHANNEL ASSIGNMENT	The remote timeslot assignment is not correct: two local timeslots are routed to the same timeslot and channel at the remote side
522	Error	ILLEGAL MAX BYTE	The maximum number of bytes in multiplex frame is not within the allowed range (100 to 1472 byte)

#### HS-ETH/SW Module Sanity Messages

540	Error	ASYMMETRIC PORT BASED VLAN	The port-based VLAN configuration must be symmetrical: if external port 1 is connected to external port 2, the same connection must be configured on external port 2
541	Error	CARD BUS OVER FLOW	The total number of timeslots assigned to WAN ports exceeds 64
542	Error	MORE THEN 2 ENTRIES FOR SAME VLAN ID	Any given VLAN ID can be assigned to a maximum of two ports
543	Error	SINGLE VLAN ENTRY	Two entries on the specified have been assigned the same VLAN ID, although they are defined on different interfaces
544	Error	ILLEGAL SLOT IN ROUTE	The module in the I/O slot specified in the definition of a route of the SUBNET or VLAN type is not HS-ETH/SW

Code	Type	Syntax	Meaning
545	Error	L3 SWITCH MODE REQUIRES IP ROUTE	At least one route must be defined for an HS-ETH/SW port configured to operate in the L3 SUBNET SWITCH mode
546	Error	DUPLICATE ROUTING ENTRIES	Each subnet defined for a given I/O slot can have a single entry in the routing table (its IP address and subnet mask must match the corresponding subnet)
547	Error	DUPLICATE VLAN ID	The VLAN ID must be unique on each module
548	Error	DUPLICATE MANAGEMENT CONNECTION	More than one Ethernet port has been configured as management port.  This may happen when MANAGEMENT = YES is selected on two or more modules, or when the Ethernet port of the CL module is configured as CONNECTED and an additional module is configured with MANAGEMENT = YES
549	Error	INTERFACE IS NOT CONNECTED IN ROUTE	One of the module interfaces configured in a route is not connected. Make sure to connect it, or change the specified route
550	Error	DEST INTERFACE MISMATCH	The bridge is configured to use STP, but the destination interface is not included in the bridge switching table
551	Error	VLAN ID OF IN1 IS NOT CONNECTED TO EXTERNAL	The VLAN ID number should be the same for the IN1 and External ports

#### VFS Additional Sanity Message

560	Error	REM TS IS ALREADY ASSIGNED FOR SAME INTERNAL	Remote timeslot cannot be assigned the same destination both in the external port and in the internal VFS port
561	Error	NO. OF COMPRESSED TS EXCEED DSP CAPACITY	Number of timeslots destined for compression (either from external or internal port) exceeds the module capacity (e.g. 30 timeslots for VFS-30 module)
562	Error	SAME TS IS USED IN EXT(1,2) AND IN RELATED INT(9,10)"	The same timeslot cannot be allocated on an external port (for compression of E1 timeslots) and on the corresponding internal port (for server compression). For example, the same timeslot cannot be allocated on EX1 and IN9, on EX2 and IN10.
563	Error	VOICE CODING LAW STD (T1/E1) MISMATCH"	The voice companding law selected for the VC module channel connected to the VFS internal port (IN9 or IN10) differs from the voice companding law selected for the corresponding VFS internal port (IN1, IN2, ..., IN8).
564 to 699	N/A	Reserved for future use	N/A

#### VC-4/OMNI Module Sanity Messages

700	Error	OTHER INTERNAL THAN THE FIRST ONE IS CONNECTED	If OPERATION MODE is set to POINT-TO-POINT for an external port, only the first internal channel of this external port (IN1 for EX1, IN5 for EX2, IN9 for EX3, IN13 for EX4) can be connected
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<b>Code</b>	<b>Type</b>	<b>Syntax</b>	<b>Meaning</b>
701	N/A	Reserved for future use	N/A
702	Error	FIRST CORRESPONDING INTERNAL (1,5,9,13) MUST BE CONNECTED	If OPERATION MODE is set to POINT2MP DST for an external port, the first Internal channel of this external port (1N1 for EX1, IN5 for EX2, IN9 for EX3, IN13 for EX4) must be connected (other internal ports can be connected as well).
703 to 999	N/A	Reserved for future use	N/A

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## 6.3 Traps Generated by Megaplex

Megaplex generates several types of traps that report special events. These traps are presented in [Table 6-3](#), together with a description of their formal object identifier (OID) and attached parameters.

**Note** *Trap parameters appearing in bold font in [Table 6-3](#) do not appear in the MIB trap definition.*

Table 6-3. Traps List

No.	Trap	Attached Parameters	Interpretation
<b>General Traps</b>			
1	<b>rfc3418.warmStart</b> ::= { snmpTraps 2 } OID: 1.3.6.1.6.3.1.1.5.2		Reports that the Megaplex has been restarted (for example, by resetting the CL modules), and successfully completed the warm-start process.  In response, a network management station should perform all the operations necessary to open the Megaplex element manager application
2	<b>rfc2863.linkDown</b> ::= { snmpTraps 3 } 1.3.6.1.6.3.1.1.5.3	<b>ifIndex, ifAdminStatus, ifOperStatus, openViewSeverity</b>	RAD proprietary. Reports that the status of the corresponding CL interface has changed to <b>down</b> .
3	<b>rfc2863.linkUp</b> ::= { snmpTraps 4 } OID: 1.3.6.1.6.3.1.1.5.4	<b>ifIndex, ifAdminStatus, ifOperStatus, openViewSeverity</b>	RAD proprietary. Reports that the status of the corresponding CL interface has changed to <b>up</b> .
4	<b>rfc3418.authenticationFailure</b> ::= { snmpTraps 5 } OID: 1.3.6.1.6.3.1.1.5.5		Reports an SNMP authentication failure (this is usually the result of an attempt by a manager using an unauthorized community to access Megaplex)
<b>radGen Traps</b>			
5	<b>rad.tftpStatusChangeTrap</b> OID: 1.3.6.1.4.1.164.6.1.0.1	tftpStatus, <b>tftpError</b> (this object will be sent only when tftpStatus=error, in order to specify the cause of failure)	Reports a change in the tftp status of the agent.  Used by map application SWDL.

No.	Trap	Attached Parameters	Interpretation
6	<b>rad.agnStatusChangeTrap</b> ::= { systemsEvents 2 } OID: 1.3.6.1.4.1.164.6.1.0.2	agnIndication, agnTestStatus, openViewSeverity (same value as agnIndication)	Reports a change in the status of the agent. Indicates the Megaplex alarm severity associated with the reported trap or event.  Used by RADView HPOV map application to provide the node status indication (for example, select the node color on the map)
7	<b>rad.agnCounterChange</b> ::= { systemsEvents 6 } OID: 1.3.6.1.4.1.164.6.1.0.6	<b>agnCmprObj.1.1.2</b>	Reports a change in the ML-IP counters.  This trap is used by the TDMoIP Service Center.
<b>WAN Traps</b>			
8	<b>rad.alarmsTrap</b> ::= { muxHubEvents 1 } 1.3.6.1.4.1.164.3.2.0.1	alrBufDescription, prtSAIrcode, prtSAIrsItIdx, prtSAIrprtIdx, prtSAIrsSeverity, prtSAIrsState, <b>openViewSeverity</b>	Provides information on alarms in a format that includes the information explained in <a href="#">Table 6-1</a> .  This trap is used by the RADView TDM Service Center.
9	<b>rad.sanityTrap</b> ::= { muxHubEvents 2 } 1.3.6.1.4.1.164.3.2.0.2	agnSSanityCheckStatus, agnCSaveCnfgIdxCmd, mngIP (of the manager that initiated the <b>Update</b> command)	Provides information on sanity warnings and errors detected by the Megaplex sanity check function, in a format that includes the information explained in <a href="#">Table 6-2</a> .
10	<b>rad.cnfgFlipTrap</b> ::= { muxHubEvents 3 } OID 1.3.6.1.4.1.164.3.2.0.3	agnSActiveCnfg, <b>mngIP</b> (of the manager that initiated the <b>Update</b> command)	Reports that a configuration update, initiated by the specified manager, is being performed.  A network management station that detects this trap should display an <b>Update Performed</b> message, and should take steps to avoid errors as a result of the configuration change (for example, close windows associated with the Megaplex being updated)
11	<b>rad.flipDbChangeTrap</b> ::= { muxHubEvents 4 } OID: 1.3.6.1.4.1.164.3.2.0.4	agnSAIrsStatusAll, agnSAIrsStatus	Reports that a configuration update has been initiated by an automatic database flip.
12	<b>rad.bundleConnectionStatus Trap</b> ::= { radSysWanEvents 15 } OID: 1.3.6.1.4.1.164.6.1.3.0.15	ifAlias (related to Bundles), ip2IfOperStatus, openViewSeverity	Reports the status of bundle connection.  This trap is used by the TDMoIP Service Center.

## 6.4 Troubleshooting

In case a malfunction occurs, perform the following preliminary checks:

- Check that the modules are properly installed.
- Check that all the cable connections are made in accordance with the installation plan.
- Check the settings of the DIP switches on the CL modules: all the sections must be set to OFF, except for section 1: this section may be set to ON to enforce the use of a supervision terminal at the CONTROL-DCE port.
- Check that all the communication equipment on the link operates properly.
- Turn the MP-2100 off for about five minutes, and then turn it on again.

After these checks, use a supervision terminal to identify the faulty module (by reading the alarm messages and performing tests as required). Replace the corresponding module.

If the problem cannot be corrected by performing the actions listed above, refer to [Table 6-4](#). Identify the best-fitting trouble symptoms and perform the actions listed under "Corrective Measures" in the order given, until the problem is corrected.

*Table 6-4. Troubleshooting Chart*

No.	Trouble Symptoms	Probable Cause	Corrective Measures
1	Megaplex does not turn on	1. No power	Check that power is available at the power outlets or power distribution panel serving the Megaplex. Check that both ends of all the Megaplex power cables are properly connected.
		2. Defective PS module	Replace the suspected PS module
		3. Defective Megaplex	Replace Megaplex
2	The local Megaplex cannot be configured through its CONTROL DCE port	1. Connection made to the inactive CL module	Check that the connection is made to the CONTROL DCE connector of the CL module whose ON LINE indicator lights
		2. Configuration problem	Restore the default parameters using DB INIT command, and then perform the preliminary supervision terminal configuration instructions given in <a href="#">Chapter 4</a>

No.	Trouble Symptoms	Probable Cause	Corrective Measures
		3. External problem	Check the equipment serving as a supervision terminal, and the connecting cable.  If the supervision terminal is connected through a data link to the Megaplex, check the equipment providing the data link for proper operation
		4. Software not yet loaded into CL module, or corrupted	Download the appropriate Megaplex software to the CL modules in accordance with Chapter 7
		5. Defective CL module	Replace the corresponding CL module
3	The local Megaplex cannot be managed through its CONTROL ETH port	1. Configuration problems	Check the CONTROL ETH port configuration. Check that the ON LINE indicator of the CL module lights
		2. Problem in the connection between the CONTROL ETH port and the LAN	Check that the LINK indicator of the CONTROL ETH port lights.  If not, check for proper connection of the cable between the LAN and the CONTROL ETH port. Also check that at least one node is active on the LAN, and that the hub or Ethernet switch to which the Megaplex CONTROL ETH port is connected is powered
		3. External problem	Check the external equipment (for example, the default gateway and other routers) that process the traffic coming from the local Megaplex CONTROL ETH port
		4. Defective CL module	Replace the corresponding CL module
		5. Defective Megaplex	Replace Megaplex
4	The status indicator of a local main link port lights in red	1. Cable connection problems	Check for proper connections of the cables to the module connector.  Repeat the check at the user's equipment connected to the port.
		2. External problem	Activate the local loopback on the corresponding main link port. If the indicator of the corresponding local port lights in green while the loop is connected, the problem is external. Check cable connections, and the transmission equipment providing the link to the remote unit.
		3. Defective main link module	Replace the main link module



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## 6.5 Performing Diagnostic Tests

The Megaplex diagnostic functions can be used to test the proper operation of the Megaplex system and to rapidly identify faulty components.

### Overview of Diagnostic Functions

Diagnostic functions are available at the following main levels:

- **I/O module level.** At this level, the activation of local loopbacks enable the user to locate problems in the module and its channels, as well as problems in the connection of the user's equipment to the module ports. Remote loopbacks can be used for end-to-end testing of signal paths.

Built-in test equipment is also available on many I/O modules:

- Voice modules include 1 kHz tone generators that enable easy checking of signal paths down to the user's earphone.
- Some types of data modules include their own BER test subsystem, which can be used to check proper processing of signals on the module, and to ensure proper end-to-end transmission through data channels.
- **Main link module level.** The main link modules can also be checked in the same way as I/O modules. However, the dedicated test subsystems located on these modules can also be used to test for proper operation at the system level, as well as test network connections. This subsystem can be used to activate local and remote loopbacks at any desired level, starting with the connection to the local channels (through the chassis TDM buses and when applicable, through the internal ports of the main link module), and down to the level of individual timeslots and even individual bits in timeslots with split assignment.

The test subsystems of the main link modules provide a central testing facility, which can send test signals to any desired direction. For example, a 1 kHz test can be sent to each voice module, whereas data paths toward the local side and the remote side can be tested by means of the BER test function.

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**Note**

*Test subsystems are located on all the main link modules, except for single-port TDM main link modules (for example, ML-1E1, MLF-1E1, ML-1T1, MLF-1T1).*

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- **IP connectivity tests.** Megaplex modules which support IP communication, for example, ML-IP and HS-ETH/SW, can use the **ping** function, part of the ICMP protocol, for checking IP connectivity with the desired IP destination.

In this chapter you will find information on the tests and loopbacks available on the main link interface modules, and a general description of the test and loopbacks applicable to I/O modules. Specific information on the tests and loopbacks available for each module is provided in the corresponding module Installation and Operation Manual.

## Automatically Disconnecting Loopbacks and Tests

The activation of a loopback or test disconnects the user's traffic, and in particular the activation of a loopback on a main link module disconnects the communication between the Megaplex units installed on the link. Therefore, when you initiate a loopback or test, you have the option to limit its duration to a selectable interval in the range of 1 through 30 minutes.

After the selected interval expires, the loopback or test is automatically deactivated, without any operator intervention. However, you can always deactivate a test or loopback activated on the local Megaplex before this time-out expires.

## Main Link Module Loopbacks

The test loopbacks that can be performed on the main link modules provide information on the functioning of the main link modules. However, since the loopbacks are performed at the interface between the Megaplex unit and the external system elements, these loopbacks also provide information on the functioning of the complete Megaplex unit.

This section explains the operation of the test loopbacks available on main link modules.

The main link modules support loopback functions at the following levels:

- **Main link ports.** The main link loopback capabilities include:
  - Local main link loopback
  - Remote main link loopback.
- **Internal ports.** The loopback capabilities supported for E1 and T1 internal ports (only E1 ports are currently available, on ML-IP modules) include:
  - Local internal port loopback
  - Remote internal port loopback.
- **Timeslots.** The loopback capabilities at the individual timeslot level include:
  - Local loopback
  - Remote loopback.

### Local Main Link Loopback

The signal paths during a local main link loopback are shown in *Figure 6-1*.

As shown in *Figure 6-1*, when a local loopback is activated on a main link port, the main link transmit signal is returned to the input of the main link receive path at a point just before the line interface. The local Megaplex must receive its own signal, and thus it must be frame-synchronized.

In addition, each I/O module connected to the corresponding link must also receive its own signal: in general, the result is that these modules are synchronized and do not generate alarm indications.

Note however that there are modules that cannot receive their own signal, for example modules with Ethernet interface: these modules do enter an alarm state while a local loopback is activated.

To provide a keep-alive signal to the transmission equipment serving the link under test while the loopback is activated, the main link module transmits an unframed "all-ones" signal (AIS) to the line. AIS reception will cause the remote equipment to lose frame synchronization while the loopback is connected. This is normal and does not necessarily indicate a fault.

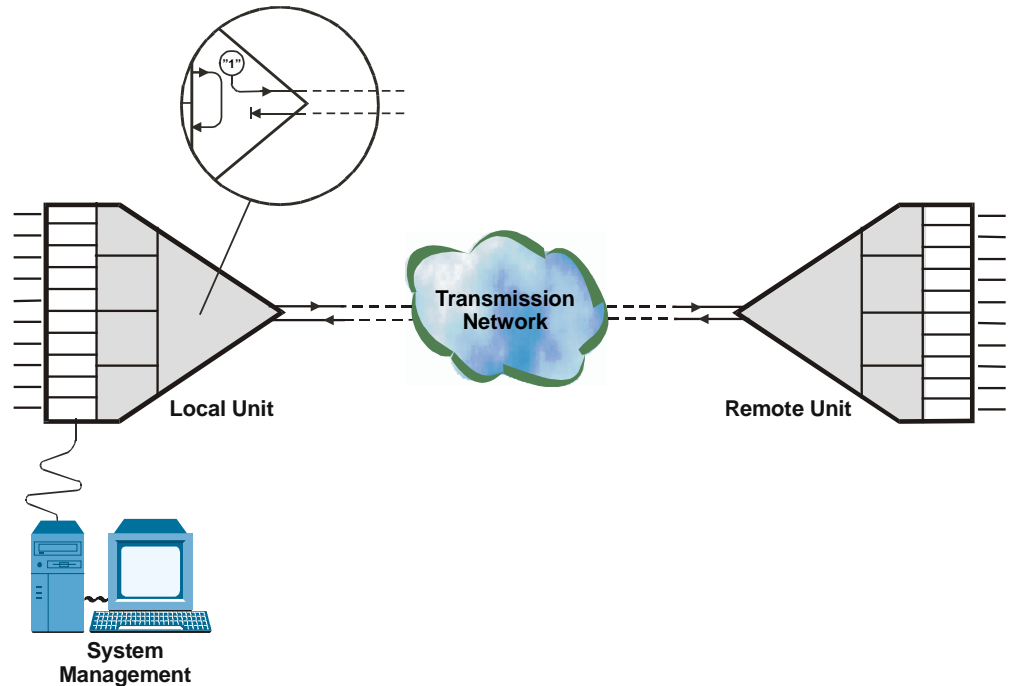


Figure 6-1. Local Main Link Loopback, Signal Paths

## Remote Main Link Loopback

The signal paths during a remote main link loopback are shown in [Figure 6-2](#).

When a remote loopback is activated on a main link port, the main link receive signal is returned to the remote unit, via the main link transmit path. The received signal remains connected to the receive path of the main link.

To correct transmission distortions, the returned signal is regenerated by the corresponding line interface circuits.

The remote loopback should be activated only after checking that the remote unit operates normally with local main link loopback. In this case, the remote unit must receive its own signal, and thus it must be frame-synchronized. The effect on individual modules is mixed, as explained above for the local loopback.

Assuming that the local Megaplex unit also operated normally when the local main link loopback has been activated, then while the remote loopback is connected the local unit should receive a valid signal, and thus it must be frame-synchronized.

The remote loopback should be activated at only one of the two Megaplex connected in a link, otherwise an unstable situation occurs.

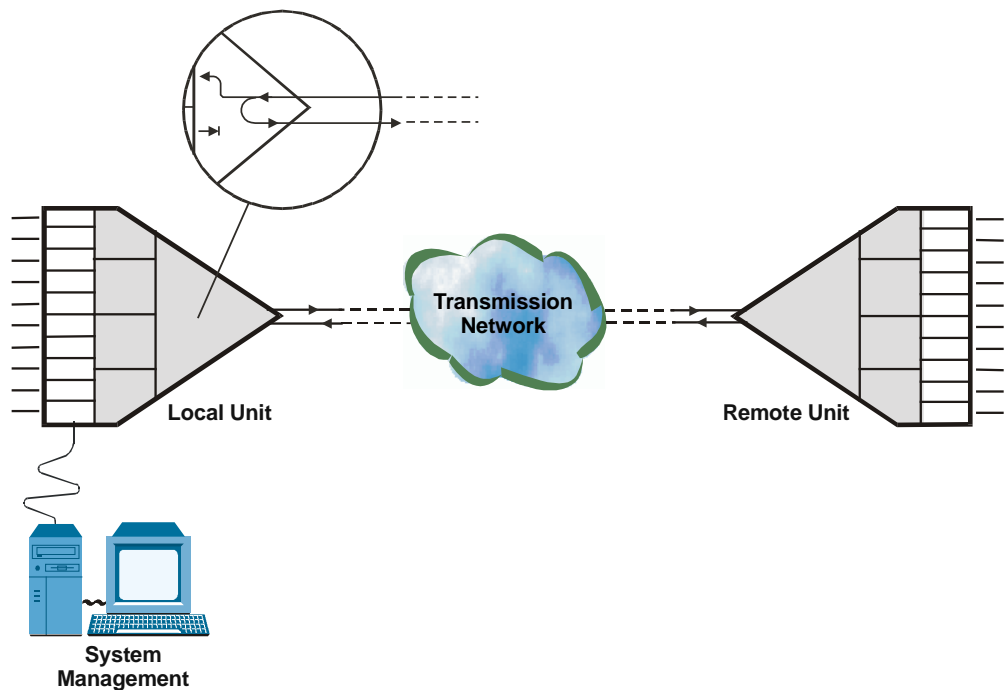


Figure 6-2. Remote Main Link Loopback, Signal Paths

### Local Internal Port Loopback

The signal paths during a local internal port loopback are shown in [Figure 6-3](#).

As shown in [Figure 6-3](#), when a local loopback is activated on an internal port of a main link module, the transmit signal of the corresponding port is returned to the input of the port receive path at a point just before the output to the external line interface. The local port must receive its own signal, and thus it must be frame-synchronized.

In addition, each I/O module connected to the corresponding port must also receive its own signal: in general, the result is that these modules are synchronized and do not generate alarm indications.

Note however that there are modules that cannot receive their own signal, for example modules with Ethernet interfaces: these modules do enter an alarm state while a local loopback is activated.

While the loopback is activated, the transmit signal of the corresponding internal port remains connected to the external link, but the signal received from the external link is disconnected.

When the loopback is activated on an internal port which is part of a redundancy pair, the CL module automatically activates the loopback on the other internal port of the pair. This convenience feature is also available for loopback deactivation: the deactivation command can be issued to either one of the ports of the redundancy pair (even if it has been activated by a command to the other port).

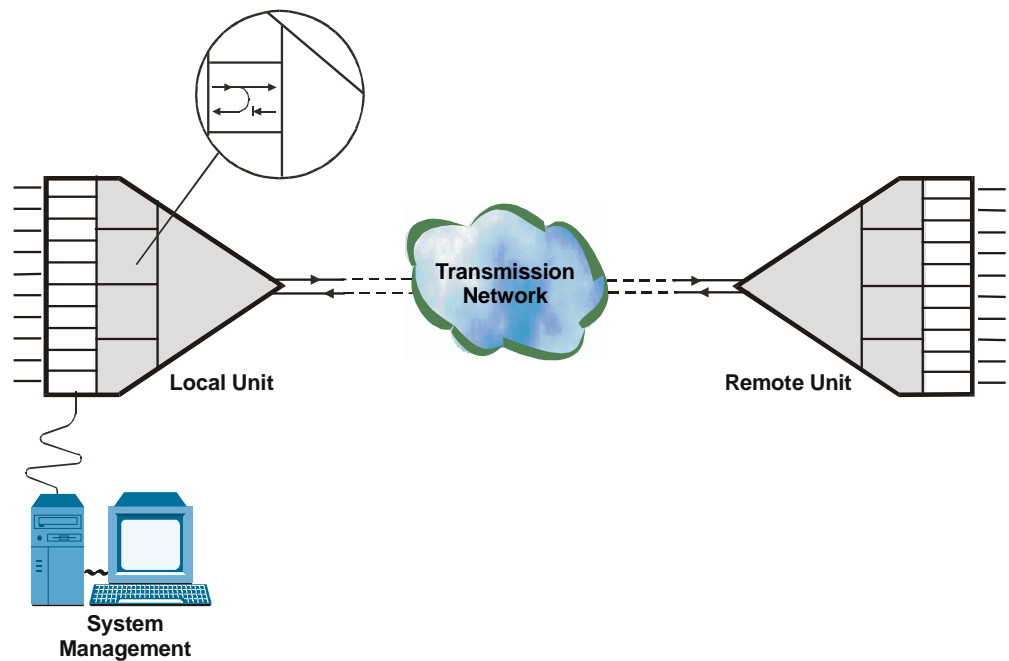


Figure 6-3. Local Internal Port Loopback, Signal Paths

## Remote Internal Port Loopback

The signal paths during a remote internal port loopback are shown in [Figure 6-4](#).

When a remote loopback is activated on one of the main link internal ports, that port returns the receive signal to the remote unit, via the transmit path of the same port.

The received signal remains connected as usual to the receive path of the corresponding port.

The remote loopback should be activated only after checking that the corresponding internal port of the remote unit operates normally during a local loopback. In this case, while the remote loopback is activated on the local unit port, the corresponding remote port must receive its own signal, and thus it must be frame-synchronized. The effect on individual modules is mixed, as explained above for the local internal port loopback.

When the loopback is activated on an internal port which is part of a redundancy pair, the CL module automatically activates the same loopback on the other internal port of the pair. This convenience feature is also available for loopback deactivation: the deactivation command can be issued to either one of the ports of the redundancy pair (even if it has been activated by a command to the other port).

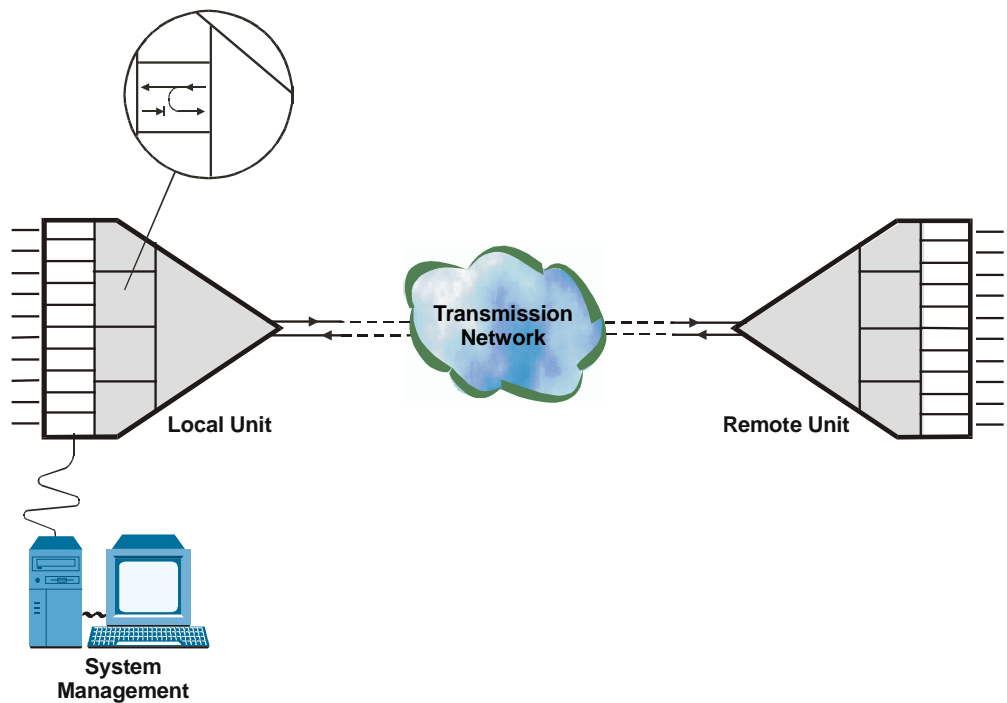


Figure 6-4. Remote Internal Port Loopback, Signal Paths

### Local Loopback on Internal or External Port Timeslots

The local loopback on individual timeslots of an internal or external port is similar to the local loopback on the whole port (see corresponding signal paths in [Figure 6-1](#) or [Figure 6-3](#)), with one difference: the loopback is activated only on the timeslots specified by the user during the activation of the loopback. As a result, there is no disturbance to services provided by means of the other timeslots of the internal or external port: only the flow of payload carried by the specified timeslots is disrupted.

The user can select to activate the loopback on any individual timeslot, on several arbitrarily selected timeslots, or on a whole bundle of timeslots, for example the bundle assigned to a module requiring fractional E1 service:

- When activating a loopback on a bundle of timeslots, it is sufficient to activate it on the last timeslot of the bundle: Megaplex will then automatically activate same loopback on all the other timeslots of the bundle. The same is true for deactivating the loopback.
- When the loopback is activated on timeslots of an internal or external port which is part of a redundancy pair, the CL module automatically activates the loopback on the same timeslots of the other E1 port of the pair. This convenience feature is also available for loopback deactivation: the deactivation command can be issued to either one of the ports of the redundancy pair (even if it has been activated by a command to the other port).

## Remote Loopback on Internal or External Port Timeslots

The remote loopback on individual timeslots of an internal or external port is similar to the remote loopback on the whole port (see corresponding signal paths in *Figure 6-2* or *Figure 6-4*), with one difference: the loopback is activated only on the timeslots specified by the user during the activation of the loopback. As a result, there is no disturbance to services provided by means of the other timeslots of the internal or external port: only the flow of payload carried by the specified timeslots is disrupted.

The user can select to activate the loopback on any individual timeslot, on several arbitrarily selected timeslots, or on a whole bundle of timeslots, for example the bundle assigned to a module requiring fractional E1 service:

- When activating a loopback on a bundle of timeslots, it is sufficient to activate it on the last timeslot of the bundle: Megaplex will then automatically activate same loopback on all the other timeslots of the bundle. The same is true for deactivating the loopback.
- When the loopback is activated on timeslots of an internal port which is part of a redundancy pair, the convenience feature of automatic activation/deactivation described above for the local loopback is also available for the remote loopback.

## Main Link Tests

### Overview of Main Link Test Subsystem

This section explains the tests that can be performed by means of the main link test subsystem. This subsystem is used to check the transmission performance and proper operation of the Megaplex system paths carrying the user's payload, without requiring any external test equipment. Accordingly, the test subsystem includes two main functions:

- BER test subsystem for evaluating data signal paths
- Tone injection subsystem for testing audio (voice) signal paths.

**Note**

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*ML-1E1, MLF-1E1, ML-1T1 and MLF-1T1 modules do not include test subsystems.*

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### **BER Test Subsystem**

The BER test subsystem comprises a test sequence generator and a test sequence evaluator. During the test, the payload data is replaced by a pseudo-random sequence generated by the test sequence generator. Many types of test sequences can be generated, enabling the user to select the one best suited for each specific test. The available selections are:

- QRSS test sequence per ITU-T Rec. O.151
- Pseudo-random sequences per ITU-T Rec. O.151:  $2^{15}-1$ ,  $2^{20}-1$ ,  $2^{23}-1$
- 2047-bit long pseudo-random sequence per ITU-T Rec. O.152/3
- 511-bit long pseudo-random sequence per ITU-T Rec. O.153
- 63-bit long pseudo-random sequence

- Repetitive patterns of one mark ("1") followed by seven spaces ("0") (1M-7S); one space followed by seven marks (1S-7M); alternating marks and spaces (ALT); continuous mark (MARK), or continuous space (SPACE).

The transmitted data is returned to the test sequence evaluator by a loopback activated somewhere along the signal path. The evaluator synchronizes to the incoming sequence, and then compares the received data, bit by bit, to the original data sequence and detects any difference (bit error).

**Note**

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*When two Megaplex units are operated in a link, it is also possible to perform the test by activating the BER test subsystems at both ends of the link at the same time, and configuring both subsystems to use the same test sequence. In this case, it is not necessary to activate a loopback, because the BER test subsystem can process the sequence transmitted by the far end subsystem in the same way as its own sequence. This avoids the need to activate a loopback when the loopback itself may alter the operating conditions on the tested path (for example, in certain cases a loopback may cause switching to an alternative clock source and thus affect the flow of timing information within the network).*

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The test results are displayed as a number in the range of 0 (no errors detected during the current measurement interval) through 63535. If the upper limit is reached, the counter stops accumulating errors and retains this maximum value until it is manually reset.

Error counts are accumulated starting from the activation of the BER test, or from the last clearing (resetting) of the error counters. During normal operation, no errors should be detected.

To provide meaningful results even under marginal transmission conditions, error counting is automatically interrupted while the test evaluator is not synchronized to the incoming test sequence, and also during periods in which the tested signal path is not available (for example, during loss of bundle signal and/or loss of frame synchronization). The number of seconds during which error counting is interrupted is reported along with the accumulated test running time.

To check that the tested path is "live", the user can inject errors at a desired (calibrated) rate in the test sequence. The available error injection rates are  $10^{-1}$ ,  $10^{-2}$ ,  $10^{-3}$ ,  $10^{-4}$ ,  $10^{-5}$ ,  $10^{-6}$  and  $10^{-7}$ ; single errors can also be injected. These errors will be counted as regular errors by the test sequence evaluator, thereby increasing the user's confidence in the measured performance.

The BER test subsystem input and output are routed by means of the main link routing matrix. Therefore, the user can request testing in any individual timeslot or any bundle of timeslots. For timeslots with split assignment, it is also possible to select the bits on which the test is performed (with the same resolution as the split timeslot assignment, that is, pairs of consecutive bits).

Moreover, the direction in which the test sequence is sent (local or remote) can also be selected. For convenience, the user can simultaneously activate a desired type of loopback together with the activation of the BER test.

At any time, only one BER test can be performed on each main link module.

**Note**

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*In contrast to loopbacks, which are automatically activated on the redundancy partner, BER tests are not activated on the partner, but can be separately performed on each port in the redundancy pair.*

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### ***Test Tone Injection Subsystem***

The test tone is a data sequence repeating at a rate of 1 kHz. This data sequence is identical to the data sequence that would have been generated if a 1-kHz signal having a nominal level of 1 mW (0 dBm0) were applied to the input of the transmit path of an ITU-T Rec. G.711 voice channel codec (that is, a PCM codec using the A-law).

The receive path of a voice channel codec receiving the test tone sequence converts it to the corresponding analog signal. The resulting 1-kHz tone can be heard in the earpiece of a telephone set connected to the tested channel (alternatively, its level can be measured by a standard audio analyzer).

The output signal of the test tone injection subsystem is also routed by means of the main link routing matrix. Therefore, the user can select the timeslot in which the test tone is injected (only one timeslot at a time), and the direction in which the test tone is sent (local or remote).

## **Description of BER Tests Supported by Main Link Modules**

### ***Local BER Test on Internal or External Port***

The local BER test is used to evaluate the internal data transmission paths ending at a selected internal or external E1 or T1 port of a main link module. This simultaneously tests all the channels routed to the corresponding port.

A functional diagram of the module showing the flow of test signals during local BER testing of an external port is shown in *Figure 6-5*. The flow of signals for an internal port is similar, except that the test sequence generator and evaluator are then connected to the internal port.

As shown in *Figure 6-5*, during testing the signal paths are modified as follows:

- The receive output of the tested port is disconnected from the TDM buses and the output of the test sequence generator is connected in its place.
- The transmit data stream intended for connection to the tested port is also disconnected from the port and is instead routed to the input of the test sequence evaluator.

The local BER test signal paths lead toward the I/O modules and channels connected to the tested main link port through the TDM buses of the Megaplex chassis. To return the BER test signal to the BER sequence evaluator, a remote loopback must be activated at each module or channel. Alternatively, a remote loopback can be activated on the user's equipment connected to the corresponding channels: in this case, the BER test paths include the cables that connect the user's equipment to the Megaplex I/O module connectors, as well as the user's equipment interfaces.

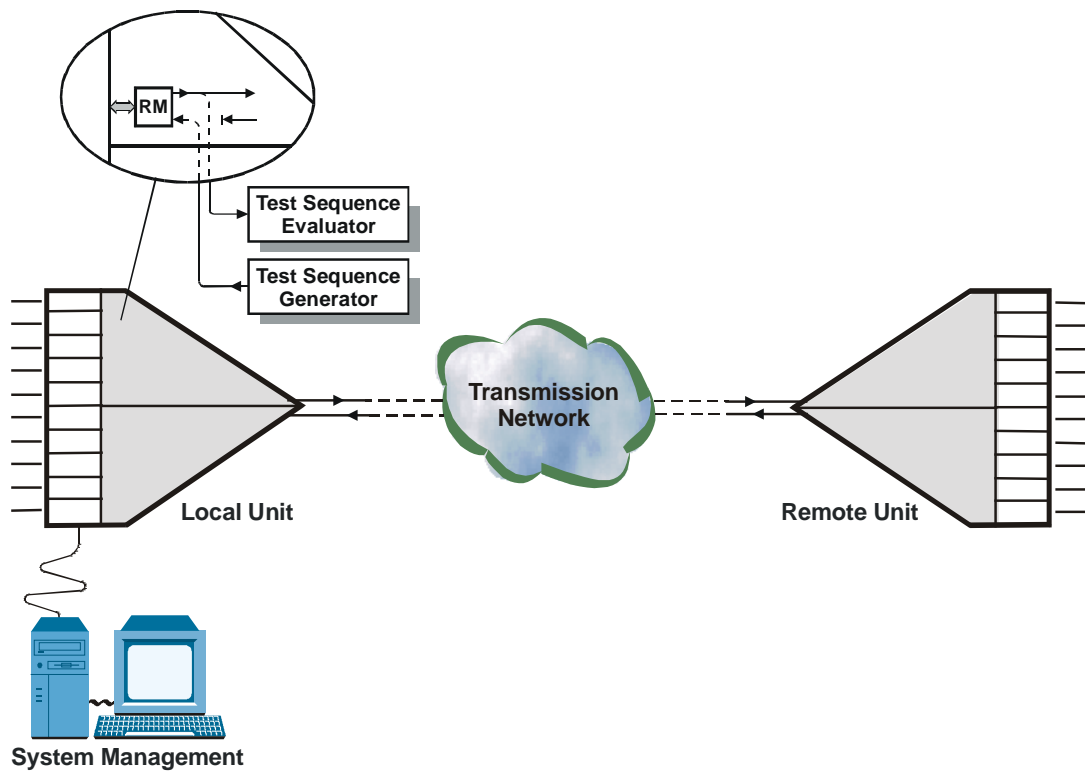


Figure 6-5. Local BER Test on External Port, Signal Paths

### **Remote BER Test on Internal or External Port**

The remote BER test is used to evaluate data transmission from a selected internal or external E1 or T1 port of the main link module toward the remote side, that is, toward a port of another main link module that communicates with the tested port through the transport network. This simultaneously tests all the channels routed between these two ports.

A functional diagram of the module showing the flow of test signals during remote BER testing of an external port is shown in [Figure 6-6](#). The flow of signals for an internal port is similar, except that the test sequence generator and evaluator are then connected to the internal port.

As shown in [Figure 6-6](#), during testing the signal paths are modified as follows:

- The transmit input of the tested port is connected to the output of the test sequence generator.
- The received data stream of the tested port is routed to the input of the test sequence evaluator.

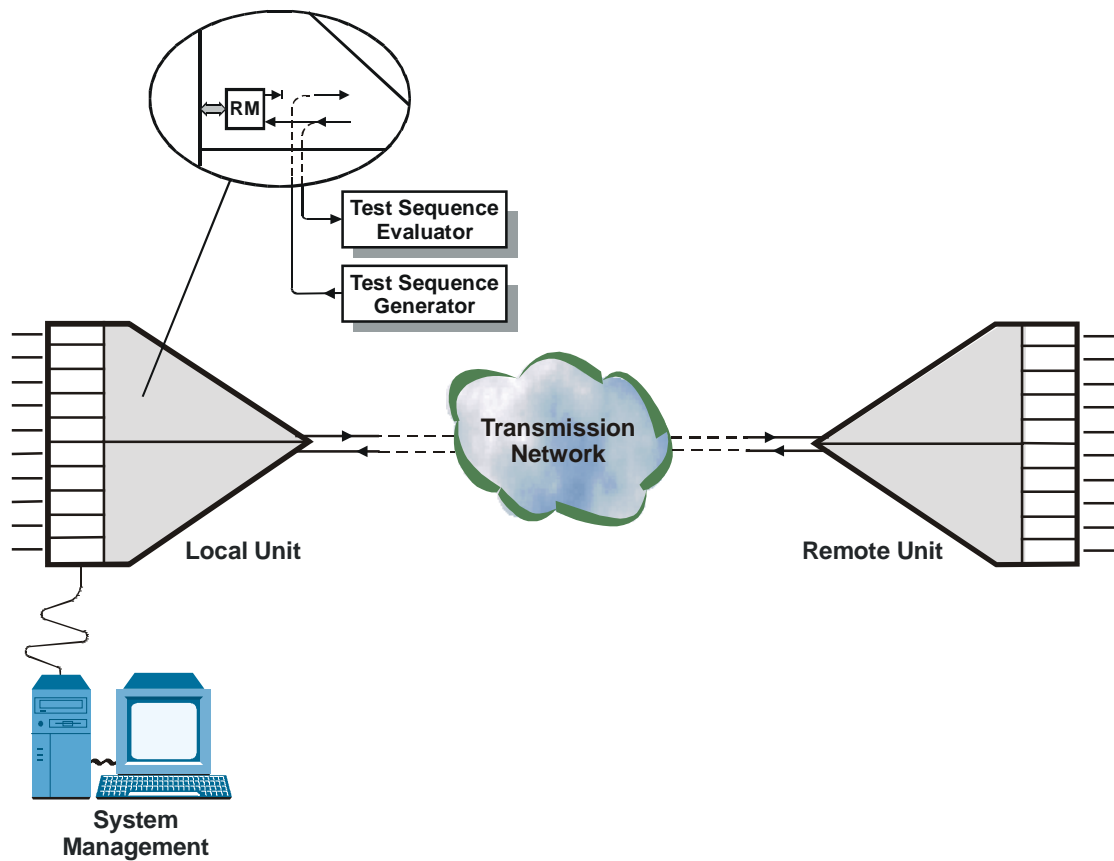


Figure 6-6. Remote BER Test on External Port, Signal Paths

### **Local BER Test on Internal or External Port Timeslots**

The local BER test described in the [Local BER Test on Internal or External Port](#) section above can also be performed on selected timeslots of an internal or external port. The flow of test signals is similar to that shown in [Figure 6-5](#), which shows BER testing on the whole port, with one difference: the loopback is activated only on the timeslots specified by the user during the activation of the test. As a result, there is no disturbance to services provided by means of the other timeslots of the internal port: only the flow of channel payload using one or more of the tested timeslots is disrupted.

The user can select to activate the loopback on any individual timeslot, on several arbitrarily selected timeslots, or on a whole bundle of timeslots, for example the bundle assigned to a module requiring fractional E1 service.

When activating a BER test on a bundle of timeslots, it is sufficient to activate it on the last timeslot of the bundle: Megaplex will then automatically activate the same BER test on all the other timeslots of the bundle. The same is true for deactivating the BER test.

In fractional E1 or T1 applications (or any other application which does not use all the timeslots of a port), you can measure the BER on the unused timeslots instead of for BER testing on the whole port. This has the advantage that it is not necessary to take the port out of service during BER testing.

When this approach is used, a correction factor must be used: to obtain the BER value for the whole port from the number of errors measured on  $n$  timeslots, multiply that number by  $32/n$ .

### ***Local BER Test on Bits in a Split Timeslot***

The local BER test described in the [Local BER Test on Internal or External Port](#) section above can also be performed on selected individual bits of a split timeslot.

The user can select bits for testing in the same way used to bits to a specific low-speed port, that is, pairs of consecutive bits always starting with an odd bit. Thus, 2, 4 or 8 bits of any one timeslot carried by the main link module can be selected for testing (8 bits is equivalent to selecting a full timeslot). Selecting any bit assigned to a local port automatically selects all the bits assigned to the same port.

The flow of test signals is similar to that shown in [Figure 6-5](#), which shows BER testing on the whole port, with one difference: the loopback is activated only on the bits specified by the user during the activation of the test. As a result, there is no disturbance to services provided by means of the other bits of the same timeslot, not of the other timeslots: only the flow of payload carried by the specified bits is disrupted.

### ***Remote BER Test on Internal or External Port Timeslots***

The remote BER test described in the [Remote BER Test on Internal or External Port](#) section above can also be performed on selected timeslots of an internal or external port. The flow of test signals is similar to that shown in [Figure 6-6](#), which shows BER testing on the whole port, with one difference: the loopback is activated only on the timeslots specified by the user during the activation of the test. As a result, there is no disturbance to services provided by means of the other timeslots of the internal port: only the flow of payload carried by the timeslot bundles using one or more of the tested timeslots is disrupted.

The other features related to BER testing described above for the local BER test on timeslots are also applicable to the remote BER test on timeslots.

### ***Remote BER Test on Bits in a Split Timeslot***

The remote BER test described in the [Remote BER Test on Internal or External Port](#) section above can also be performed on selected individual bits of a split timeslot.

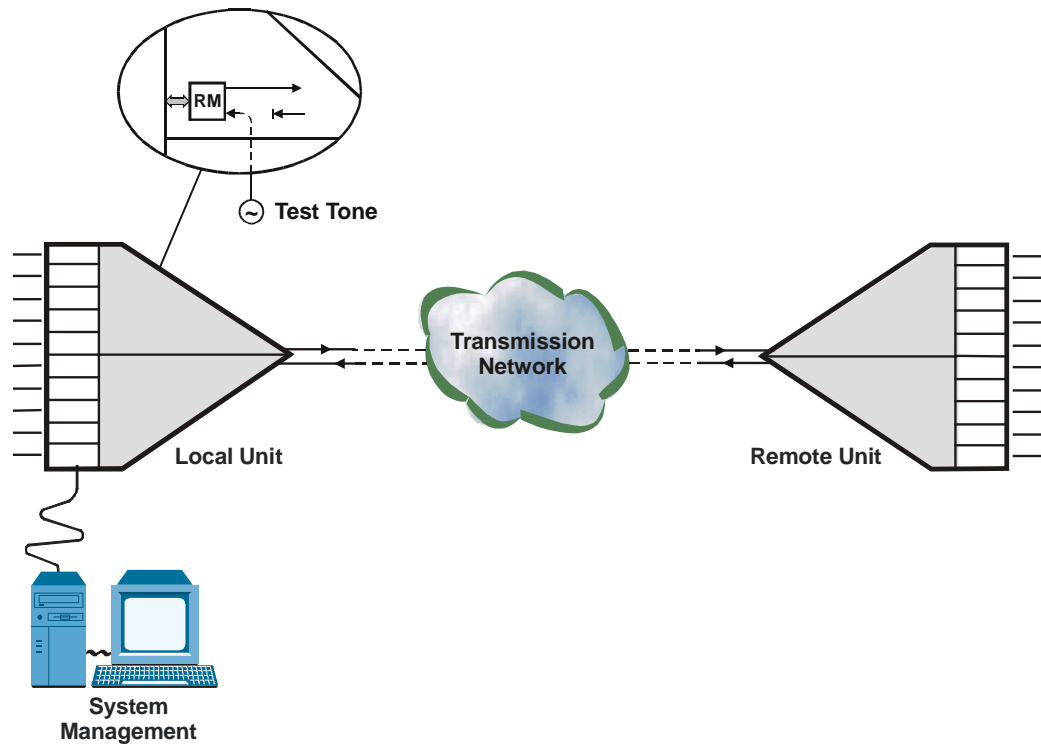
The selection of bits for testing is subject to the same requirements described above for the local BER test on split timeslot bits.

The flow of test signals is similar to that shown in [Figure 6-6](#), which shows BER testing on the whole port, with one difference: the loopback is activated only on the bits specified by the user during the activation of the test. As a result, there is no disturbance to services provided by means of the other bits of the same timeslot, not of the other timeslots: only the flow of payload carried by the specified bits is disrupted.

## Description of Tone Injection Tests Supported by Main Link Modules

### *Local Test Tone Injection*

The user can instruct a main link module to inject a test tone in any desired timeslot toward any desired local voice channel. *Figure 6-7* shows the signal paths.



*Figure 6-7. Local Test Tone Injection Path*

The test tone is a data sequence repeating at a rate of 1 kHz. This data sequence is identical to the data sequence that would have been generated if a 1-kHz signal having a nominal level of 1 mW (0 dBm0) were applied to the input of a standard PCM codec, that is, a PCM codec using the A-law in accordance with ITU-T Rec. G.711.

When the local test tone injection is enabled, the data received from the network in the corresponding timeslot of the local port is replaced by the test tone sequence. This enables the test tone to reach the receive input of the voice channel decoder, and the resulting analog signal is supplied to the local subscriber. As a result, a 1-kHz tone should be heard clearly and loudly in the earpiece of a telephone set connected to the corresponding voice channel.

The signal transmitted by the voice channel toward the other end remains connected to the corresponding transmit timeslot.

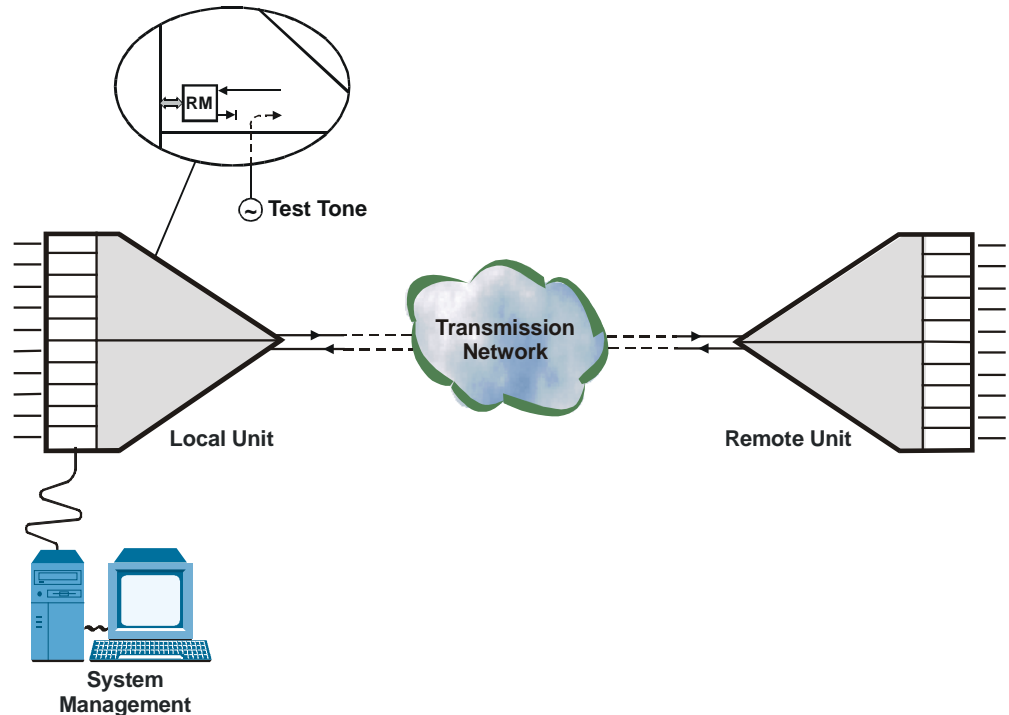
### *Remote Test Tone Injection*

The remote test tone injection is similar to the local test tone injection, except that the test tone sequence is inserted in the corresponding timeslot of the local port transmit path, instead of the transmit signal received from of the channel.

The signal received from the other end remains connected to the local voice channel.

As a result, a 1-kHz tone should be heard clearly and loudly in the earpiece of a telephone set connected to the corresponding remote voice channel.

*Figure 6-8* shows the signal path.



*Figure 6-8. Forward Test Tone Injection Path*

## I/O Module Tests and Loopbacks

### I/O Module Loopbacks

The tests and loopbacks available for the I/O modules depend on the module type, however in general the I/O modules support local and remote loopbacks at two levels: at the level of the individual module channel, and the level of the multiplexed output of the module (the output towards the TDM bus).

- A local loopback on an individual channel (*Figure 6-9*) includes only a small part of the module hardware, but helps in the location of connection problems, such as cable faults, wrong wiring, etc. This type of loopback is present on all the I/O modules.

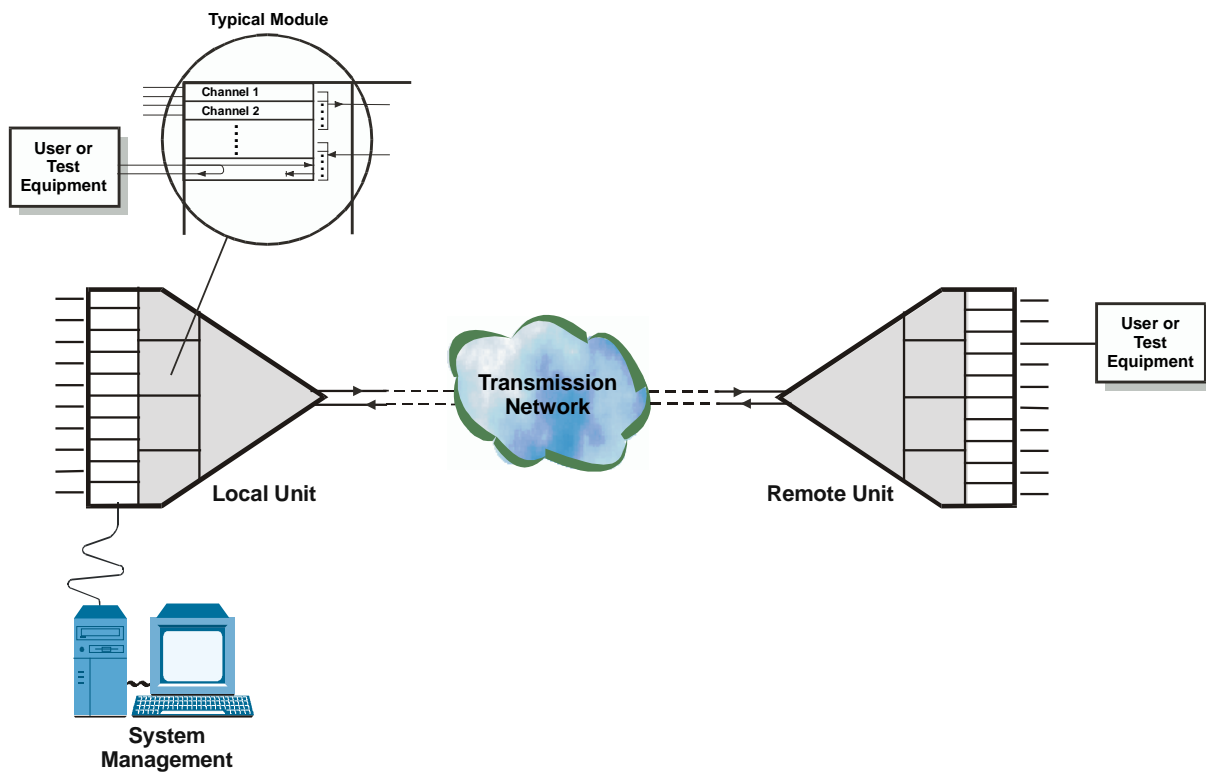


Figure 6-9. I/O Module, Local Loopback on Individual Channel

- A local loopback on the multiplexed output signal of the module ([Figure 6-10](#)) allows the separation of faults in the module itself from faults in the other Megaplex hardware: if the test at the module level fails, the problem is certainly in the module itself.
- This type of loopback is available only on I/O modules that include sub-rate multiplexing, on I/O modules that do not include the option of local loopback at the individual channel level, and on bridge/extender modules.
- A remote loopback on an individual channel ([Figure 6-11](#)) allows the remote side to check the complete transmission path down to the local channel circuits. It is a rapid test when everything seems to be working OK.

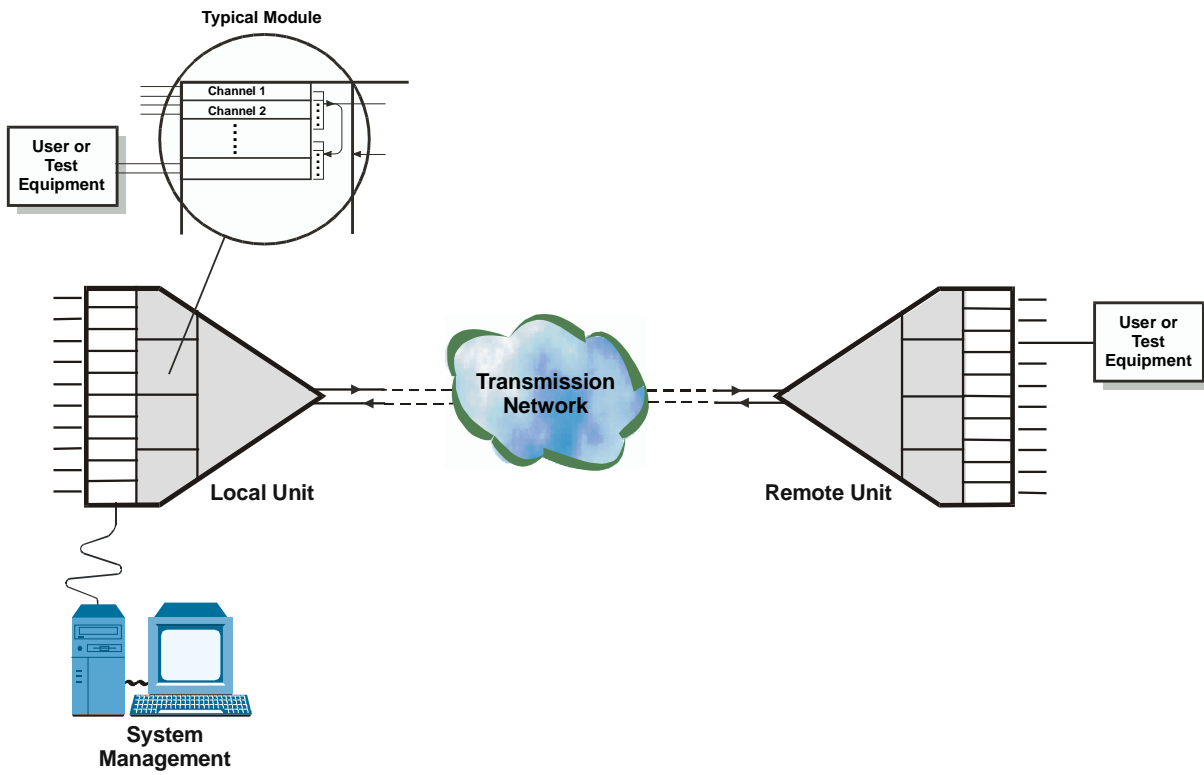


Figure 6-10. I/O Module, Local Loopback on Module Output

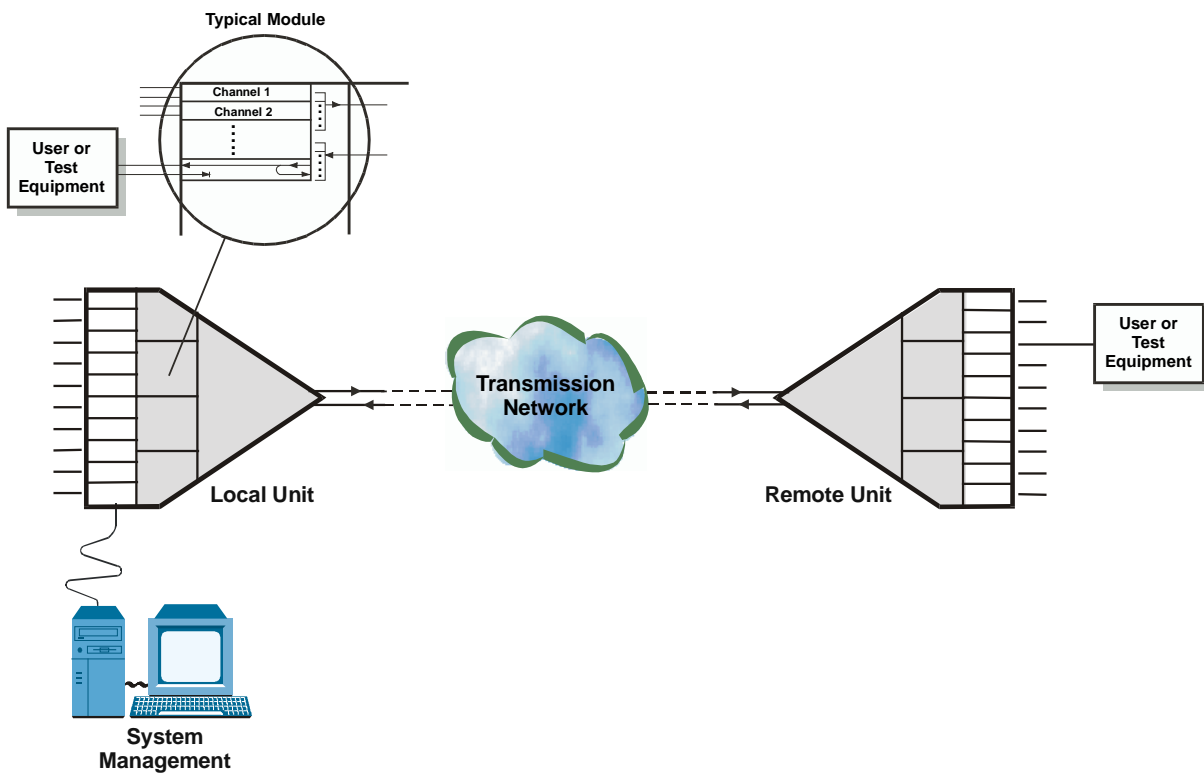


Figure 6-11. I/O Module, Remote Loopback on Individual Channel



- A remote loopback on a module (*Figure 6-12*) allows the remote side to check the complete transmission path down to, but without including, the local module. This type of loopback is available for the same types of modules that support the local loopback. It is useful for locating faults in the remote module, and in the path up to the local module.

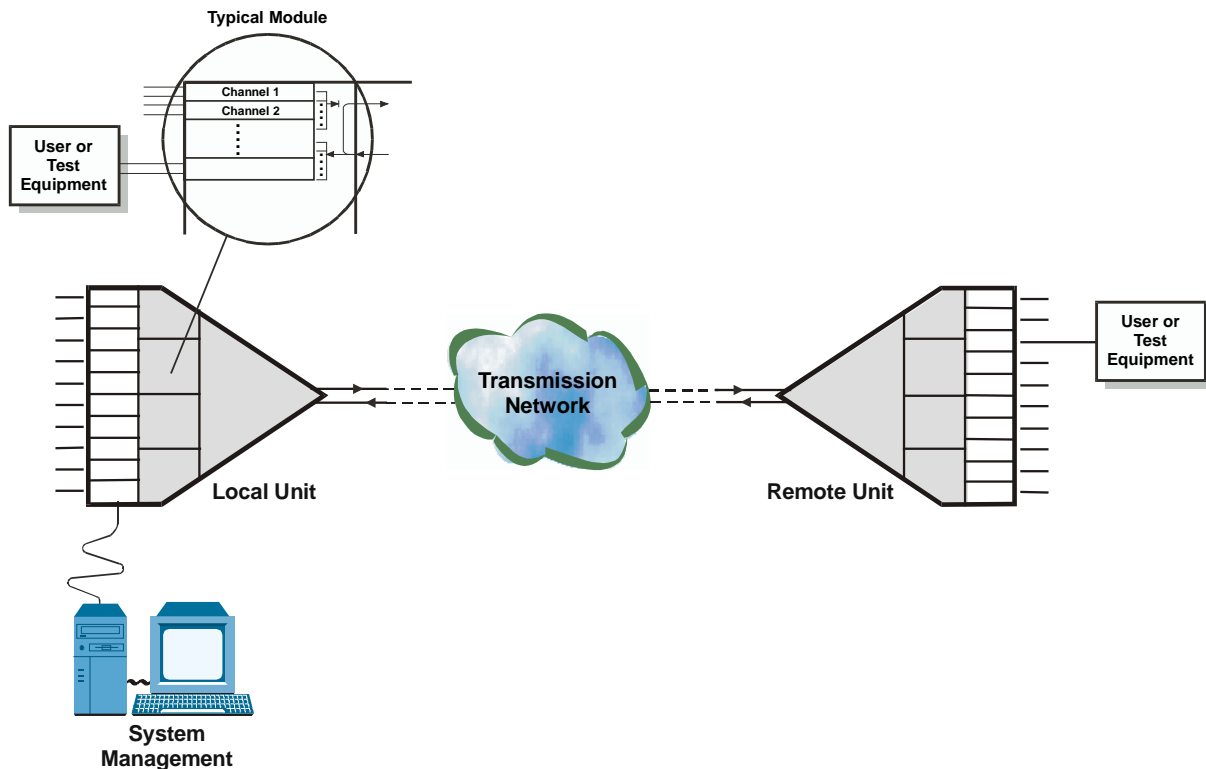


Figure 6-12. I/O Module, Remote Loopback on Module Output

## I/O Module Bit Error Rate Testing (BERT)

The BER test is used to check for proper data transmission through the channels of data modules. Its purpose is to obtain a qualitative evaluation of data transmission without using external test equipment.

When using the internal BER testing subsystem available on most data modules, the BER is measured by applying a  $2^4 - 1$  pseudo-random test signal generated by an internal test sequence generator to the input of the tested channel transmit path. The transmitted data is returned by means of a loopback somewhere along the data path (e.g., by connecting a local or remote main link loopback) to the receive path of the module, and routed to a test sequence evaluator.

The evaluator compares the received data, bit by bit, to the original data and detects any difference (bit error). The output of the evaluator is sampled during module polling, to check whether errors were detected in the interval between consecutive pollings. The total number of intervals during which errors were detected are counted and can be displayed to the operator.

During the BERT test, the tested channel is disconnected from the user data equipment, and the DSR line is turned off. *Figure 6-13* shows typical signal paths during I/O module BER testing.

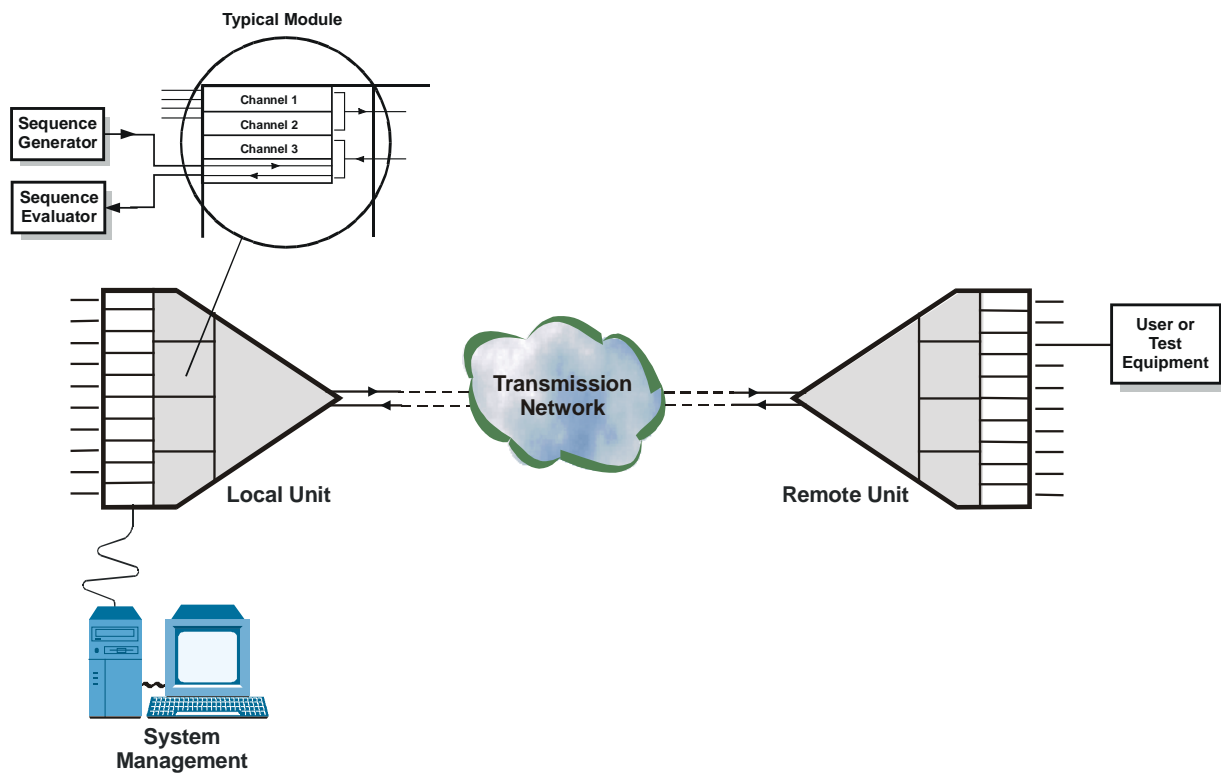


Figure 6-13. I/O Module, BER Test in I/O Channel

## I/O Module Tone Injection Functions

The test tone is a data sequence repeating at a rate of 1 kHz. This data sequence is identical to the data sequence that would have been generated if a 1 kHz signal having a nominal level of 1 mW (0 dBm0) were applied to the input of the channel codec.

The test tone is connected to the transmit path multiplexer, instead of the transmit signal of the channel.

The tone can be connected to only one channel of a voice module at a time. Tone injection automatically disconnects the local subscriber signal.

*Figure 6-14* shows the test tone injection path.

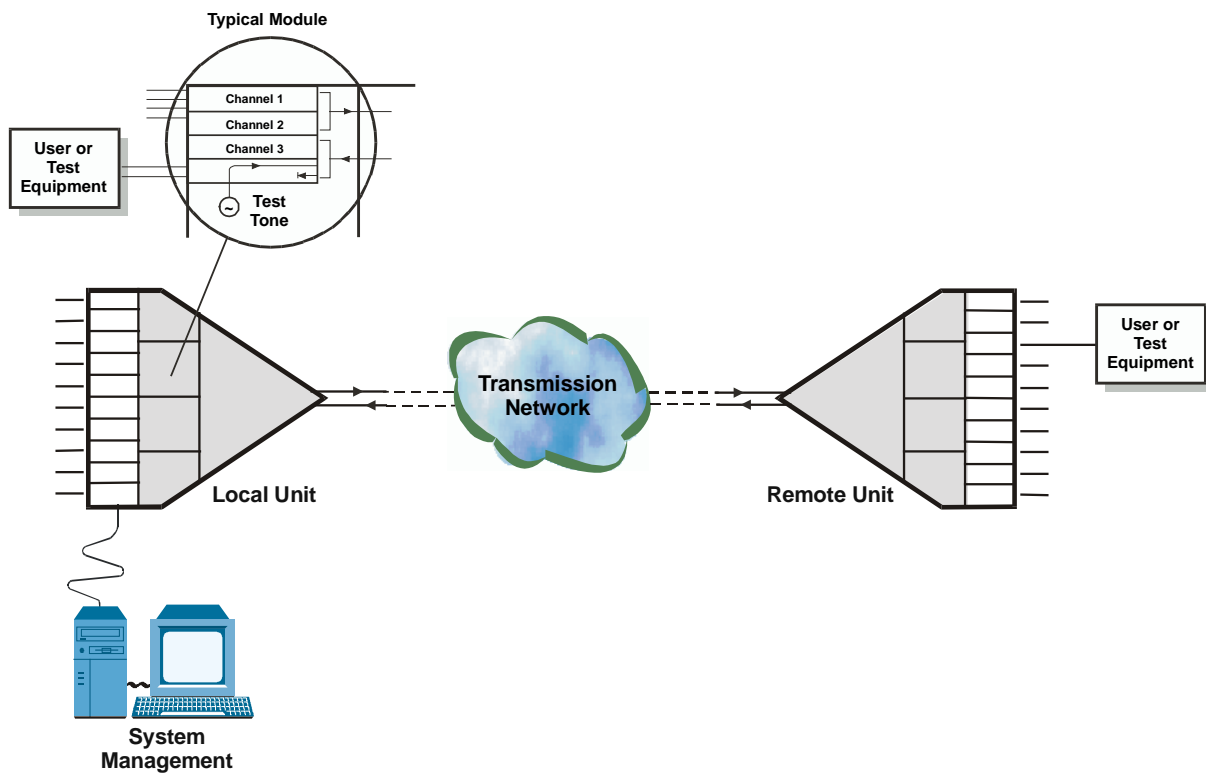


Figure 6-14. Test Tone Injection Path

## 6.6 Frequently Asked Questions

- Q** In case of a redundant power supply in the MP-2100, is it possible that both AC and DC power supplies are installed in the same chassis?
- A** Yes, it is possible to have both AC and DC power supplies in a redundant mode in the same MP-2100 chassis.
- Q** Is it possible to download Megaplex software versions using RADview TFTP?
- A** Yes, starting from Version 12.6.
- Q** What are the configuration, software and hardware requirements for downloading a NVRM.DAT file into a Megaplex CL.2 module?
- A** In order to copy NVRM.DAT from one MP CL to another CL, the target CL must be configured with the same IP address and Mux name as the source CL. Also, they must have the same CL HW/SW versions.
- Q** Can CL redundancy be configured for two CL modules with different versions?
- A** For CL redundancy, both CL must have the same SW version. The HW versions can be different only for the special case of HW 5 & HW 6.
- Q** Does the Megaplex support Q.931 signaling?

**A** No. Q.931 is ISDN's connection control protocol, roughly comparable to TCP in the Internet protocol stack. Q.931 doesn't provide flow control or perform retransmission, since the underlying layers are assumed to be reliable, and the circuit-oriented nature of ISDN allocates bandwidth in fixed increments of 64 kbps. Q.931 does manage connection setup and breakdown. Like TCP, Q.931 documents both the protocol itself and a protocol state machine.

**Q How do I calculate the Availability Time of a product? (MTBF)**

**A** The Availability of a product over a period of time can be calculated from the following formula:

$$A = (MTBF / (MTBF + T)) * 100\%$$

Where:

A = Availability Time (in percentage),

MTBF = Mean Time Between Failures

T = Period of time over which the Availability Time is required.

**Q Can Megaplex accommodate contra-directional and co-directional G.703 traffic?**

**A** No, it supports only co-directional interface.

**Q How we can activate the Database Flip from RADview ?**

**A** To activate the Database flip from the RADView:

1. Open Configuration > DB Operations > Flip DB > Update. A confirmation message appears.
2. Click <OK> to perform Update. The Flip configuration is saved in the Megaplex CL.2 card.

**Q In Megaplex-2100/2104 can you provide automatic backup from a TDM-E1 link to a TDMoIP IP link?**

**A** Yes, this can be done using separate databases and the DB Flip procedure. A flip event in this case should be configured as PORT FAIL.

The TDM – (E1/T1) port fail indications are:

- Signal Loss
- Sync Loss
- AIS.

The ETH port fail indications are:

- Signal Loss
- PW bundle Sync Loss.

The DB flip time can be up to 2-3 minutes, depending on the corresponding DB size.

**Q Does the fan in the PS always operate?**

- A** In Megaplex-2100, PS-180 and PS-200 power supply modules have a miniature cooling fan installed on their front panels. The PS-200 fan operates only when the temperature is high, whereas that of the PS-180 operates at all times. On the PS-200's board there is a transformer, and only when the temperature on this transformer will be 57 degrees, the fan will start working. Note we are not talking on the environment temperature, but only on the transformer's temperature.

**Q What is the meaning of BPV error, and what can be the reason for such an error?**

- A** A BPV error event on AMI-coded signal is the occurrence of a pulse of the same polarity as the previous pulse. A BPV error event for a B8ZS- or HDB3-coded signal is the occurrence of a pulse of the same polarity as the previous pulse without being a part of the zero substitution code. A normal DS-1 signal uses Alternate Mark Inversion as the line code.

In other words, if the terminal data stream is 11111111, then the line code is transmitted as marks (pulses) of alternating polarity, so we would see +1, -1, +1, -1, +1, -1, +1, -1. If a one BPV has been created, we would see two consecutive pulses of the same polarity. In this case, we might see +1, -1, +1, +1, -1, +1, -1, and +1.

Usually a BPV occurs as a result of bad wiring connections. We recommend rechecking the wiring/physical connections.

**Q Referring to Megaplex's DB FLIP feature, how many Time Events can we configure per day?**

- A** Only one Time Event is allowed for each day category. Every day category you define by DEF AGENDA command.

**Q Does RING redundancy support 50 msec switching time?**

- A** No, RING redundancy doesn't support 50 msec. This feature is supported only by the Parallel Tx redundancy (in the same module).

**Q What are the criteria for performing the flip in Ring redundancy as well as Parallel Tx redundancy?**

- A** In Ring redundancy as well as Parallel Tx redundancy, the criteria for performing the flip are:
- Sync Loss of MultiFrame
  - Sync Loss of Signal
  - Signal Loss
  - AIS
  - REM Sync Loss
  - Excessive error ratio.

- Q What are the capabilities of FCD, DXC and MP for performing management through TS0?**
- A** From the E1s TS0 spare bits for national use:  
FCD-E1 uses only Sa4 (4 kbps bandwidth).  
FCD-E1A, FCD-E1M, and DXC use Sa4 to Sa8. Any bit combination is possible (for example, it is possible to use only bits 4, 5 and 7). Bandwidth: 4, 8, 12, 16 or 20 kbps.  
Megaplex uses Sa4 to Sa8.  
If configured for a bandwidth of 4 kbps, the MP will use Sa4.  
If configured for a bandwidth of 8 kbps the MP will use Sa4 and Sa5, and so on, until reaching a bandwidth of 20 kbps, for which the MP will use Sa4 to Sa8.
- Q Is it possible to split the bandwidth while working in Unframed mode?**
- A** No. When you work in Unframed mode, it is impossible to split the bandwidth to more than one user. The E1 port transparently transfers the incoming data stream on a bit-by-bit basis. This allows the transfer of Unframed 2048 kbps data streams.
- Q Can the channels of Megaplex low-speed modules provide the clock source for the Megaplex?**
- A** The channels of the Megaplex low speed modules can provide the clock source for the Megaplex only if the low-speed modules' external channel is configured with a rate of 8 kbps or a multiple of it.
- Q What is the aim of FLG (floating ground)?**
- A** The aim of this option is to connect a +24 VDC power source.  
In DC installations generally the positive pole of the battery is connected to earth at the building installation, and in most RAD products, the chassis (safety) ground and the digital ground are connected together at one point on the PCB.  
Thus if your power source indeed provides -24VDC and the chassis ground is connected to the + of the battery, then everything should work properly without the floating ground.  
But if the situation is opposite and the earth is connected to the negative pool of the power supply, we recommend using this option in order to avoid a short circuit.
- Q What is the polarity of the voltage feeding for the 24 VDC and 48 VDC options of MP-2100/2104?**
- A** By default, the battery feeding voltage polarity for these options is negative.  
This means that MP-2100/2104 works with -24 VDC or -48 VDC (according to the ordering option). By default the MP-2100/2104 DC power supplies come with the positive pole of the battery shorted to the frame ground (chassis).  
The MP-2100 DC power supplies can also be set to work with the frame ground (chassis) separated from the battery poles by setting the jumper BGND=FGND to "NO" position. Using this setting while creating an external

short between the negative pole of the battery and the MP-2100 chassis will create a positive voltage DC (+24 or +48 VDC).

MP-2104 DC can be set to work with positive battery voltage by ordering the unit with the floating ground option ("/FLG"), which comes with a separate frame ground and battery signals. These units can be set to work with positive DC voltage by an external short between the negative pole of the battery and the MP-2104 chassis.

➤ **To obtain fully floating ground for MP-2100:**

- Set the GND=FGND jumper of the power supply "NO".
- Set the BGND=FGND jumper of the power supplies to "NO".
- Order all the modules with floating ground as well (the CL.2 and ML-xE1 modules are by default floating ground).

➤ **To obtain fully floating ground for MP-2104:**

- Order the chassis with the "/FLG" option.
- Order all the modules with floating ground as well (the CL.2 and ML-xE1 modules are by default floating ground).

**Q Is it possible to work with VC FXS modules in a MP-2100/2104 chassis working with positive DC voltage?**

**A** No. One important limitation of positive DC voltage operation, i.e. frame chassis (FGND) in shortcut with the negative pole of the battery, is that VC/FXS cards cannot be used. If FXS modules are needed, then the DC-powered Megaplex must work either with negative DC voltage or in floating ground.

➤ **To obtain fully floating ground for MP-2100:**

- Set the GND=FGND jumper of the power supply "NO".
- Set the BGND=FGND jumper of the power supplies to "NO".
- Order all the modules with floating ground as well (the CL.2 and ML-xE1 modules are by default floating ground).

➤ **To obtain fully floating ground for MP-2104:**

- Order the chassis with the "/FLG" option.
- Order all the modules with floating ground as well (the CL.2 and ML-xE1 modules are by default floating ground).

**Q To test my application I am using the internal BERT of the product, opposite a T1 tester. Although I am using the same pattern (2E15-1 or 2E23-1), the T1 tester reports a "Data Inverted" alarm. Why?**

**A** The implementation of these patterns (2E15-1 or 2E23-1) in RAD products is according to ITU version. Your tester probably has the ANSI version. The polynomials for both versions are the same as stated in O.151 but the standard implementation in North American is to not run the output through an inverter. ITU versions of the patterns have the output of the shift registers

run through an inverter. This warning on the differences in some of the pseudorandom patterns can be found in ANSI T1M1.3.

**Q Do E1/T1 Ring configurations support the transfer of time slots defined as "Bi-Directional Broadcast"?**

**A** No. E1/T1 Ring configurations do not support Bi-Broadcast timeslots transferring. However, Chain applications do support Bi-Broadcast timeslots.

**Q What is the state of the DSR pin in DCE mode and the DTR pin in DTE mode for the Megaplex high-speed modules when the Main Link is working properly?**

**A** Because of the fact that the high-speed modules convert high-speed data into TDM time slots (i.e., a constant flux of data), when the Main Link is working properly, a high-speed DCE channel's DSR pin will always be in the ON state, and a high-speed DTE channel's DTR pin will always be in the ON state.

**Q Does Megaplex equipment allow the configuration of "split" timeslots in Broadcast mode?**

**A** No. A timeslot defined as 'SPLIT' (even when all its bits have information allocated to them) cannot be configured in Broadcast mode.

**Q How many ML modules can be installed in the chassis?**

**A** In principle, there aren't any limitations on the number of main link modules in the chassis. The only limitations in practice are the number of I/O slots and current consumption.

**Q Does Megaplex have a module supports RS-485 interface?**

**A** No, Megaplex does not support the RS-485 interface. You have to use with a converter from RS-485 to RS-232 in order to transmit data from a source RS-485 interface over the Megaplex.

There are several products that perform this conversion:

- SRM-6DC (Asynchronous Multipoint Short Range Modem), which converts RS-232 to RS-485.
- FOM-485 (Miniature RS-485 Fiber Optic Modem), which converts from RS-485 to fiber.
- MIC-232/485 (Miniature Interface Converters): to convert the RS-485 to RS-232 (without a modem).

**Q I have Megaplex with CL.2 and two or more ML.2 modules. When the system clock is set to INTERNAL, how do I know which Main Link is the source for the Internal clock?**

**A** Use the command DSP ST SYS. This displays the field "TDM master <ML>"



- Q Is it possible to send V.24 asynchronous data through a V.24 synchronous interface?**
- A** It is possible to send this kind of data using oversampling. The frequency of the synchronous interface that will sample the asynchronous signal should be at least four times higher than the asynchronous data pace. In order to make the synchronous interface of a V.24 module working opposite the asynchronous interface, it is sometimes necessary to connect jumpers (shortcut) between the DCD and the RTS pins, and between the DSR and DTR. In this way, the synchronous equipment will transparently transmit the asynchronous information from one side to another. Thus it is possible to send asynchronous information with different, uncommon bit structures (for example, words of 20 data bits, etc.)
- Q How do I configure my router for inband management of one of the above products using a dedicated Frame Relay protocol?**
- A** DLCI = 100  
LMI = NO  
Encapsulation = RFC 1490
- Q What is the conversion formula from volts to dBm?**
- A** dBm is a standard measurement unit of POWER, based on 1 mW = 0 dBm.
- The conversion formula from power in mW to dBm is:  $D = 10 * \text{Log } P$   
where  
 $P = \text{Power (mW)} / 1 \text{ mW}$   
 $D = \text{Power (dBm)}$ .
- Example:* For a 3V, 120 Ohm (balanced, UTP E1 connector), you have an output power of:  $P_{\text{out}} = V^2 / R = 3^2 / 120 = 75\text{mW} = 18.75 \text{ dBm}$ .
- Q Why doesn't Megaplex remove the management station's IP address from its table?**
- A** This behavior is normal. When you define the IP address of the Management Station in the Manager List of the Megaplex, after the first request from the Management station, Megaplex will enter the Management station's IP statically with its routing path to its routing table, and will remove it only after restart.
- Q If a redundant power supply module is installed in the chassis, what is the switchover time when one power supply fails?**
- A** When using two power supply modules in order to achieve power supply redundancy, both power supply modules should be turned on. In normal operation, the two modules share the power load between them. When one power supply module fails, the other will keep providing the required power without any break in the power which is provided to the system.
- Note:** Always make sure that a single power supply module can support the power consumption required by the system.

**Q What is the meaning of the "Recovery Time" parameter that is available while configuring main-link Redundancy?**

**A** The **Recovery Time** parameter is a time period used as a delay between consecutive redundancy flips (except for the first flip which is performed while ignoring this parameter). The **Recovery Time** parameter is needed in order to allow a system with two faulty main-links to stabilize and synchronize. In Y-cable redundancy mode, it is important to configure the devices on both sides of the Y-cable with different **Recovery Time** values, in order to allow the application to stabilize.

**Q What is the maximum number of Megaplex and/or FCD-IP units in an E1 Ring application?**

**A** The total number of devices in an E1 ring, including FCD-IPs, Megaplex units or network management stations, cannot exceed 67. This is a limitation of the DTS routing protocol.

Note that this number includes also adjacent rings that are somehow interconnected, for example via a CL of one Megaplex to another, or adjacent rings located on the same Megaplex ring.

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## 6.7 Technical Support

Technical support for this product can be obtained from the local partner from whom it was purchased.

[RADcare Global Professional Services](#) offers a wide variety of [service](#), [support](#) and [training](#) options, including expert consulting and troubleshooting assistance, online tools, regular training programs, and various equipment coverage options.

For further information, please contact the [RAD partner](#) nearest you or one of [RAD's offices](#) worldwide.

RAD Data Communications would like your help in improving its product documentation. Please [send us an e-mail](#) with your comments.

Thank you for your assistance!

# Chapter 7

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## Software Upgrade and File Transfer

This chapter describes installing new software releases in the CL module and transfer of configuration files.

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### 7.1 Installing New CL Software Releases

The CL module stores the software in flash memory. The software is stored in compressed format, and is decompressed and loaded into the module RAM upon power-up. Since the flash memory is not used to run the software, new software can be loaded in two ways:

- Off-line, using any PC directly connected to the serial port of the CL module. In this case, the Megaplex system cannot carry traffic while software downloading takes place. This procedure can be used both to upgrade the module software version, as well as to install software in a new CL module, for example, a repaired module. This installation method is called *cold*, or *local*, software installation.
- On-line, through the management link connecting a RADview network management station (directly or through other Megaplex systems), without stopping the operation of the Megaplex system in which the CL module is installed.

This procedure can only be used to upgrade the module software version while the equipment operates, and therefore it is called *warm*, or *remote*, software installation.

Software releases contain the compressed software file, CLX\_YZ.ARJ, where X\_YZ stands for the number of the software release to be downloaded (the file name may include additional letters, which identify subversions).

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**Note** *Software releases may be found on RAD distributor's site.*

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A downloading utility is required for performing the cold installation. Two downloading utilities are available from RAD:

- Downloading utility running under DOS, DL.EXE. When using this utility, the cold software installation process should be performed from the DOS prompt. A DOS window under Windows may not work in some PCs.

- Downloading utility running under Windows, DL\_WIN.EXE. This utility is needed when your PC runs Windows XP.

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## 7.2 CL Modules with Hardware Version 6.0

Since some of the CL hardware components (HW 5.0) have recently become obsolete, a new CL version (HW 6.0) has been designed to replace the old CL modules. This new hardware is not compatible with older versions of CL software and requires an updated software version (SW 12.6).

However, a CL with HW 5.0 can be upgraded with the new SW 12.6.

If you had CL redundancy between old CL modules (with SW versions older than 12.6) and a new module (HW 6.0) is replacing one of these modules, you have to upgrade the SW version of the remaining CL module to a number SW xx.6x and up (9.6x and up, 10.6x and up, 11.6x and up, or 12.6x and up). For example, if your CL module had SW 11.2 version, you have to upgrade it to SW 11.6 version.

For additional information, please contact RAD Technical Support Department.

► **To replace a second CL module of a redundancy pair with a new one:**

1. Remove the CL module to be replaced.
2. Update the remaining CL module with SW xx.6x and up version (the same as the new CL) and verify that the version is updated and the application/DB is working.
3. Insert the new CL module into the chassis.
4. Once the new CL module is recognized by the first CL module, perform the DB UPD 1 command.
5. This will update the new CL with the updated database from the old CL.

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## 7.3 Cold (Local) Installation Procedure

Before starting, copy the distribution files, CLX\_YZ.ARJ and DL.EXE or DL\_WIN.EXE, to the desired directories of your PC.

### Cold (Local) Installation Procedure Using DL.EXE

#### Downloading Procedure – Megaplex with Single CL

1. Set section 4 of the DIP switch located on the panel of the CL module to the ON position.
2. Turn the Megaplex on, and wait until all the CL indicators turn off.
3. Set section 4 of DIP switch on the panel of the CL module to OFF, then to ON, and then back to OFF. This is needed to prevent erasing the CL software in case you mistakenly turn the power on while section 4 of the DIP switch is set to ON.

4. Wait until the green ON indicator of the CL module is turned on. Now the flash memory is erased.

---

**Note** *If a fault occurs during the erase process, the red ALARM indicators turn on. In this case, turn the Megaplex off, and start again the procedure with section 4 of the DIP switch at ON.*

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5. Connect the serial port of the PC to the 9-pin connector designated CONTROL-DCE on the front panel of the CL module. Use a standard straight communication cable.
6. Run the DL.EXE program.
7. After the program starts, select the option **C**, and configure the PC for downloading as follows:
  - Select the option **P**, and then select the PC serial port, COM1 or COM2, which is connected to the CL module.
  - Press ESC.
  - Select the option **F** and type the file name to be downloaded. For example, a typical name for the file used to download software release 11.1 would be **CL11\_01.ARJ**.
  - Press ESC.
  - Now you can select the downloading rate, by pressing **B**.

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**Note** *The high rate is not supported by PCs whose serial communication port does not support the 115.2 kbps rate.*

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8. Start file sending by selecting the option **S**.

The software file is sent to the Megaplex, and you can monitor the progress of file transmission on the PC as the software is being sent to the Megaplex. The green ON indicator of the CL module flashes while data transfer proceeds normally.

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**Note** *If a fault occurs during file sending, the red ALARM indicators of the CL module turn on. In this case, turn the Megaplex off, and start again the procedure with section 4 of the DIP switch at ON.*

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9. Wait until all four CL indicators turn on: this indicates that the sending process has been successfully completed.
10. Quit the DL.EXE program (select the option **Q**).
11. The new software is now decompressed and loaded into the module RAM. Note that the yellow TEST indicator flashes during decompression.
12. After the decompression process is completed, the software start running. The green (ON) indicator turns on.

The ALARM MAJ and/or ALARM MIN indicators may also turn on if an alarm condition is present in the Megaplex.

## Downloading Procedure – Megaplex with Two CL

When the Megaplex includes two CL modules, it is necessary to separately download the software to each module. Use the same procedure as explained above.

## Cold (Local) Installation Procedure Using DL\_WIN.EXE

### Familiarizing with the Downloading Utility

The downloading utility, DL\_WIN.EXE, runs under Microsoft™ Windows 98 and later versions (including XP). Before using the utility for the first time on your PC, it is necessary to configure it.

This section explains how to use the DL\_WIN.EXE downloading utility.

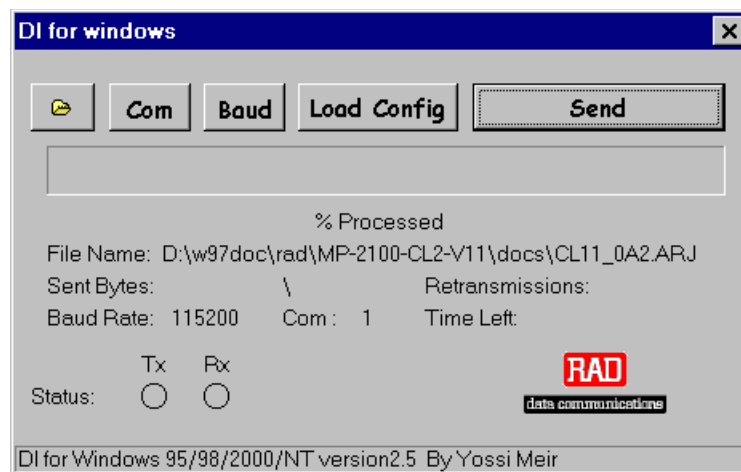
#### ► To start the utility:

Use any standard Windows procedure, for example:

- Double-click the utility filename in the Windows Explorer window
- Open the Windows **Start** menu, select **Run**, type **dl\_win** in the **Open** field of the **Run** dialog box, and click the **OK** button
- Create a shortcut to the filename on the Windows desktop, and double-click it to start.

### Main DL\_WIN Window

*Figure 7-1* shows a typical DL\_WIN main window, as seen after being opened.



*Figure 7-1. DL\_WIN Main Window*

The functions of the five buttons at the top of the window are explained in *Table 7-1*, and the functions of the other fields are explained in *Table 7-2*.

Table 7-1. DL\_WIN Main Window Buttons








Button	What it Does
	Used to select the file to be downloaded: <ol style="list-style-type: none"> <li>1. Click the button to open a standard Windows file <b>Open</b> window.</li> <li>2. Browse to the location of the distribution file, CLX_YZ.ARJ.</li> <li>3. Select the filename, and then click the <b>Open</b> button of the <b>Open</b> window.</li> <li>4. The <b>Open</b> window closes, and the name of the file, together with the complete path, appears in the <b>File Name</b> field of the main window.</li> </ol>
	Used to select the PC serial port to be used for communication with the CL module to be loaded: <ol style="list-style-type: none"> <li>1. Click the button to open the <b>COM Port</b> dialog box.</li> <li>5. Click the button corresponding to the PC serial port, COM1 or COM2, to be connected to the CL module.</li> <li>6. After selecting the desired port, close the box by clicking its  button.</li> </ol>
	Used to select the data rate used for communication with the CL module: <ol style="list-style-type: none"> <li>2. Click the button to open the <b>Baud Rate</b> dialog box.</li> <li>7. Click the button corresponding to the desired data rate, 115200 bps or 57600 bps.</li> <li>8. After selecting the desired rate, close the box by clicking its  button.</li> </ol>
	Used to select a downloading configuration file for the downloading utility. A downloading configuration file, which is named <b>config.wdl</b> , is automatically created in the same directory when the utility is run, and therefore this function is not needed.
	Used to start the downloading process. After downloading is started, the button name changes to <b>Terminate Send</b> : clicking it stops the downloading

Table 7-2. DL\_WIN Main Window Fields

Field	What it Does
Progress Bar and <b>% Processed</b> field	After downloading is started, displays the progress of downloading. In addition to the progress bar, the percentage of the task accomplished is indicated by the <b>% Processed</b> field, located just under the bar
<b>File Name</b> field	Displays the name of the file selected for downloading. The last selection is stored in the configuration file, and automatically displayed when the utility is started again
<b>Sent Bytes</b> field	After downloading is started, displays the number of bytes that have already been sent. The number after the reverse slash indicates the total number of bytes to be sent
<b>Retransmissions</b> field	In case an error is detected, the utility will automatically attempt to retransmit the file to the CL module. The number of times transmissions have been repeated is displayed in this field

Field	What it Does
<b>Baud Rate</b> field	Displays the data rate selected for downloading (see <a href="#">Table 7-1</a> )
<b>Com</b> field	Displays the PC serial port selected for communication with the CL module (see <a href="#">Table 7-1</a> )
<b>Time Left</b> field	After downloading is started, displays the approximate time remaining until downloading is completed
<b>Status</b> field	<p>Includes two indicators that display the communication status:</p> <ul style="list-style-type: none"> <li>• <b>TX</b> – After downloading is started, changes color from gray to yellow, to indicate that transmission progresses normally. Red means that a problem occurred.</li> <li>• <b>RX</b> – After downloading is started, changes color from gray to green, to indicate that the CL module confirmed correct reception of data. Red means that an error has been detected: in such cases, retransmission is attempted.</li> </ul> <p>A status report may be displayed to the right of the <b>RX</b> indicator</p>

► **To configure the utility:**

1. Select the serial communication port.
2. Select the communication data rate.
3. Select the file to be downloaded.

► **To end the utility:**

Click its  button.

### Downloading Procedure – Megaplex with Single CL

1. Set section 4 of the DIP switch located on the panel of the CL module to the ON position.
2. Turn the Megaplex on, and wait until all the CL indicators turn off.
3. Set section 4 of DIP switch on the panel of the CL module to OFF, then to ON, and then back to OFF. This is needed to prevent erasing the CL software in case you mistakenly turn the power on while section 4 of the DIP switch is set to ON.
4. Wait until the green ON indicator of the CL module is turned on. Now the flash memory is erased.

**Note**

*If a fault occurs during the erase process, the red ALARM indicators turn on. In this case, turn the Megaplex off, and start again the procedure with section 4 of the DIP switch at ON.*

5. Connect the selected serial port of the PC to the 9-pin connector designated CONTROL-DCE on the front panel of the CL module. Use a standard straight communication cable.
6. Run the DL\_WIN.EXE utility.
7. After the utility starts, start downloading by clicking the **Send** button:



- The TX indicator should turn yellow.
- The RX indicator in the DL\_WIN window should turn green.
- The green ON indicator of the CL module flashes while data transfer proceeds normally.

---

**Note** *If you see a **Waiting for request from CL** message, check again the connections between the selected PC port and the CL module. If the problem is not in the connections, repeat the erase procedure described above.*

---

- The progress of downloading and the approximate time to completion are displayed in the corresponding fields.

---

**Note** *If a fault occurs during file sending, the red ALARM indicators of the CL module turn on. In this case, turn the Megaplex off, and start again the procedure with section 4 of the DIP switch at ON.*

---

8. Wait until the DL\_WIN utility reports that downloading has been successfully completed.
9. Quit the DL\_WIN utility.
10. The new software is decompressed and loaded into the module RAM. Note that the yellow TST indicator flashes during decompression.
11. After the decompression process is completed, the software start running. The green (ON) indicator turns on.

The ALARM MAJ and/or ALARM MIN indicators may also turn on if an alarm condition is present in the Megaplex.

### **Downloading Procedure – Megaplex with Two CL**

When the Megaplex includes two CL modules, it is necessary to separately download the software to each module. Use the same procedure as explained above.

---

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## **7.4 Warm Installation (Upgrading) Procedure – Windows-Based Stations**

If you manage the Megaplex using a Windows-based network management station which includes TFTP software, or have a Windows station with TFTP software, you can also upgrade the CL software via TFTP, locally or remotely.

### **Preparations**

- Run Windows.
- Copy the specified distribution file, for example, **CLX\_YZ.ARJ** (where X\_YZ stands for the number of the software release to be downloaded; for example, a typical name for the file used to download software release 11.1

would be **CL11\_01.ARJ**), to the desired directory of the PC used as a management station.

- Make sure the network management station can communicate with the Megaplex.

## Downloading Procedure – Megaplex with Single CL

- Run the TFTP application.
- Open the TIME-OUT menu and fill in the fields of the dialog box as follows:
 

<b>Retransmission</b>	20 seconds.
<b>Total Retransmission</b>	200 seconds.

---

**Note** *The following procedure uses typical field designations. However, your TFTP suite may use different designations, or may have more or less options.*

*For example, if your TFTP application does not support retransmission, the **TIME-OUT** menu, or its equivalent, will not appear (in this case, the transfer of files may fail if frames are lost in the network).*

*Use the descriptions of the various fields to identify the equivalent designations in your TFTP suite.*

---

- Open the TRANSFER menu and fill in the fields of the dialog box as follows:
 

<b>Host Name</b>	Enter the IP address of the destination Megaplex, in dotted quad notation
<b>Remote File</b>	Enter the remote file name, for example, MP2100.CL2
<b>Transfer Type</b>	Select Send
<b>Transfer Mode</b>	Select Binary
<b>Local File</b>	Enter the full path needed to reach the local file, for example, CLX_YZ.ARJ
- When done, press the OK button.
- The selected file, for example, **CLX\_YZ.ARJ**, is now sent to the Megaplex. The TFTP window displays the number of bytes already sent to the Megaplex. If a fault occurs, an error message will be displayed: in this case, wait at least 3 minutes and then start again by displaying the TRANSFER menu.
- After the transfer is successfully completed, the CL module is automatically reset, in order to cause the new software to be loaded. The other Megaplex modules continue operating normally. If the CL module software has been changed, its yellow TST indicator flashes during decompression.

## Downloading Procedure – Megaplex with Two CL Modules

When performing the warm installation procedure, the software is always downloaded into the on-line CL module.

As explained above, if the CL module software has been changed, then after software decompression is completed, the on-line CL module is automatically reset. As a result, the other CL module (which currently stores the previous

software version) is switched on-line. Therefore, after receiving the messages which indicate switching to the other module, you can repeat the downloading procedure: this time the new software will be downloaded into the other module. Following the automatic reset at the end of software downloading, the original CL module returns on-line.

If the software of the CL module has not been changed, it is necessary to manually reset the currently on-line module, by entering the command `RESET CL-A` or `RESET CL-B` (in accordance with the on-line module).

---

---

## 7.5 Warm Installation (Upgrading) Procedure – Unix-Based Stations

If you manage the Megaplex using a UNIX-based network management station which includes TFTP software, or have a UNIX station with TFTP software, you can also upgrade the CL software via TFTP, locally or remotely.

When entering commands, remember that UNIX is case-sensitive.

### Preparations

- Copy the distribution file, for example, `CLX_YZ.ARJ` (where X\_YZ stands for the number of the software release to be downloaded), to the desired directory of the UNIX station.
- Make sure the station can communicate with the Megaplex.

### Downloading Procedure – Megaplex with Single CL

- Open an X-Terminal window.
- Run the TFTP application from that window. You should see the prompt `tftp>`, meaning that the TFTP application is running.
- Type the command `binary` at the prompt line, to select the binary transfer mode for downloading.
- Enable the generation of progress messages by entering the command `trace`.
- Select a 30-second retransmission time by entering the command `rexmt 30`.
- Select the over all time-out interval by entering the command `timeout 300`.
- Initiate the connection to the Megaplex unit by entering the command `connect hhh.hhh.hhh.hhh`, where `h` stands for the digits composing the IP address of the desired Megaplex unit.
- Check the connection status by entering the command `status`. The reported status should be `connected`, the transfer mode – `binary`, and `trace` – `ON`.
- Start the transmission of the software file by entering the command `put CLX_YZ.arj MP2100.CL2`.
- The selected file, for example, `CLX_YZ.arj`, is now sent to the destination Megaplex. The TFTP window displays the number of bytes already sent to the

Megaplex. If a fault occurs, an error message will be displayed: in this case, wait 3 minutes and then start again from the **connect** command.

---

**Note** *If the above procedure failed, repeat the procedure but without using the "Trace" command.*

---

- After the transfer is successfully completed, the CL module checks which software has been changed (its own software and/or the software of a frame relay module), and automatically resets all the modules whose software has been changed in order to cause the new software to be loaded. The other Megaplex modules continue operating normally. If the CL module software has been changed, its yellow TST indicator flashes during decompression.

## Downloading Procedure – Megaplex with Two CL

Use the procedure explained in the *Downloading Procedure – Megaplex with Two CL Modules* section of *Section 7.4*.

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## 7.6 Transfer of Configuration Files

This section presents procedures for uploading and downloading Megaplex configuration files, using the TFTP protocol.

Network administrators can use these procedures to distribute verified configuration files to all the managed Megaplex units in the network from a central location, and create backup copies of the databases of each individual Megaplex unit.

### Overview

The configuration information that can be transferred by means of TFTP consists of database files. Two types of database files can be transferred:

- The database stored in the edit buffer of the active CL module. This type of file is named **CNFG.DAT**.
- All of the 10 databases that are stored in the NVRAM of the active CL module. This type of file is named **NVRM.DAT**.

The CL module identifies the file being transferred in accordance with the above-mentioned names, and handles them accordingly.

The uploading and downloading of configuration files is made on-line, through any CL port configured to carry management traffic, without stopping the operation of the Megaplex system. All the transfers are made to or from the active (on-line) CL module, which then handles the internal transfers needed to update the standby (off-line) CL module, when installed in the chassis.

Any PC that supports the TFTP protocol can be used for file transfer.

## Handling the CNFG.DAT File

The CNFG.DAT file is downloaded to the Megaplex edit buffer. After the TFTP transfer is successfully completed, the contents of the CNFG.DAT file replace the edit database, and can be further modified as required by any of the management facilities supported by the Megaplex. The active Megaplex database can be updated as usual, by entering the DB UPD command.

The contents of the Megaplex edit buffer can also be uploaded to the management station as a standard disk file. The management station can then distribute this file, as a CNFG.DAT file, to other units which use similar configuration. The configuration of each unit can then be customized as required.

---

**Note** *In order to copy CNFG.DAT from one Megaplex CL module to another CL module, the target CL must have the same SW version (such as 10.xx, 11.xx, 12.xx, etc). The HW versions can be different only for the special case of HW 5.0 & HW 6.0.*

---

## Handling the NVRM.DAT File

The NVRM.DAT file is used to transfer complete sets of databases, and in most cases is used to keep a backup copy of all the configurations stored in a Megaplex unit.

The information carried in the NVRM.DAT file is retrieved from the NVRAM of the active CL module, and therefore it includes all the Megaplex databases. The standard procedure is to upload the Megaplex databases to the management station to create a backup. The file can then be downloaded to the same unit in whenever required.

After the TFTP transfer is successfully completed, the contents of the NVRM.DAT file overwrite the 10 databases in the NVRAM of the receiving Megaplex unit. As a result, if the particular database downloaded under the number of the currently-active database is different from that overwritten, the Megaplex will automatically switch to the new configuration.

To protect against errors, the Megaplex includes its IP address and agent name (as defined by means of the DEF AGENT command) in the uploaded NVRM.DAT file, and checks during downloading that the file being received carries the same IP address and agent name.

---

**Note** *To restore the configuration of a Megaplex using a NVRM.DAT file, configure the appropriate IP address and agent name before starting the TFTP transfer.*

---

**Note** *In order to copy NVRM.DAT from one Megaplex CL module to another CL module, the target CL must not necessarily have the same SW version, but must be configured with the same IP address and NAME.*

*The databases in the NVRM.DAT file must be supported by the SW version of both modules, that is, the target module must have the same or higher SW version than the source module. For example, if NVRM.DAT was uploaded from the CL module with SW 12.52, it can be downloaded to a CL module with the same SW version or higher (e.g. 12.53, 12.6x).*

---

## Preparations for TFTP Transfer

Before starting, make sure the PC or network management station can communicate with the Megaplex.

When using a serial supervisory port, it is necessary to use the SLIP or PPP protocol, and configure the required IP address of the Megaplex serial port.

## Downloading Procedure

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**Note** *The following procedure uses typical field designations. However, your TFTP suite may use different designations, or may have more or less options.*

*For example, if your TFTP application does not support retransmission, the **TIME-OUT** menu, or its equivalent, will not appear (in this case, the transfer of files may fail if frames are lost in the network).*

*Use the descriptions of the various fields to identify the equivalent designations in your TFTP suite.*

---

1. Run the TFTP application.
2. Open the **TIME-OUT** menu and fill in the fields of the dialog box as follows:
 

<b>Retransmission</b>	20 seconds.
<b>Total Retransmission</b>	200 seconds.
3. Open the **TRANSFER** menu and fill in the fields of the dialog box as follows:
 

<b>Host Name</b>	Enter the IP address of the destination Megaplex, in dotted quad notation. This is the IP address assigned to its management subsystem, using the DEF AGENT command.
<b>Remote File</b>	Enter the appropriate file name, as needed by the destination Megaplex, in accordance with its contents: <b>CNFG.DAT</b> or <b>NVRM.DAT</b> .
<b>Transfer Type</b>	Select <b>Send</b> .
<b>Transfer Mode</b>	Select <b>Binary</b> .
<b>Local File</b>	Enter the full path needed to reach the desired database file.
4. When done, press the OK button.
5. The selected file is now sent to the selected Megaplex unit. The TFTP window displays the number of bytes already sent to the Megaplex. If a fault occurs, an error message will be displayed: in this case, wait at least 3 minutes and then start again by displaying the TRANSFER menu.
6. After the transfer is successfully completed:
  - If you have transferred a **CNFG.DAT** file, send the command DB UPD with the number of the appropriate database (1 to 10) to the destination Megaplex to cause the downloaded database to be stored in the local NVRAM, and the new configuration will take effect. You may also make

changes to the downloaded database, which is now in the edit buffer, before sending the DB UPD command.

If you need to download an additional database to the same Megaplex, wait for the database update process to be completed, and then repeat the whole process.

- If you have transferred a **NVRM.DAT** file, do not send the command DB UPD to the destination Megaplex, because the configuration contained in the database will automatically take effect.

## Uploading Procedure

Use the procedure described above, except that to upload the configuration file stored by the Megaplex unit it is necessary to select Receive for the **Transfer Type**.

---

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## 7.7 TFTP File Transfer via RADview

If you manage the Megaplex using the RADview network management station, or another network management station running SNMP client software in a Windows environment, you can also upgrade the CL software in running time (perform warm installation).

For detailed description of this procedure, refer to *TFTP File Transfer* section in the RADview User's Manual matching your Megaplex version.





# Chapter 8

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## Configuring Typical Applications

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### 8.1 Introduction

This chapter provides configuration instructions and guidelines for typical Megaplex applications.

The examples presented in this Chapter assume that a Megaplex unit is configured using a standard ASCII terminal.

However, after preliminary configuring the terminal and the Megaplex in accordance with [Chapter 4](#), the same configuration activities can also be performed by means of a Telnet host, or an SNMP network management station.

For general information regarding the supervision language syntax, usage and commands, refer to [Chapter 4](#).

Detailed descriptions of each command appear in Chapter 5. For any additional information, refer to the Installation and Operation Manuals of the various modules.

## 8.2 Configuration Sequence

To prepare a typical Megaplex system for operation in accordance with customer's requirements, perform the following activities in the order given in *Table 8-1*.

*Table 8-1. Outline of Configuration Sequence*

Step	Activity	Reference
1	Preliminary configuration	<i>Section 4.4</i>
2	Define system configuration parameters	<i>Section 8.3</i>
3	Configure the TDM main links	<i>Section 8.4</i>
4	Configure each module and channel	<i>Section 8.5</i>
5	Configure the timeslot routing (including split timeslot utilization) for each channel	<i>Section 8.6</i>
6	Define the TDMoIP configuration parameters (only for Megaplex with ML-IP module)	<i>Section 8.8</i>
7	Define the flip database parameters	<i>Section 8.9</i>
8	Save the flip database	<i>Section 8.9</i>
9	Define the general system parameters	<i>Section 8.10</i>
10	Define IP filtering parameters (for SNMP and Telnet management)	<i>Section 8.10</i>
11	Define alarm handling parameters	<i>Section 8.11</i>
12	Save the configuration database	<i>Section 8.12</i>
13	Select the default configuration database	<i>Section 8.12</i>

During the configuration process, it is recommended to check the results of each command by displaying the new parameters, and checking for consistency with the previous selections and compliance with the prescribed system configuration requirements.

When the database is ready, it is recommended to check it using the DB CHK command.

You should make the checks before entering a DB UPD/DB NET UPD or FLIP DB NET UPD command: in this case, if an error is detected, you can undo the changes by entering the DB UNDO, respectively FLIP DB UNDO, command.

---

---

## 8.3 Defining the System Configuration

The purpose of the system configuration activity is to define system-wide parameters, for example:

- The modules to be included in the Megaplex database
- Select the system timing sources
- Define signaling profiles.

### Preparations

Before starting system configuration, it is recommended to reload the factory-default parameters, using the following procedure:

1. Type **INIT DB<Enter>**.
2. Type **DB UPD1<Enter>**.

### Defining the Modules Installed in the System

Megaplex enables the user to include in its database modules that are not physically installed in the enclosure. This enables the user to preprogram module parameters so that when a module is installed, it will start immediately to operate in the desired mode.

To define the system parameters, type:

```
DEF SYS<Enter>
```

The first part of the system parameters data form appears. The first part consists of several lines:

- The first line is used to define the common modules installed in the unit, i.e., the PS and CL modules.
- The following lines are used to define the I/O modules.

---

**Note** *HS-R is used to identify both the HS-R and HS-RN versions (you can identify a HS-RN module by reading the hardware version by means of the DSP REV command: version 6 or higher denotes a HS-RN module).*

---

If necessary, change the module types as required. When the desired selection is displayed, press **<Enter>** to display the next line. A typical form for a Megaplex-2100, as seen after all the lines are displayed, is shown below.

SLOT:	PS-A	PS-B	CL-A	CL-B	
TYPE:	PS	PS	MCL.2	MCL.2	
SLOT:	IO-01	IO-02	IO-03	IO-04	IO-05
TYPE:	ML-2E1	ML-2E1	LS-12	VC-6/E&M	LS-12
SLOT:	IO-06	IO-07	IO-08	IO-09	IO-10
TYPE:	VC-6/E&M	HS-S	HS-S	HS-U-6/1	VFS-24
SLOT:	IO-11	IO-12			
TYPE:	HS-U-6/I	HS-RN			

## Selecting the System Operating Mode

After the desired module types are selected, press **<Enter>**. You will see the second part of the system parameters definition form, which is not relevant for the current version. Confirm the defaults by pressing **<Enter>**.

V5.2 APP	Interface ID	Startup Mode	Reprovision
NONE	N/A	N/A	N/A

## Selecting the Timing Sources

The third part of the system parameters definition form is used to select the master and fallback clock sources.

Refer to [Chapter 1](#) for background information on system timing selection. In most applications, the master clock source is the received clock signal of a main link module port, however when the Megaplex includes TDMoIP modules, the adaptive timing mode is also used. The various options are described below.

### Megaplex with TDM Main Link Modules

A typical screen for a Megaplex which has only TDM main link modules, showing all the available fields, is shown below. Note that the **Slot** and **Ch** fields are displayed only if an external source is selected: in this example, the source is link 1 of the main link module installed in slot 1, however the source could also be the external (station) clock interface, which is identified as external port 3 for ML-2E1 or ML-2T1 modules, or the receive clock supplied to a user-specified data module channel with DTE interface.

	Master	Fallback
Mode:	RX CLOCK	INTERNAL
Slot:	IO-1	N/A
Ch :	EX1	N/A

After the desired parameter values are selected, press the **<Enter>** key to end.

### Megaplex with TDMoIP Main Link Modules

A typical screen which illustrates the use of the adaptive timing mode for a Megaplex which includes ML-IP modules is shown below.

	Master	Fallback
MODE:	ADAPTIVE	INTERNAL
BND :	003	N.C.

The main difference is the addition of the **BND** fields, which appear when **Adaptive** is selected for one (or both) of the **MODE** fields.

To use the adaptive timing mode, first make sure that the bundle (or bundles) that will serve as timing sources have already been defined in accordance with [Section 8.8](#).

#### Note

*If you are preparing a configuration for a new system, first use the ADD BND command to define the prescribed bundles. You can define the desired bundles even without first using the DEF SYS command to define the corresponding ML-IP modules in the system.*

If the desired bundles have already been defined, select **Adaptive** under the **Main** and/or **Fallback** columns, in accordance with the clock signal to be locked to a timeslot bundle, and then press **F** or **B** to scroll among the currently defined bundles until the desired bundle is displayed.

After the desired parameter values are selected, press the **<Enter>** key to end.

## Defining Signaling Profiles

The signaling profiles are used to select the signaling protocol (legacy or R2) and control the conversion of signaling information (carried by bits A, B, C, D – see [Appendix B](#)).

The total number of profiles that can be defined is 5. Profiles are defined by means of the command DEF PROFILE.

### Legacy Profiles

Profiles for legacy signaling are used for regular CAS. These profiles enable the user to define two separate conversions:

- Conversion of signaling information received through a main link, in order to match the internal Megaplex signaling interpretation conventions.
- Conversion of the internal signaling information to the format used by the equipment connected to Megaplex links.

Each link can use different receive and transmit translation rules.

A profile enables the user to select the translation of each individual signal bit. The available selections are A, B, C, D (value copied from the corresponding incoming bit), ~A, ~B, ~C, ~D (inverted value of corresponding incoming bit), 0 (always 0), and 1 (always 1).

#### Note

*When the Megaplex includes an audio interface module which supports defining its own profile, it is necessary to select a main link profile that does not affect the signaling bits of that module. This is obtained by selecting A=A, B=B, C=C, D=D in the active profile.*

In addition to the translation of individual bits, the receive path conversion section can also be used to define the signaling bit patterns that indicate the busy and idle states. The pattern is specified by a hexadecimal digit (0 to 9, A to F), which when converted to binary format yields the ABCD sequence. For example, if busy is indicated by the incoming sequence 1000, select 8.

The contents of the profiles recommended for use with voice modules using standard interface types (E&M, FXO1, FXO2, FXS1, and FXS2) are listed *in Table 8-2*.

*Table 8-2. Default Legacy Profiles for Voice Modules*

Profile	For Use with	Transmit Side				Receive Side			
		A	B	C	D	A	B	C	D
1	Voice Modules with FXS1, FXO1, E&M Interfaces	A	B	C	D	A	B	C	D
2	Voice Modules with FXS2 Interface	A	B	A	B	~B	~A	~B	~A
3	Voice Modules with FXO2 Interface	~B	~A	~B	~A	A	B	A	B

### Profiles for R2 Signaling Protocol

Most of the parameters included in an R2 profile can be automatically selected by specifying a national (country) implementation. In addition, it is necessary to select the type of link (terrestrial or satellite).

R2 profiles enable the user to specify, for each individual channel (identified by the main link timeslot to which it is routed), the call permissions: incoming only, outgoing only, or both.

The user can also select the signaling bit, B or C, used for metering. This is necessary only when the profile must support the metering function. In this case, the user can specify, for each channel (timeslot), whether the metering function is enabled or disabled.

## 8.4 Configuring TDM Main Links

The Megaplex main links are configured by means of the DEF CH command (see [Section 8.8](#) for information on TDMoIP main links).

For first-time configuration, use the DEF CH SS \* command, where SS is the module slot number (this command displays the configuration parameters of all the module ports).

### Typical Data Forms

A typical data form for an E1 TDM main link port operating in the LEGACY service mode (in this example – port 1 of an ML-2E1 module using dual-cable parallel transmit redundancy) is shown below.

```

Port EX1 Parameters
-----
Service          Logical link Id  Interface id     Startup mode     Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A
Connect          Frame            Sig. Profile     Idle Code        CGA              Redundancy
-----
YES              G.732N-CRC4 (1) FF              None             DUAL CABLE P. TX
Rx Gain          Voice OOS Data OOS  OOS signaling    Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT
Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR          64 KBPS              PROPRIETARY RIP
Redundancy Partner Slot  Redundancy Partner Ch  Recovery Mode Primary
-----
IO-1              EX2                  NORMAL           NO
Recovery Time (sec)
-----
12
    
```

A typical data form for a T1 TDM main link port (in this example – port 1 of an ML-2T1 module with Y-cable redundancy), is shown below.

```

Module : ML-2/T1
Port EX1 Parameters
-----
Connect          Frame            Sig. Profile     Idle Code        CGA              Redundancy
-----
YES              ESF              (1)              7F              None             Y-CABLE
FDL Type          Line Code        Interface         Attenuation(CSU)/Length (DSU)
-----
RESPONSE          B8ZS            CSU              0 dBm
Rx Gain          Voice OOS Data OOS  OOS signaling    Error Source      Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      NONE             10 SECONDS(62411)
Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR          64 KBPS              PROPRIETARY RIP
Redundancy Partner Slot  Redundancy Partner Ch  Recovery Mode Primary
-----
IO-1              EX2                  NORMAL           YES
Recovery Time (sec)
-----
12
    
```

It is recommended to select parameter values in accordance with the following guidelines.

### Selecting the Frame

Whenever possible, for E1 links select a framing mode which supports the CRC-4 mode.

This enables the collection of performance diagnostic data. When the link carries voice channels, make sure to use G.704 multiframe (G732S).

For T1 links, use the ESF framing mode whenever possible.

## Selecting Rx Gain (CSU Interfaces Only)

Select **SHORT HAUL**, unless you are using long cables, i.e., cables whose attenuation exceeds 12 dB.

---

**Note** *When using the **LONG HAUL** setting, it is important to configure unused ports as unconnected (CONNECT=NO), because the high sensitivity of the receive path may be sufficient to detect noise as an above-threshold signal. This problem is present for both balanced and unbalanced interfaces, but with unbalanced interfaces it is more pronounced, because ground noise make the effect more severe. This will lead to incorrect reporting of actual port state (it may report the presence of a signal even when no valid signal is actually connected). Although in general this is only a minor nuisance, it may have serious consequences when any form of redundancy is used and the active but unconnected port is the redundancy partner.*

---

## Selecting Inband Management Parameters

Refer to Chapter 4 and Section III of Chapter 9.

## Switching to OOS at Excessive Error Rates

For T1 ports, you may specify parameters that will cause the port to enter the OOS state when the rate of errors (that is, the average number of errors per second) exceeds a certain threshold. This prevents annoying disturbances that may be heard on voice channels when the link BER is high, but not high enough to cause loss of synchronization.

The threshold at which the OOS state is cancelled can be independently set (usually this would be a much lower rate than that used to declare the OOS state).

This option is available for both ESF and SF (D4) framing: for SF (D4) framing, the system monitors BPV events instead of block errors. The monitored events (FRAMING or BPV) are selected by means of the ERROR SOURCE parameter; selecting NONE disables this feature.

## Selecting Redundancy Parameters

For normal protection levels, use one of the basic redundancy modes (Y-cable or dual-port parallel TX). When you are using redundancy, make sure to define the redundancy partners (the two ports defined as a redundant pair) symmetrically, and select different recovery times at the two ends of a link.

To achieve maximal protection for critical data, ring redundancy can be used. When configuring a network for ring redundancy:



1. Make sure to select in a consistent way the direction of data propagation through each ring path. The direction is selected by means of the PRIMARY parameter: YES indicates the direction of the transmit path.
3. Pay special attention to configure properly the main and fallback clock sources, to ensure that the reference clock can be reliably distributed through the network in both main and backup directions.

---

## 8.5 Configuring the I/O Module and Channel Parameters

After configuring the TDM main links, the user can define the parameters of the individual I/O modules and module channels, according to the required application, and route the channels to the desired main link.

### General I/O Module Configuration Procedure

To define the module parameters, or the parameters of the composite channel of a specific module, type:

```
DEF CH SS<Enter>
```

where **ss** is the number of the slot in which the desired module is installed.

To configure the specific parameters of a port, type:

```
DEF CH SS CC <Enter>
```

where **ss** is the slot number in which the module is installed and **cc** is its port number.

The configuration parameters of each module are explained in the corresponding module Installation and Operation Manual, together with the applicable configuration guidelines.

### Channel Routing

For channels connected to links operating in the regular mode, the Megaplex timeslot assignment algorithm enables the user to route channels simply by selecting the channel operating mode and specifying the destination.

The channel routing parameters, which are also defined by means of the DEF CH command, are explained in [Table 8-3](#).

*Table 8-3. Routing Parameters (DEF CH Command)*

Parameter	Description
<b>Oper Mode</b>	Selects the channel operation mode:
<b>BI-DIR</b>	Bidirectional (regular) mode.
<b>UNI-BRD TX</b>	Unidirectional broadcast transmit mode.
<b>UNI-BRD RX</b>	Unidirectional broadcast receive mode.
	<b>Default: BI-DIR</b>

Parameter	Description
<b>ML Slot</b>	<p>Selects the I/O slot number of the destination main link port:</p> <ul style="list-style-type: none"> <li>When using the <b>BI-DIR</b>, <b>UNI-BRD RX</b> and <b>BID-BRD RX</b> modes, you can select the desired I/O slot number.</li> <li>When using the <b>UNI-BRD TX</b>, this field automatically changes to <b>BRD</b>, to remind you that the destination must be selected using the DEF TS command.</li> </ul> <p><b>Default: I/O-1</b></p>
<b>ML Channel</b>	<p>Selects the number of the destination main link port.</p> <ul style="list-style-type: none"> <li>When using the <b>BI-DIR</b>, <b>UNI-BRD RX</b> and <b>BID-BRD RX</b> modes, you can select the desired external port number. The supported range depends on the number of external ports available on the main link module installed in the slot selected by the <b>ML Slot</b> parameter.</li> <li>When using the <b>UNI-BRD TX</b> mode, this field automatically changes to <b>BRD</b>, to remind you that the destination port must be selected using the DEF TS command.</li> </ul> <p><b>Default: EX1</b></p>
<b>Map Type</b>	<p>Selects the timeslot mapping method to the destination main link port:</p> <ul style="list-style-type: none"> <li>When using the <b>BI-DIR</b> and <b>UNI-BRD TX</b> modes, this field automatically changes to <b>N/A</b>, to remind you that the destination must be selected using the DEF TS command.</li> <li>When using the <b>UNI-BRD RX</b> and <b>BID-BRD RX</b> modes, you can select the desired mode: <ul style="list-style-type: none"> <li><b>USER</b> You can select the desired main link timeslots on the timeslot map.</li> <li><b>SEQUENCE</b> The channel is assigned consecutive timeslots, starting with the timeslot specified by means of the <b>Start TS</b> parameter.</li> </ul> </li> </ul> <p><b>Default: USER</b></p>
<b>Start TS</b>	<ul style="list-style-type: none"> <li>When using the <b>SEQUENCE</b> mapping mode, this field can be used to select the starting timeslot in the frame of the destination main link port. The allowed range is 1 to 31 for E1 ports, and 1 to 24 for T1 ports.</li> <li>When using any other mode, this field automatically changes to <b>N/A</b>.</li> </ul> <p><b>Default: N/A</b></p>

If the **Map Type** parameter is **USER**, and you selected the **UNI-BRD RX** or **BID-BRD RX** mode, then after pressing **<Enter>** to end selecting the routing parameters you will see the first line of the timeslot selection map.

A typical display is shown below:

<b>TS 01</b>	<b>TS 02</b>	<b>TS 03</b>	<b>TS 04</b>	<b>TS 05</b>	<b>TS 06</b>	<b>TS 07</b>
<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>	<b>NO</b>

Move the cursor to the desired timeslot field by pressing the spacebar, and then type F or B to change the selection to **YES**. After making the selections in the first line, press **<Enter>** to continue to the second line (timeslots 8 to 14). Repeat the operations until the last line (ending in timeslot 31 for an E1 port, or in timeslot 24 for a T1 port).

You must select enough timeslots to carry the channel payload rate.

---

---

## 8.6 Timeslot Routing

The purpose of timeslot routing is to assign bandwidth at a specific location within the desired TDM main link frame, to each channel routed to an external (main) link.

**Note**

See [Section 8.8](#) for additional information specific to TDMoIP modules.

---

The basic bandwidth allocation unit for E1 and T1 links is the timeslot. One timeslot contains 8 data bits (see [Appendix B](#)), resulting in a bandwidth of 64 kbps. To increase bandwidth utilization efficiency for channels that carry low payload data rates, the Megaplex system also enables the user to assign bandwidth in units of two bits (16 kbps).

When you perform timeslot routing on a new system, use the following procedure:

- If the system is used in a drop & insert application, start by performing the routing of the timeslots bypassed between main links. This activity is performed by means of the DEF TS command.
- Assign full timeslots to all the channels that require allocation of full timeslots on each main link. This activity is performed by means of the DEF TS command.
- Assign timeslots to channels operating in the unidirectional and bidirectional broadcast modes. This activity is performed by means of the DEF TS and DEF CH commands, as explained below.
- Select timeslots to be used for split timeslot allocation, and then assign bandwidth to low-rate channels. This activity is performed by means of the DEF SPLIT TS command.

### Assigning Full Timeslots

This activity is used to route bypassed timeslots, and allocate timeslots to channels requiring bandwidth in multiples of 64 kbps.

When assigning timeslots, you can also define the timeslot type (voice, data, or management) and their handling (unidirectional, bidirectional or regular). These parameters determine the processing of the data stream carried by each timeslot, and when applicable – also determine the processing of the signaling information associated with each timeslot.

### Special Considerations Regarding Timeslot Assignment

The connection between I/O modules and main link module ports is performed by means of TDM buses, therefore the timeslot routing actually assigns timeslots on the TDM buses. The corresponding port interface of the main link module then places the timeslots in the frame type selected by the user, for transmission over the external link.

Assigning timeslots on the TDM buses is performed automatically by the timeslot assignment algorithm. This algorithm takes into consideration the following factors:

- The I/O module types (voice, data, etc.)
- The number of TDM buses that can be used
- The bandwidth (number of timeslots) needed by each channel. For the purpose of timeslot allocation, timeslots with split (bit-level) assignment are handled in the same way as regular timeslots
- The bandwidth available on the TDM buses.

**Note**

---

*The bypassing of timeslots between external ports of the same main link module is performed on the module itself, and therefore such bypassing does not consume TDM bus bandwidth.*

---

Based on these factors, the timeslot assignment algorithm makes the required internal routing in a way which is completely transparent to the user. The user may become aware of this internal process only when the required bandwidth exceeds the available bandwidth, for example:

- When the number of timeslots that must be assigned to channels that can be connected only to TDM buses A and B exceeds the available number of timeslots. This problem can be corrected in two ways:
  - Whenever possible, install modules that can use the additional TDM buses supported by the Megaplex chassis.
  - Check the total bandwidth needed by each channel and decrease it to the minimum that still meets the system requirements.
- When the number of timeslots that must be assigned to channels installed in this chassis exceeds the available number of timeslots (124 timeslots). In this case, check the total bandwidth needed by each channel and decrease it to the minimum that still meets the system requirements.

The new timeslot assignment algorithm automatically changes the internal timeslot routing, when the current assignment of timeslots on the internal TDM buses cannot support the newly added channels. When the changes include the rerouting of timeslots, the flow of data is momentarily disrupted.

In this case, you will receive a message, to warn you before you confirm the database update. In response, you can postpone the database update, either to prepare for the disruption or to select a time at which the disruption has minimal effect on the traffic.

The total number of user timeslots that can be assigned to the user's I/O modules is determined by the main link module type: the maximum is 31 times the number of TDM buses in use.

The timeslot assignment for a given I/O module is valid only when the total number of timeslots that has been assigned is equal to the number of timeslots required to carry the module payload. As a result, you can assign timeslots only to modules and channels currently configured as **connected**.

Observe the following rules when preparing the timeslot assignment for bypassing:

- Timeslots to be bypassed must be routed between ports of main link modules.

- When channel-associated signaling information must be bypassed between E1 ports, the framing mode of both main link module ports must be G.704 multiframe (G732S), with or without CRC-4.

If your application requires the transmission of voice channels through one or more main links, make sure to select the E1 ports, the framing mode of both main link module ports must be G.704 multiframe (G732S) framing mode for all those links.

**Note**

*If the Megaplex includes both E1 and T1 TDM main link modules, it is not possible to bypass channel-associated signaling information, but only the contents of whole payload timeslots.*

## Example of Timeslot Assignment

This section provides a configuration example. For your orientation, in the example given below:

- An E1 main link module is installed in slot 1, and the data form is used to assign timeslots on port 1 of that module
- HS-Q/N modules are installed in slots 3 and 8 (note that channel 2 of the HS-Q/N module installed in slot 3 is configured for the unidirectional broadcast mode)
- VC-6 modules are installed in slots 4, 5
- A HS-U-6/1 module is installed in slot 6 (with channel 1 requiring split timeslot assignment)
- An HS-Q/N module is installed in slot 12.

The data form includes two sections:

- The top section defines the current timeslot requirements for all the I/O slots available in the corresponding configuration. The number of required timeslots is automatically derived from the current configuration of the relevant modules. The symbols appearing in this section are as follows:

- B1** indicates a channel using the UNI-BRD-TX mode.
- BP** indicates that bypassing may be used.
- SP** indicates a module channel that requires split timeslot assignment.
- - indicates that no timeslot is required.

- The other section is used to specify timeslot assignment and the timeslot type. The information presented for each timeslot of the selected module is as follows:

- - - - Indicates that the timeslot is not connected.
- SPLIT** Indicates split timeslot assignment (refer to the DEF SPLIT TS command for details).
- [Slot]:[Channel]** The timeslot is assigned to the listed I/O module channel.
- [Slot]:[Timeslot]** The timeslot is routed (bypassed) to the listed timeslot of another main link port.

```

DEF TS IO-1 EX1
Module : ML-2E1
Required Timeslots For IO-01:
CH-01:
      IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01  - - - - - - - - - - SP - - - - - - - - - -
Channel 02  - - - - B1 - - - - 01 - - 03 - - - - - 01
Channel 03  - - - - - - - - - - 01 - - - - - - - - - 02
Channel 04  - - - - - - - - - - 01 - - - - - - - - - 05
Channel 05  - - - - - - - - - - 01 - - - - - - - - - -
Channel 06  - - - - - - - - - - - - - - - - - - - - -
Channel 07  - - - - - 01 01 - - - - - - - - - - - - -
Channel 08  - - - - - 01 - - - - - - - - - - - - - -
Channel 09  - - - - - 01 - - - - - - - - - - - - - -
Channel 10  - - - - - 01 - - - - - - - - - - - - - -
Channel 11  - - - - - - - - - - - - - - - - - - - - -
Channel 12  - - - - - - - - - - - - - - 2 - - - - - - -
Channel 13  - - - - - - - - - - - - - - - - - - - - -

      * Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
03:02      04:07      04:08      04:09      04:10      - - -
UNI BRD D  DATA      DATA      DATA      DATA      DATA      DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
05:05      05:07      06:IN02   06:IN03   06:IN04   08:02
DATA      DATA      DATA      DATA      DATA      DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
08:02      08:02      12:02     12:03     12:03     12:04
DATA      DATA      DATA      DATA      MNG      DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
12:04      12:04      12:04     12:04     Split     - - -
DATA      DATA      DATA      DATA      DATA      DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
- - -      - - -      - - -      - - -      - - -      - - -
DATA      DATA      DATA      DATA      DATA      DATA

TS 31
- - -
DATA

```

**Note**

The maximum number of channels appearing in the required timeslots section is equal to the number of channels available on the connected module with most channels, and therefore changes in accordance with the types of modules configured in the database.

If inband management using a dedicated timeslot is configured on the selected port, you will see an additional line, which reminds you that a timeslot is required for management.

1. The lower part is displayed line by line. To assign a timeslot, or to change its current assignment, move the cursor to the desired position using the space bar, and then press the F or B key until the desired assignment is displayed (only valid assignment requirements will be displayed: any other combinations will be skipped). If you want to reserve a timeslot for split timeslot assignment, press the F or B key until SPLIT is displayed.
2. After the timeslots in the first line are properly assigned, press the **<Enter>** key to continue to the next line, used to select the timeslot type:

**DATA** Data timeslot. This is the default timeslot type.

**VOICE** Voice timeslot.

**MNG** Timeslot dedicated to inband management. If the corresponding main link module port is configured for inband management, you must select one timeslot as management timeslot. Note that only one timeslot of any main link port can be defined as management timeslot.

**UNI BRD D** Unidirectional broadcast timeslot carrying data.

**UNI BRD V** Unidirectional broadcast timeslot carrying voice.

**BID BRD D** Bidirectional broadcast timeslot carrying data.

**BID BRD V** Bidirectional broadcast timeslot carrying voice.

**D\_CH** Data timeslot carrying D-channel payload associated with a V5.1 link (not relevant for the current version)

---

**Note** *In the **Bidirectional Broadcast** mode, you can bypass timeslots only between ports located on the same main link module.*

---

3. After selecting the types for the timeslots in the first line, press the **<Enter>** key to display the next timeslot line. Repeat the assignment procedure described in [Steps 1, 2](#) above for the remaining timeslots. The total number of timeslots is 24 for T1 interfaces, and 31 for E1 interfaces.
4. After the desired timeslot assignments are made, press the **<Enter>** key to end. Megaplex reminds you that it is necessary to use the DB UPD command to activate the changed parameters, followed by the Megaplex prompt.

---

**Note** *When you press **<Enter>** to end, the timeslot assignment is automatically checked for validity. If errors are detected, a detailed list of errors is displayed. The list identifies omissions, double assignments and incorrect assignment, for example, channels which require more timeslots. If the assignment is not correct, it is not possible to update the database.*

---

## Configuration Guidelines for Unidirectional and Broadcast Modes

When configuring the routing of timeslots assigned to channels operating in the unidirectional and bidirectional broadcast modes, it is necessary to configure the timeslot parameters at two ends:

- At the channel end: this is performed using the DEF CH command
- At the main link port end: this is performed using the DEF TS command.

## Timeslot Selection Method

Selecting timeslots must be made in accordance with the transmission direction of the timeslot:

- Several channels configured for unidirectional receive, or broadcast receive, can be connected to the same main link timeslot. Therefore, for each channel you must use the DEF CH command to select the main link timeslots from which the channel receives its payload.

To prevent conflicts in timeslot assignments, any main link timeslot to which the timeslot selection is made at the channel level must be left unconnected in the timeslot map of the main link port, displayed by means of the DEF TS command.

Nevertheless, you must define the correct type for the corresponding timeslot: **UNI BRD D** or **BID BRD D** for data channels, or **UNI BRD V** or **BID BRD V** for voice channels.

- Several main link ports can be connected to a channel configured for unidirectional transmit. Therefore, for each main link port you must use the DEF TS command to select the timeslots that will transmit the channel payload.

## Number of Timeslots Needed

The number of timeslots needed by a channel depends on its data rate. Even if the channel carries split timeslot assignments, you must allocate it a full timeslot.

To help you determine the number of timeslots needed by a channel operating in the unidirectional and bidirectional broadcast modes, a special identifier, **B1**, appears in the requirements timeslot map of the main link port.

For timeslot assignments made at the channel level, pay attention to the following points when completing the timeslot assignment at the main link port level:

- Always make sure to select the number of main link port timeslots that matches the channel data rate (e.g., for a channel operating at 128 kbps, you must select two timeslots).
- When using the **USER** mapping mode, you can select any free timeslot.
- When using the **SEQUENCE** mapping mode, consecutive main link timeslots must be selected, starting with the timeslot selected by means of the **Start TS** parameter of the channel.

## Split Timeslot Allocations

This activity is used to allocate bandwidth to channels that require less than a full timeslot. Assigning split timeslots is made using the DEF SPLIT TS command.

## Special Considerations Regarding Split Timeslot Assignment

Split (bit-level) timeslot assignment can be defined for any timeslot of a module, e.g., for main link modules.



Before starting, make sure the desired target timeslot is not yet assigned, or select a timeslot with split assignment in which some of the bits have not yet been assigned. Split timeslot assignment can be performed only when the selected modules (both user's I/O modules and main link modules) are configured as *connected*.

When assigning the bits in a selected timeslot, observe the following:

- Always assign a group of consecutive bits to a channel.
- Channels which require half-timeslot assignment (4 bits, or 32 kbps) must be assigned either bits 1-4, or 5-8.
- Channels which require quarter-timeslot assignment (2 bits, or 16 kbps) must start at an odd bit (1-2, 3-4, 5-6, 7-8).
- When timeslots with split assignment are bypassed, make sure to have identical splitting assignments at all the Megaplex units.
- It is not allowed to use split timeslot assignment for broadcast timeslots.

### Configuration Example

The following example shows a typical data form, displayed in response to the command DEF SPLIT TS 1:1:7.

For your orientation, in the example given below, the configured timeslot is associated with the first port of an E1 main link module installed in slot 1; an HS-U-6/1 module is installed in slot 5, and an HS-S module is installed in slot 7.

#### Note

*The maximum number of channels appearing in the required timeslots section is equal to the number of channels available on the connected module with most channels, and therefore changes in accordance with the types of modules configured in the database.*

*If inband management using a dedicated timeslot is configured on the selected port, you will see an additional line, which reminds you that a timeslot is required for management.*

For your convenience, the data form includes two sections:

- The top section defines the current bit-level assignment requirements for all the I/O slots available in the corresponding configuration. The number of required bits is automatically derived from the current configuration of the relevant modules, and is separately given for each channel which requires main link timeslot bit level assignments.

- - indicates that bit-level assignment is not required.

In the example given above, channel 1 of the module installed in slot 5 needs 32 kbps (4 bits), and each of the channels 1 and 3 of the module installed in slot 7 require 16 kbps (2 bits). Note that none of the channels which require a full timeslot appears on this data form.

- The other section is used to specify the assigned bits in the selected timeslot. For each bit position, it either shows - - - to indicate that the timeslot bit is not connected, or lists the channel to which it is currently connected in the format **slot** -[**channel**].

Note that none of the channels which require a full timeslot appears on this data form.

To assign a bit, or change its current assignment, move the cursor to the desired position using the space bar, and then press the F or B key until the desired assignment is displayed (only valid assignment requirements will be displayed: any other combinations will be skipped).

After pressing the <Enter> key to end the command, the timeslot assignment is automatically checked for validity. If the errors are detected, a detailed list of errors is displayed. The list identifies omissions, double assignments and incorrect assignment, e.g., when the channel requires more or less bits. If the assignment is not correct, it is not possible to update the database.

```

DEF SPLIT TS 1:1:7
Module : ML-2E1
Required Split Timeslot Bits For IO-01 :
CH 01:

```

	IO - 01	02	03	04	05	06	07	08	09	10	11	12
Channel 01	- -	-	-	-	4	- -	2	-	-	-	-	-
Channel 02	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 03	- -	-	-	-	-	- -	2	-	-	-	-	-
Channel 04	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 05	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 06	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 07	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 08	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 09	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 10	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 11	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 12	- -	-	-	-	-	- -	-	-	-	-	-	-
Channel 13	- -	-	-	-	-	- -	-	-	-	-	-	-

	Bit1	Bit2	Bit3	Bit4	Bit5	Bit6	Bit7	Bit8
TS 01	05:IN0	05:IN0	05:IN0	05:IN0	07:IN0	07:IN0	07:IN0	07:IN0
	1	1	1	1	1	1	3	3

## 8.7 Typical Configuration Procedures for Ring Redundancy Applications

Using the ring redundancy capabilities (described in *Chapter 9*) requires special attention to several issues, in particular proper timeslot assignment and timing flow.

This section illustrates the configuration procedure for ring redundancy by presenting configuration details for the network of *Figure 8-1*.

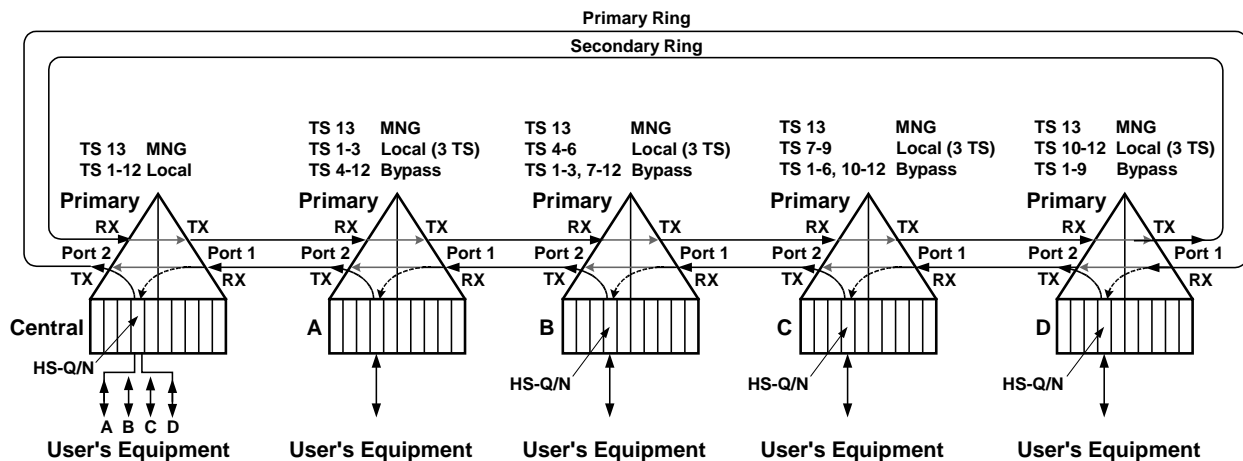


Figure 8-1. E1 Ring Redundancy Topology – Signal Flow during Normal Operation

The I/O slots are used as follows:

- In each Megaplex unit, the ML module participating in ring redundancy is installed in I/O slot 1, and the payload is carried by a HS-Q/N module installed in I/O slot 4.
- In the Megaplex unit designated **CENTRAL**, each of the 4 channels of the HS-Q/N module is assigned 3 timeslots for communication with one channel of the HS-Q/N module installed in the corresponding Megaplex unit, **A**, **B**, **C**, and **D**.

## Configuring the CENTRAL Megaplex Unit

1. Configure the modules and timing sources for the CENTRAL Megaplex unit:

```

CENTRAL>DEF SYS

SLOT:  PS-A      PS-B      CL-A      CL-B
TYPE:  PS        PS        MCL.2    MCL.2
SLOT:  IO-01    IO-02    IO-03    IO-04    IO-05
TYPE:  ML-2E1   - - -    - - -    HS-Q/N   - - -
SLOT:  IO-06    IO-07    IO-08    IO-09    IO-10
TYPE:  - - -    - - -    - - -    - - -    - - -
SLOT:  IO-11    IO-12
TYPE:  - - -    - - -

V5.2 APP      Interface ID      Startup Mode      Reprovision
- - - - -    - - - - - - -    - - - - - - -    - - - - -
NONE          N/A              N/A              N/A

Mode:        Master      Fallback
Slot:        RX CLOCK    RX CLOCK
Ch :         IO-1        IO-1
              EX2          EX1

```

## 2. Configure the ML-2E1 links for the CENTRAL Megaplex unit:

```

CENTRAL>DEF CH 1

Module : ML-2/E1

Port EX1 Parameters
-----

Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect         Frame           Sig. Profile      Idle Code         CGA               Redundancy
-----
YES             G.732S         (1)              FF               None             RING REDUNDANCY

Rx Gain         Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL     00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX2              12

Primary
-----
NO

Port EX2 Parameters
-----

Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect         Frame           Sig. Profile      Idle Code         CGA               Redundancy
-----
YES             G.732S         (1)              FF               None             RING REDUNDANCY

Rx Gain         Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL     00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX1              12

Primary
-----
YES

```

## 3. Configure the HS-Q/N channels for the CENTRAL Megaplex unit:

```

CENTRAL>DEF CH 4

Module : HS-Q/N

Port EX1 Parameters
-----
Connect Rate          Clock Mode      CTS   FIFO Size
-----
YES      3x64 = 192 KBPS  DCE           ON    16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1       EX2           N/A         N/A

Port EX2 Parameters
-----
.
.
.

Port EX3 Parameters
-----
.
.
.

Port EX4 Parameters
-----
Connect Rate          Clock Mode      CTS   FIFO Size
-----
YES      3x64 = 192 KBPS  DCE           ON    16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1       EX2           N/A         N/A

```

4. Assign timeslots to each HS-Q/N channel, and a MNG timeslot, to the CENTRAL Megaplex unit in accordance with *Figure 8-1*:

```

CENTRAL>DEF TS 1 2

Module : ML-2/E1

Required Time Slots For IO-01 :

CH-02 :

      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  03  --  --  --  --  --  --  --  --
Channel 02    --  --  --  03  --  --  --  --  --  --  --  --
Channel 03    --  --  --  03  --  --  --  --  --  --  --  --
Channel 04    --  --  --  03  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --

+ Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
04:01      04:01      04:01      04:02      04:02      04:02
DATA       DATA       DATA       DATA       DATA       DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
04:03      04:03      04:03      04:04      04:04      04:04
DATA       DATA       DATA       DATA       DATA       DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
MNG        DATA       DATA       DATA       DATA       DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA       DATA       DATA       DATA       DATA       DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA       DATA       DATA       DATA       DATA       DATA

TS 31
-----
DATA
    
```

## Configuring Megaplex Unit A

1. Configure the modules and timing sources for Megaplex Unit A:

```

CENTRAL>DEF SYS

SLOT:  PS-A      PS-B      CL-A      CL-B
TYPE:  PS        PS        MCL.2    MCL.2
SLOT:  IO-01    IO-02    IO-03    IO-04    IO-05
TYPE:  ML-2E1   - - -    - - -    HS-Q/N   - - -
SLOT:  IO-06    IO-07    IO-08    IO-09    IO-10
TYPE:  - - -    - - -    - - -    - - -    - - -
SLOT:  IO-11    IO-12
TYPE:  - - -    - - -

V5.2 APP      Interface ID      Startup Mode      Reprovision
- - - - -    - - - - - - -    - - - - - - -    - - - - -
NONE          N/A              N/A              N/A

Mode:        Master      Fallback
Slot:        RX CLOCK    RX CLOCK
Ch :         IO-1        IO-1
              EX2          EX1

```



## 2. Configure the ML-2E1 links for Megaplex unit A:

```

A>DEF CH 1

Module : ML-2/E1

Port EX1 Parameters
-----
Service          Logical link Id   Interface id     Startup mode     Reprovision
-----
LEGACY           N/A              N/A             N/A             N/A

Connect         Frame           Sig. Profile    Idle Code       CGA             Redundancy
-----
YES             G.732S         (1)            FF             None           RING REDUNDANCY

Rx Gain         Voice OOS Data OOS  OOS signaling   Restoration Time
-----
SHORT HAUL     00             00             FORCED IDLE     CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX2                12

Primary
-----
NO

Port EX2 Parameters
-----
Service          Logical link Id   Interface id     Startup mode     Reprovision
-----
LEGACY           N/A              N/A             N/A             N/A

Connect         Frame           Sig. Profile    Idle Code       CGA             Redundancy
-----
YES             G.732S         (1)            FF             None           RING REDUNDANCY

Rx Gain         Voice OOS Data OOS  OOS signaling   Restoration Time
-----
SHORT HAUL     00             00             FORCED IDLE     CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX1                12

Primary
-----
YES

```

## 4. Configure the HS-Q/N channel 1 of Megaplex unit A:

```

A>DEF CH 4 1

Module : HS-Q/N

Port EX1 Parameters
-----

Connect Rate          Clock Mode    CTS    FIFO Size
-----
YES      3x64 = 192 KBPS  DCE          ON     16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1      EX2           N/A         N/A

```

- Assign timeslots on main link port 2 of Megaplex unit A to HS-Q/N channel 1, a MNG timeslot, and then bypass timeslots in accordance with *Figure 8-1*:

```

A>DEF TS 1 2

Module : ML-2/E1

Required Time Slots For IO-01 :

CH-02 :

      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  03  --  --  --  --  --  --  --  --
Channel 02    --  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --

+ Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
04:01      04:01      04:01      01:01TS04  01:01TS05  01:01TS06
DATA       DATA       DATA       DATA       DATA       DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
01:01TS07  01:01TS08  01:01TS09  01:01TS10  01:01TS11  01:01TS12
DATA       DATA       DATA       DATA       DATA       DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
MNG        DATA       DATA       DATA       DATA       DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA       DATA       DATA       DATA       DATA       DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA       DATA       DATA       DATA       DATA       DATA

TS 31
-----
DATA
    
```

## Configuring Megaplex Unit B

1. Configure the modules and timing sources for Megaplex unit B:

```

B>DEF SYS

SLOT:  PS-A      PS-B      CL-A      CL-B
TYPE:  PS        PS        MCL.2     MCL.2
SLOT:  IO-01     IO-02     IO-03     IO-04     IO-05
TYPE:  ML-2E1    - - -     - - -     HS-Q/N    - - -
SLOT:  IO-06     IO-07     IO-08     IO-09     IO-10
TYPE:  - - -     - - -     - - -     - - -     - - -
SLOT:  IO-11     IO-12
TYPE:  - - -     - - -

V5.2 APP      Interface ID      Startup Mode      Reprovision
- - - - -     - - - - - - -     - - - - - - -     - - - - -
NONE          N/A              N/A              N/A

Mode:        Master      Fallback
Slot:        RX CLOCK    RX CLOCK
Ch :         IO-1        IO-1
            EX2          EX1

```

## 2. Configure the ML-2E1 links for Megaplex unit B:

```

B>DEF CH 1

Module : ML-2/E1

Port EX1 Parameters
-----
Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES              G.732S          (1)              FF                None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX2              12

Primary
-----
NO

Port EX2 Parameters
-----
Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES              G.732S          (1)              FF                None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX1              12

Primary
-----
YES

```

## 3. Configure the HS-Q/N channel 1 of Megaplex unit B:

```

B>DEF CH 4 1

Module : HS-Q/N

Port EX1 Parameters
-----

Connect Rate          Clock Mode    CTS    FIFO Size
-----
YES      3x64 = 192 KBPS  DCE          ON     16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1      EX2           N/A         N/A

```

4. Assign timeslots on main link port 2 of Megaplex unit B to HS-Q/N channel 1, a MNG timeslot, and then bypass timeslots in accordance with *Figure 8-1*:

```

B>DEF TS 1 2

Module : ML-2/E1

Required Time Slots For IO-01 :

CH-02 :

      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  03  --  --  --  --  --  --  --  --
Channel 02    --  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --

+ Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  01:01TS02  01:01TS03  04:01      04:01      04:01
DATA       DATA       DATA       DATA       DATA       DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
01:01TS07  01:01TS08  01:01TS09  01:01TS10  01:01TS11  01:01TS12
DATA       DATA       DATA       DATA       DATA       DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
MNG        DATA      DATA      DATA      DATA      DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA       DATA      DATA      DATA      DATA      DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA       DATA      DATA      DATA      DATA      DATA

TS 31
-----
DATA
    
```

## Configuring Megaplex Unit C

1. Configure the modules and timing sources for Megaplex unit C:

```

C>DEF SYS

SLOT:  PS-A      PS-B      CL-A      CL-B
TYPE:  PS        PS        MCL.2     MCL.2
SLOT:  IO-01     IO-02     IO-03     IO-04     IO-05
TYPE:  ML-2E1    - - -     - - -     HS-Q/N    - - -
SLOT:  IO-06     IO-07     IO-08     IO-09     IO-10
TYPE:  - - -     - - -     - - -     - - -     - - -
SLOT:  IO-11     IO-12
TYPE:  - - -     - - -

V5.2 APP      Interface ID      Startup Mode      Reprovision
- - - - -     - - - - -        - - - - -        - - - - -
NONE          N/A              N/A              N/A

Mode:         Master      Fallback
Slot:         RX CLOCK    RX CLOCK
Ch  :         IO-1        IO-1
              EX2          EX1

```



2. Configure the ML-2E1 links for Megaplex unit C:

```

C>DEF CH 1

Module : ML-2/E1

Port EX1 Parameters
-----
Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES              G.732S          (1)              FF               None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX2              12

Primary
-----
NO

Port EX2 Parameters
-----
Service          Logical link Id  Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES              G.732S          (1)              FF               None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX1              12

Primary
-----
YES
    
```

## 3. Configure the HS-Q/N channel 1 of Megaplex unit C:

```

C>DEF CH 4 1

Module : HS-Q/N

Port EX1 Parameters
-----

Connect Rate          Clock Mode    CTS    FIFO Size
-----
YES      3x64 = 192 KBPS  DCE          ON     16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1      EX2           N/A         N/A

```

4. Assign timeslots on main link port 2 of Megaplex unit C to HS-Q/N channel 1, a MNG timeslot, and then bypass timeslots in accordance with *Figure 8-1*:

```

C>DEF TS 1 2

Module : ML-2/E1

Required Time Slots For IO-01 :

CH-02 :

      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  03  --  --  --  --  --  --  --  --
Channel 02    --  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --

+ Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  01:01TS02  01:01TS03  01:01TS04  01:01TS05  01:01TS06
DATA      DATA      DATA      DATA      DATA      DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
04:01      04:01      04:01      01:01TS10  01:01TS11  01:01TS12
DATA      DATA      DATA      DATA      DATA      DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
MNG      DATA      DATA      DATA      DATA      DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA

TS 31
-----
DATA
    
```

## Configuring Megaplex Unit D

1. Configure the modules and timing sources for Megaplex unit D:

```

D>DEF SYS

SLOT:  PS-A      PS-B      CL-A      CL-B
TYPE:  PS        PS        MCL.2    MCL.2
SLOT:  IO-01    IO-02    IO-03    IO-04    IO-05
TYPE:  ML-2E1   - - -    - - -    HS-Q/N   - - -
SLOT:  IO-06    IO-07    IO-08    IO-09    IO-10
TYPE:  - - -    - - -    - - -    - - -    - - -
SLOT:  IO-11    IO-12
TYPE:  - - -    - - -

V5.2 APP      Interface ID      Startup Mode      Reprovision
- - - - -    - - - - -        - - - - -        - - - - -
NONE         N/A              N/A              N/A

Mode:      Master      Fallback
Slot:      RX CLOCK    RX CLOCK
Ch :      IO-1        IO-1
          EX2          EX1

```

## 2. Configure the ML-2E1 links for Megaplex unit D:

```

D>DEF CH 1

Module : ML-2/E1

Port EX1 Parameters
-----
Service          Logical link Id   Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES             G.732S          (1)              FF                None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX2              12

Primary
-----
NO

Port EX2 Parameters
-----
Service          Logical link Id   Interface id      Startup mode      Reprovision
-----
LEGACY           N/A              N/A              N/A              N/A

Connect          Frame            Sig. Profile      Idle Code         CGA               Redundancy
-----
YES             G.732S          (1)              FF                None              RING REDUNDANCY

Rx Gain          Voice OOS Data OOS  OOS signaling     Restoration Time
-----
SHORT HAUL      00              00              FORCED IDLE      CCITT

Inband Management  Inband Management Rate  Routing Protocol
-----
DEDICATE FR      64 KBPS          PROPRIETY RIP

Redundancy Partner Slot  Redundancy Partner Ch  Recovery time, sec
-----
IO-1              EX1              12

Primary
-----
YES

```

## 3. Configure the HS-Q/N channel 1 of Megaplex unit D:

```

D>DEF CH 4 1

Module : HS-Q/N

Port EX1 Parameters
-----

Connect Rate          Clock Mode    CTS    FIFO Size
-----
YES      3x64 = 192 Kbps  DCE          ON     16 BITS

bert pattern          FT1 mode
-----
RJ-011                DISABLED

Oper Mode    ML Slot    ML Channel    Map Type    Start Ts
-----
BI-DIR      IO-1      EX2           N/A         N/A

```

4. Assign timeslots on main link port 2 of Megaplex unit D to HS-Q/N channel 1, a MNG timeslot, and then bypass timeslots in accordance with *Figure 8-1*:

```

D>DEF TS 1 2

Module : ML-2/E1

Required Time Slots For IO-01 :

CH-02 :

      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  03  --  --  --  --  --  --  --  --
Channel 02    --  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --

+ Additional timeslot is required for management.

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  01:01TS02  01:01TS03  01:01TS04  01:01TS05  01:01TS06
DATA      DATA      DATA      DATA      DATA      DATA

TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
01:01TS07  01:01TS08  01:01TS09  04:01      04:01      04:01
DATA      DATA      DATA      DATA      DATA      DATA

TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
MNG      DATA      DATA      DATA      DATA      DATA

TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA

TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA

TS 31
-----
DATA
    
```

This completes the configuration of the E1 ring in accordance with *Figure 8-1*.

## 8.8 Configuring Typical TDMoIP Applications

This section provides configuration guidelines for a Megaplex equipped with TDMoIP main link modules, ML-IP.

The configuration procedure includes the following main steps:

1. Configuring general ML-IP module parameters.
2. Configuring ML-IP module ports:
  - Configuring ML-IP external (LAN) port parameters.
  - Configuring ML-IP internal TDM port parameters.
3. Defining timeslot bundles carried by the ML-IP module.
4. Assigning internal TDM port timeslots to bundles.
5. When necessary, defining routes for the ML-IP static IP routing table.

For detailed configuration instructions, and background information, refer to the *ML-IP Installation and Operation Manual*.

### Configuring General ML-IP Module Parameters

The general parameters of the ML-IP module are used to control the protection options supported by the module: support for the ring topology, and the associated option of fast redundancy protection for user-selected destinations.

To configure the general parameters of the desired ML-IP module, type:

```
DEF CH SS<Enter>
```

A typical general parameters data form is shown below.

```
Module: ML-IP
Main Parameters
-----
Ring Mode          Protected IP's
-----          -
ENABLE            ENABLE
Protected IP Address
-----
1) 192.121.14.2
2) 192.121.106.17
.
.
31) 0.0.0.0
```

The data form includes two parameters:

- **Ring Mode:** this parameter is used to enable the use of the RAD-proprietary RFER protocol, which supports fast redundancy switching in ring topologies. When a ring topology is used, the RFER protocol is capable of restoring full connectivity for any single failure within the ring. For TDMoIP traffic processed by the ML-IP module, the connectivity is restored within 50 msec; for other Ethernet traffic, it takes longer (approximately 20 seconds).

If the network includes non-RAD equipment, select **DISABLE** for **Ring Mode**.



Because of the characteristics of the RFER protocol, which is based on the use of VLAN tagging for protection purposes, it is not possible to enable VLAN tagging on the ML-IP ports when the **Ring Mode** is **ENABLE**.

- **Protected IP's:** When the **Ring Mode** is **ENABLE**, the fast redundancy protection is available to TDMoIP traffic processed by the ML-IP module, which is connected to the WAN through the NET 1 and NET 2 ports.

However, it is possible to extend the fast redundancy protection to equipment connected to the USER port of the ML-IP module as well. This capability is turned on by selecting **ENABLE** for **Protected IP's**.

The extended protection is provided to up to 32 IP addresses, which are defined by the user in the **Protected IP Address** list, displayed after selecting **ENABLE**. The protected addresses are destination addresses for traffic connected to the ML-IP module through the USER port: this may be traffic from another ML-IP module, when the chained topology is used, or from any other type of equipment using the ML-IP module to connect to the WAN.

## Configuring ML-IP Module Ports

### Configuration Instructions for External Ports

The ML-IP module has three external ports. For management purposes, the ports are identified as follows:

- NET1 – identified as 1 or EX1
- NET2 – identified as 2 or EX2
- USER – identified as 3 or EX3.

Each port can be independently configured, in accordance with the characteristics of the LAN to which it is connected.

To configure the external port parameters of the desired, type:

```
DEF CH SS CC<Enter>
```

where SS is the module slot number, and CC is the desired external port number. To configure all the ports, omit the port number, CC.

A typical data form for the ML-IP external ports is shown below.

Module : ML-IP		
<b>Port EX1 Parameters</b>		
-----		
<b>Auto Negotiation</b>	<b>Max Capability Advertised</b>	<b>Lan Rate</b>
-----	-----	-----
YES	100Mbps FD	N/A
<b>Lan Type</b>	<b>Mng Vlan Tagging</b>	<b>Traffic Priority</b>
-----	-----	-----
ETHERNET II	YES	N/A
<b>Mng Vlan ID</b>	<b>Mng Vlan Priority</b>	
-----	-----	
1	0	
<b>Port EX2 Parameters</b>		
-----		
<b>Auto Negotiation</b>	<b>Max Capability Advertised</b>	<b>Lan Rate</b>
-----	-----	-----
YES	100Mbps FD	N/A
<b>Lan Type</b>	<b>Mng Vlan Tagging</b>	<b>Traffic Priority</b>
-----	-----	-----
ETHERNET II	YES	N/A
<b>Mng Vlan ID</b>	<b>Mng Vlan Priority</b>	
-----	-----	
1	0	
<b>User Port Parameters</b>		
-----		
<b>Auto Negotiation</b>	<b>Max Capability Advertised</b>	<b>Lan Rate</b>
-----	-----	-----
YES	100Mbps FD	N/A
<b>Lan Type</b>	<b>Mng Vlan Tagging</b>	<b>Traffic Priority</b>
-----	-----	-----
ETHERNET II	N/A	LOW

The parameters appearing in the data form are as follows:

- Auto-negotiation parameters **Auto Negotiation**, **Max Capability Advertised**: when auto-negotiation is enabled, you can specify the highest traffic handling capability to be advertised during the auto-negotiation process. The operating mode selected as a result of auto-negotiation cannot exceed the advertised capability.

The available selections are listed in ascending order of capabilities:

<b>10Mbps HD</b>	Half-duplex operation at 10 Mbps.
<b>10Mbps FD</b>	Full-duplex operation at 10 Mbps.
<b>100Mbps HD</b>	Half-duplex operation at 100 Mbps.
<b>100Mbps FD</b>	Full-duplex operation at 100 Mbps.

- LAN interface type **LAN Type**: this field displays the physical interface of the corresponding port: **ETHERNET II** for 10/100BaseT interfaces, or **100BaseFX** for optical interfaces.
- LAN interface selection **LAN Rate**: when auto-negotiation is disabled, you must select the LAN interface operating mode from the selections listed above.
- Management traffic VLAN tagging control parameters **Mng Vlan Tagging**, **Mng Vlan ID**, **Mng Vlan Priority**: these parameters are applicable only to the NET 1 and NET 2 ports, and are relevant only when the Ethernet port of the CL module is disabled (see also the [Configuring CL Connection through Modules with Ethernet Interfaces](#) section starting on [page 8-55](#)):
  - When the WAN or IP network used to carry the management traffic supports VLAN tagging, it is recommended to enable the use of VLAN tagging for the management traffic, to enhance security and improve quality of service.
  - When the ring topology is used, it is necessary to disable VLAN tagging.

**Note**


---

*When **Mng Vlan Tagging** is **YES** for the NET 1 port, the management VLAN specified in the **Mng Vlan ID** field is also the default VLAN for untagged frames received through the USER port: such frames will be sent through the NET 1 port tagged with the management VLAN. The processing priority of the frames is determined by the **Traffic Priority** parameter.*

---

- **Traffic Priority**: this parameter is relevant only for the USER port. Its purpose is to define the processing priority for untagged frames received through this port. Two selections are available:
  - **LOW** – equivalent to priorities in the range of 0 to 3
  - **HIGH** – equivalent to priorities in the range of 4 to 7.

**Note**


---

*The priority used by the internal Ethernet switch of the ML-IP module to process other traffic is as follows:*

- *Traffic from the internal ports (TDMoIP traffic) is always assigned high priority.*
  - *The priority of traffic from the NET 1 and NET 2 ports is determined by the VLAN priority tagging (low for 0 to 3, and high for 4 to 7).*
- 

## Configuration Instructions for Internal TDM Ports

The ML-IP module has two internal TDM ports, identified as IN1 and IN2. Each internal TDM port can be independently configured in accordance with the system requirements, except that both ports must be assigned the same IP address.

To define the parameters of the desired internal TDM port, type:

```
DEF CH SS CC<Enter>
```

where SS is the module slot number, and CC is the desired internal TDM port number (IN1 or IN2).

A typical data form for the ML-IP internal ports is shown below.

Port IN1 Parameters				
Connect	Signaling	Sig. Profile	IP Address	Subnet Mask
YES	YES	(1)	172.17.171.40	255.255.255.0
Routing Protocol		OOS Sig	Echo Cancellor	
NONE		FORCED IDLE	N/A	
Port IN2 Parameters				
Connect	Signaling	Sig. Profile	IP Address	Subnet Mask
YES	YES	(1)	172.17.171.40	255.255.255.0
Routing Protocol		OOS Sig	Echo Cancellor	
NONE		FORCED IDLE	NO	

The data form includes several of the TDM main link port parameters described in [Section 8.4](#), and in addition enables defining the source IP address of the ports, and the associated subnet mask:

- The IP address of the internal TDM port is the source IP address of the TDMoIP packets sent by this port. The internal port processes only TDMoIP packets carrying this address in their destination address field.
- The subnet mask associated with the IP address of the internal TDM port is used together with the IP address to determine the IP hosts that can be directly reached.

**Note** *The internal port IN2 is automatically assigned the same IP address as the internal port IN1.*

Both internal TDM ports of the ML-IP module are assigned the same IP address and subnet mask.

ML-IP modules can also be ordered with an internal near-end echo canceller. The echo canceller is always installed on internal port 2 (IN2). Therefore, when the echo canceller is installed, for port IN2 you can enable (select YES) the echo canceller: otherwise, the **Echo Cancellor** is always N/A (N/A is the only option for port IN1). The echo canceller operates on PCM signals encoded either in accordance with the A-law or  $\mu$ -law. The encoding law is determined by the **Far End Type** parameter: A-law for E1 and  $\mu$ -law for T1.

When the echo canceller is enabled, it operates only on timeslots defined as voice timeslots: it is automatically disabled on other types of timeslots. Moreover, when a fax or modem tone is detected in a voice channel, the echo canceller is temporarily disabled for the duration of the corresponding call.

## Configuration Instructions for Bundles

### Note

*RAD offers a dedicated TDMoIP calculator that can be used to calculate the optimum packet rate and the total bandwidth needed for a bundle, considering the desired quality and other constraints that may apply in your particular application.*

The connection of TDMoIP user's payload to the IP network is made through timeslot bundles defined on its internal TDM ports.

The total number of bundles that can be defined on an ML-IP module depends on the internal port configuration:

- Without support for CAS signaling: up to 24 bundles per ML-IP module
- With support for CAS signaling: up to 14 bundles per ML-IP module.

Bundles are identified by a number in the range of 1 to 120. The bundle number must be unique within a Megaplex chassis, irrespective of the number of ML-IP modules installed in the chassis.

To define a new bundle, type:

```
ADD BND B<Enter>
```

where B is the desired bundle number.

A typical bundle data form is shown below.

Bundle 11 Parameters				
Connect	ML-IP Slot	ML-IP TDM	Destination IP	Next Hop IP
ENABLE	I/O-2	IN1	172.17.156.2	0.0.0.0
IP TOS	Ext Eth	Dest Bundle	Jitter Buffer	Name
0	AUTO	BND1	3 msec	
TDM Bytes In Frame	Voice OOS	Data OOS	Far End Type	
48	00	00	E1	
OAM Connectivity	VLAN Tagging	VLAN Id	VLAN Priority	Redundancy
DISABLE	NO	N/A	N/A	YES
Redundancy Bundle	Recovery Time			
BND3	00			

The data form includes several groups of parameters:

- Local parameters **Voice OOS**, **Data OOS**, used to specify the module and port on which the bundle is defined.
- Routing parameters: used to specify the routing of the bundle through the IP network, and its handling:

<b>Destination IP</b>	<p>Specifies the IP address of the destination bundle (another TDMoIP device).</p> <p>When the destination bundle is located on another ML-IP module, enter in this field the IP address of the internal TDM port on which the bundle is defined.</p>
<b>Next Hop IP</b>	<p>When the destination address is not within the IP subnet of the local internal TDM port on which the bundle is defined, enter here the IP address to which the bundle packets will be sent, to enable reaching the destination IP address. This is usually the address of an IP router port.</p> <p>To use the default gateway, leave this field at the default value, 0.0.0.0.</p>
<b>Dest Bundle</b>	<p>Specifies the number of the destination bundle at the remote device. The supported range is 1 to 2016, however the range of values that can be used in any given application is device-specific. For example, for an IPmux-1 the only allowed value is 1, whereas for another ML-IP module the range is 1 to 120.</p>
<b>Ext Eth</b>	<p>Specifies the external (LAN) port of the module through which the bundle IP traffic is transmitted to the IP network.</p> <p>You can select a specific port only when VLAN tagging is enabled: if not, select <b>AUTO</b>.</p>
<b>IP TOS</b>	<p>When the IP network supports this feature, you can specify the IP type-of-service parameter for this bundle.</p> <p>The type-of-service parameter is interpreted, in accordance with RFC 791 or RFC 2474, as a set of qualitative parameters for the precedence, delay, throughput and delivery reliability to be provided to the IP traffic generated by this bundle.</p> <p>These qualitative parameters may be used by each network that transfers the bundle IP traffic to select specific values for the actual service parameters of the network, to achieve the desired quality of service.</p>
<b>OAM Connectivity</b>	<p>When operating in a network comprising only RAD TDMoIP equipment (that is, ML-IP modules and IPmux TDMoIP gateways), it is recommended to use the RAD proprietary OAM connectivity protocol.</p> <p>This protocol enables detecting loss of communication with the destination of TDMoIP traffic and take steps that prevent the resulting flooding of this traffic. The protocol also enables checking that the destination uses a compatible configuration. If OAM connectivity protocol is not used, the detection of loss of communication is performed by periodical pinging. This requires the remote TDMoIP device to be able to answer pings: in the case of the ML-IP modules, this requires defining static routes (this is performed by</p>

means of the ADD ROUTE command).

- **Jitter Buffer.** The jitter buffer is used to mitigate the effects of delay variation in the IP network.

For reliable operation, the jitter buffer must be large enough to ensure that it is not emptied when the transmission delay increases temporarily (an effect called *underflow*, or *underrun*), nor fills up to the point that it can no longer accept new frames when the transmission delay decreases temporarily (an effect called *overflow*).

The ML-IP module supports individually-configured jitter buffers for each timeslot bundle. The minimum size of the jitter buffer depends on the intrinsic jitter: for the ML-IP module, the minimum value is 3 msec. The maximum size is 300 msec.

The theoretically correct value for the size of the jitter buffer of any given bundle is slightly more than the maximum variation in the transmission delay through the network, as observed on the particular path between the bundle source and the destination. For practical reasons, it is sufficient to select a value that is not exceeded for any desired percentage of time: for example, a value of 99.93% means that the jitter buffer will overflow or underflow for an accumulated total of only one minute per day.

Jitter buffers are located at both ends of a link, therefore the delay added by the buffers is twice the selected value. The resultant increase in the round-trip delay of a connection may cause problems ranging from inconvenience because of long echo delays on audio circuits (similar to those encountered on satellite links) to time-out of data transmission protocols. Therefore, the size of each jitter buffer must be minimized, to reduce the round-trip delay of each connection in as far as possible, while still maintaining the link availability at a level consistent with the application requirements.

- **Number of TDM bytes per packet (frame).** You can specify, separately for each bundle, the number of payload (TDM) bytes to be inserted in each package. The allowed range is 48 to 384 bytes, in 48-byte increments.

When a larger number is selected, bandwidth utilization efficiency increases. However, there are additional aspects that must be considered when selecting the **TDM Bytes per Frame** parameter:

- **Filling time:** the filling time, which is the time needed to load the payload into an Ethernet frame, increases in direct proportion to the **TDM Bytes per Frame** parameter. This is particularly significant for bundles with few timeslots; for example, a voice channel could be carried by a single-timeslot bundle. The time needed to fill a single-timeslot bundle is as follows:
  - At 48 TDM bytes per frame: □ 5.5 msec with CAS support and 5.9 msec without CAS support
  - At 384 TDM bytes per frame: □ 44 msec with CAS support and 47 msec without CAS support.

Therefore, before considering any other delays encountered along the end-to-end transmission path, the round-trip (or echo) delay for the voice channel example presented above is 92 msec at 384 TDM bytes per frame (including the additional intrinsic jitter – see below).

Such long delays may also cause time-out in certain data transmission protocols.

- **Intrinsic jitter:** the transmission of packets to the network is performed at nominally equal intervals of 1 msec. This means that every 1 msec the packet processor of the ML-IP module sends to the network (through the appropriate Ethernet interface) all the frames ready for transmission. As a result, the actual payload transmission intervals vary in an apparently random way whose peak value depends on the bundle size, an effect called *delay variance* (or jitter).

For example, a bundle with 6 timeslots will fill a 48-byte payload field of an Ethernet frame every 1 msec. If the sending instants are not perfectly synchronized with the filling instants, the sending time will sometimes occur just in time and sometimes will be delayed by 1 msec relative to the ideal, creating a peak delay variance of 1 msec at the transmitting side. The intrinsic jitter in other cases is lower, therefore the delay variance generated by the ML-IP module cannot exceed 2 msec.

- OOS parameters, **Voice OOS** and **Data OOS**: these parameters are used to specify the code transmitted in the bundle timeslots defined as voice and data timeslots, during out-of-service periods.
- Compatibility parameter **Far End Type**: when the bundle is terminated at an IPmux unit, you must specify the type of interface used by the destination IPmux unit: E1, T1 interface with ESF framing, or T1 interface with SF (D4) framing. However, even when the bundle is terminated at another ML-IP module, make sure to select the same value at both ends.
- Bundle VLAN tagging control parameters **VLAN Tagging**, **VLAN ID**, **VLAN Priority**: when the WAN or IP network supports VLAN tagging, it is recommended to enable VLAN tagging, to enhance security and improve quality of service.

When several bundles are routed through the same external port, tagging should be either enabled or disabled on all these bundles.

- Bundle redundancy control parameters **Redundancy**, **Redundancy Bundle** and **Recovery Time**: you can increase availability for each desired bundle by enabling redundancy. When redundancy is enabled, the two bundles configured as a redundancy pair transmit in parallel the same data. Therefore, the remote unit can select the bundle from which to retrieve the payload, and does not have to synchronize its selection with that at the local Megaplex unit.

When using the redundancy feature, it is necessary to select the same values for the following parameters of the two bundles defined as a redundancy pair: **Connect**, **TDM Bytes in Frame**, **Voice OOS**, **Data OOS**, **Far End Type**, **Redundancy**, **OAM Connectivity**, **Recovery Time**. In addition, the **Redundancy Bundle** fields on the two bundles must point one to the other (symmetrical assignment).



In addition, make sure to select identical values for the **OOS Sig.** parameter of the two ports. The mechanism used to initiate and execute bundle redundancy switching is capable of rapid response (less than 50 msec). Therefore, when the two bundles are defined on the same module, the time needed to perform redundancy switching, following the detection of a fail condition on the currently active bundle, can be maximum 50 msec. However, this is not possible if the jitter buffer size is close to 50 msec (or larger). When the bundles are located on different ML-IP modules, the redundancy switching time increases because of the need to alert the Megaplex central control subsystem located on the CL module. In this case, the redundancy switching time is a few seconds.

## Assigning Timeslots to Bundles

The bundles serve as virtual internal ports, to which one or more I/O channels are routed for transmission to the network through the ML-IP module. The only difference is that bundles are defined on the internal TDM ports of the module, and therefore timeslots are routed to a bundle through the mediation of the internal port.

When performing timeslot assignment, observe the following rules:

1. A bundle can include timeslots from only one internal TDM port
2. The maximum number of timeslots per bundle is 31. The maximum number of timeslots decreases to 30 when CAS support is enabled on the corresponding internal port (**Signaling is YES**), because in this case timeslot 16 is reserved and cannot be assigned.
3. Timeslot assignment is performed by means of the DEF TS command. When the bundle includes channels using less than one timeslot, use the DEF SPLIT TS command.
4. For convenience, when two bundles configured on the same ML-IP module are defined as a redundancy pair, you need to assign timeslots only to one of these two bundles: the assignment is automatically copied to the other bundle of the redundancy pair.

The following example shows the response to a DEF TS command issued to internal port IN1 of the ML-IP module installed in I/O slot 2.

```

Module : ML-IP
Required Timeslots For IO-02:
CH-01:
      IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01      BP BP - - - - - - - - - - 01 - - - -
Channel 02      BP BP - - - - - - - - - - 01 - - - -
Channel 03      - - - - - - - - - - - - 01 - - - -
Channel 04      - - - - - - - - - - - - - - - - - -
Channel 05      - - - - - - - - - - - - - - - - - -
Channel 06      - - - - - - - - - - - - - - - - - -
Channel 07      - - - - - - - - - - - - - - - - - -
Channel 08      - - - - - - - - - - - - - - - - - -
Channel 09      - - - - - - - - - - - - - - - - - -
Channel 10      - - - - - - - - - - - - - - - - - -
Channel 11      - - - - - - - - - - - - - - - - - -
Channel 12      - - - - - - - - - - - - - - - - - -
Channel 13      - - - - - - - - - - - - - - - - - -
Channel 14      - - - - - - - - - - - - - - - - - -
Channel 15      - - - - - - - - - - - - - - - - - -
Channel 16      - - - - - - - - - - - - - - - - - -

TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
10:01      10:02      10:03      01:01      01:02      -----
BND:003    BND:003    BND:003    -----
VOICE      VOICE      VOICE      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
DATA

```

The Megaplex chassis covered by this example includes the following modules:

- Two ML-IP modules installed in I/O slots 1 and 2
- One VC-16 module installed in I/O slot 10.

The upper section of the data form shows the following timeslot routing requirements:

- Two channels (1 and 2) are bypassed between the two ML-IP modules
- Three voice channels (1, 2, and 3) of the VC-16 are to be routed to the ML-IP module in I/O slot 1.

The lower section of the data form shows the timeslot routing made in response to these requirements. For each of the 31 timeslots available on the ML-IP

internal port, the data form includes the following 4 subfields (listed from top to bottom):

- Timeslot number, in the range of TS01 through TS31
- The I/O module and channel to be connected to the corresponding bundle timeslot, in the format SS CC, where SS is the module slot number, and CC is the desired external port number. By scrolling with the F, B, J and I keys, you can display any of the desired channels appearing in the upper section of the data form that are waiting for assignment.
- The destination bundle, in the format BND:B, where B is the bundle number. You can scroll only among the bundles currently defined on this port.
- The timeslot type, in accordance with the standard types explained for the DEF TS command in Chapter 5.

Note that timeslot 16 cannot be assigned when the internal TDM port is configured to support CAS signaling (**Signaling** is **YES**).

## Defining Routes for ML-IP Static IP Routing Table

The ML-IP module includes an IP traffic handling subsystem, which enables sending the traffic of each bundle to its destination through the IP network. This subsystem also provides limited routing capabilities for the CL management traffic.

You can influence the routing by defining static entries in the IP routing table. These entries are used to answer *pings* addressed to the ML-IP module, and when applicable – for routing the management traffic generated by the CL module.

To add a static entry, type:

```
ADD ROUTE R<Enter>
```

where R is the static route index number, in the range of 1 to 100. Each entry is identified by its index number in the routing table.

For ML-IP modules, select the SINGLE IP type. A typical data form, as seen after filling all its fields, is shown below:

Entry Type			
-----			
SINGLE IP			
Destination Ip	Next Hop Ip	Subnet Mask	Metric
-----	-----	-----	-----
1.2.3.5	2.0.0.1	255.0.0.0	15

The data form is used to enter the basic IP address information (the destination IP address, and the IP subnet mask associated with the destination IP address), together with the **Next Hop** IP address, used as the destination for the first hop en route to the specified destination. This IP address is usually the address of an IP router port. The next hop address must be in the same IP subnet with the bundle source address (for the ML-IP module, the bundle source address is actually the IP address assigned to the corresponding internal TDM port).

In addition, you can also enter the metric associated with the IP traffic passing through this route. The metric is in the range of 1 to 15, and specifies the maximum number of hops that an IP packet can traverse before being discarded.

---

---

## 8.9 Configuring the Flip Database

The Megaplex supports automatic network reconfiguration in accordance with user-defined criteria. The reconfiguration capabilities are defined by means of a special database – the *flip database*.

The reconfiguration is performed by automatically changing (*flipping*) the active database in all the Megaplex units included in the network, when a certain type of event, or a user-specified combination of events, occurs.

### Note

---

*To ensure that all the Megaplex units start from a known configuration, use the DEF DEFAULT DB command to select the desired default database.*

---

Megaplex supports two different types of events:

- Predetermined daily database switching (flipping) schedules (“day/night” operation). Separate schedules can be defined for regular working days, partial working days, and weekends (this differentiation is defined by means of the DEF AGENDA command).
- Failures of critical links. Critical failure events defined by means of this command can be used as database flipping triggers. The flipping criteria are defined by logical expressions included in the flip database entries, which are defined by means of the ADD FLIP ENTRY command.

To enable network-wide reconfiguration, it is necessary to enable the flip broadcasting function (this is made using the DEF FLIP BROADCAST command). When flip broadcasting is enabled, the status of each event is reported to all the other equipment units in the network.

To ensure that all the equipment in the network understands correctly the reported condition, each event is assigned an identification number, which must be unique on a network-wide basis.

Event reporting is made by means of a 512-bit word, called network status word. Each bit in this word is assigned to a specific event in the network (in accordance with the event ID), and thus its state (“0” or “1”) is an unambiguous indication for all the other equipment in the network whether this event occurred or not.

In general, an event occurs at only one Megaplex unit, and thus it is defined only once. However, if the event is common to more than one Megaplex unit, it is necessary to use the same bit number at all these Megaplex units.

To create virtual networks, in which each Megaplex reports to the other units the predefined events status, each Megaplex is assigned a network number, in the range of 1 through 255. This number is assigned by means of the DEF AGENT command.

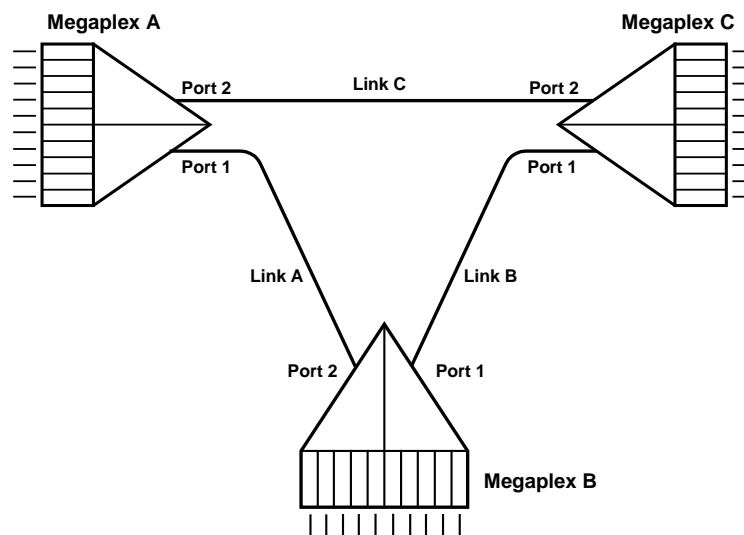
## Preparing the Flip Database

The preparation of the flip database includes the following steps:

Step	Action	Command
1	Define the Megaplex network number	<b>DEF AGENT</b>
2	Enable flip broadcasting	<b>DEF FLIP BROADCAST</b>
3	Define the flip activation delay	<b>DEF NET DELAY</b>
4	Define flip events (up to 10): <ul style="list-style-type: none"> <li>• Time events</li> <li>• Failure events</li> <li>• To change an existing event</li> </ul>	<b>DEF AGENDA</b> <b>ADD FLIP EVENT</b> <b>DEF FLIP EVENT</b>
5	Define flip entries (up to 10) To change an existing entry	<b>ADD FLIP ENTRY</b> <b>DEF FLIP ENTRY</b>
6	To save and activate the new flip data only on the local Megaplex unit	<b>FLIP UPD</b>
7	To update all the Megaplex units in the network, use the following command on each Megaplex:  To activate the updated flip database, use the following command on each Megaplex:	<b>FLIP NET UPD</b>  <b>FLIP NET GO</b>

### Example

This section provides an example that illustrates the use of flipping to recover from a failure of link A or link B in the network shown in *Figure 8-2*. This example assumes that the required configuration databases have already been prepared to provide the alternate routing in each case.



*Figure 8-2. Network Topology*

*{Steps 1, 2, 3 are used to define the failures of links A or B as events}*

1. Define the link A failure event on Megaplex A:

```
>DEF FLIP EVENT
No   Event Type  Bit No  Slot  Port  In-Service Delay  Out-Of-Service Delay
---  -
01   LINK DOWN   003    IO-1  EX1   001 sec           010 sec
```

2. Define the link A and B failure events on Megaplex B:

```
>DEF FLIP EVENT
No   Event Type  Bit No  Slot  Port  In-Service Delay  Out-Of-Service Delay
---  -
01   LINK DOWN   003    IO-1  EX2   002 sec           010 sec
No   Event Type  Bit No  Slot  Port  In-Service Delay  Out-Of-Service Delay
---  -
02   LINK DOWN   002    IO-1  EX1   001 sec           010 sec
```

3. Define the link B failure event on Megaplex C:

```
>DEF FLIP EVENT
No   Event Type  Bit No  Slot  Port  In-Service Delay  Out-Of-Service Delay
---  -
01   LINK DOWN   002    IO-2  EX1   001 sec           010 sec
```

*{Steps 4 to 7 are used to define the logical conditions for flipping}*

4. Define the required flip entry on Megaplex A:

```
>ADD FLIP ENTRY
Entry No   Logical expression  DB No   Discard Eligible
-----
01         3                   03     N/A
Entry No   Logical expression  DB No   Discard Eligible
-----
02         2                   02     N/A
```

5. Define the required flip entry on Megaplex B:

```
>ADD FLIP ENTRY
Entry No   Logical expression  DB No   Discard Eligible
-----
01         2                   02     N/A
Entry No   Logical expression  DB No   Discard Eligible
-----
02         3                   03     N/A
```

6. Define the required flip entry on Megaplex C:

```
>ADD FLIP ENTRY
Entry No   Logical expression  DB No   Discard Eligible
-----
01         2                   02     N/A
Entry No   Logical expression  DB No   Discard Eligible
-----
02         3                   03     N/A
```

*{Steps 8 and 9 define the general parameters that control the propagation of flip data in the network}*

7. Enable the broadcasting of flip data on each of the three Megaplex units:

```
>DEF FLIP BROADCAST
Flip Broadcast      Broadcast Interval [sec]
-----
ON                  10
```

8. Define the flip delay on each of the three Megaplex units:

```
>DEF NET DELAY
Net delay [sec]
-----
010
```

This completes the preparation of the flip conditions.

---

## 8.10 Configuring the General System Parameters

The general system parameters include:

- Password: define using the DEF PSW command.
- Custom prompt: define using the DEF MMI command.
- For management purposes, you must also define the following parameters:
  - SNMP agent parameters: define using the DEF AGENT command.
  - IP address filtering parameters: define using the ADD NET ENTRY command (not mandatory).
  - List of network management stations that will receive traps from this Megaplex: define using the ADD MANAGER LIST command (not mandatory: by default, all the network management stations that communicate with this Megaplex will receive traps).
  - List of management agents for which the routing information will be learnt using the RIP2 protocol so that when another RAD agent that uses the RIP2 protocol communicates with the Megaplex, the Megaplex will automatically update its routing table so that it can manage those agents (note that the use of this feature is not mandatory): define using the ADD RIP2 AGENT command.

### Configuring CL Connection through Modules with Ethernet Interfaces

When the Megaplex chassis is equipped with a CL module with Ethernet interface, the preferred method for its connection to a network management station, for example, a RADview station, is through an Ethernet LAN. If the RADview station is at a remote location, the connection is made through a WAN.

As an alternative to connecting via the CL Ethernet port, you can also connect through one of the following modules, which have Ethernet interfaces and can serve as proxies for the CL module:

- ML-IP module
- HS-ETH/SW module.

To configure CL modules with Ethernet interface installed in the Megaplex to route their traffic through one of these modules, use the **Direct LAN Connection** parameter, configured by means of the DEF SP CON2 command:

- When this parameter is set to **YES**, the CL module uses its local Ethernet port for management communication.
- When this parameter is set to **NO**, the Ethernet port of the CL module is effectively disabled, and the management communication normally directed through this port is directed to the IP traffic handling subsystem of the module that will serve as proxy for the management traffic.

### Connecting via an ML-IP Module

If the Megaplex includes an ML-IP, that module can provide the connection to a remote management station, provided that station can be reached through the same IP network used for payload transmission.

In this case, make sure to configure the ML-IP **Routing** parameter as **RIP2**: in this case, the IP router of the CL module advertises its presence to standard IP routers by sending routing tables in accordance with the RIP2 protocol.

### Connecting via a HS-ETH/SW Module

If the Megaplex includes HS-ETH/SW modules, one of their Ethernet ports can provide the connection to a remote management station, provided that station can be reached through the same IP network used for payload transmission.

For HS-ETH/SW modules, you can explicitly configure one of its ports to provide the management connection, by selecting **YES** for the **MNG CL** parameter.

---

---

## 8.11 Configuring the Alarm Handling Parameters

Megaplex systems provide a wide range of alarm handling parameters, which enable the user to customize alarm handling in accordance with the requirements of its specific application.

Moreover, the Megaplex provides convenience tools that enable to modify temporarily the response to alarm conditions under special circumstances, e.g., during maintenance, trunk failure, etc.

The alarm handling parameters cover three areas:

- Alarm reporting policy
- Alarm filtering.
- Alarm processing.



## Alarm Reporting Policy

To meet the needs of large organizations for a standardized, unified alarm reporting method adapted to specific needs of each organization, the Megaplex system provides two functions:

- User-configurable alarm priorities. The priority (severity) of each alarm can be defined by means of the DEF AP command.

Megaplex supports five alarm priorities: event (lowest level – level 1), warning, minor, major, and critical (highest level – level 5). The alarm priorities are stored in non-volatile memory, and therefore remain in effect even after the Megaplex is turned off and then on again.

To return the default alarm priorities, use the command INIT AP.

### Example

The priority of the alarm **001 DB CONTROL WAS TAKEN BY TERM MMI** is *event*.

To change its priority to *major*, use the command as follows:

```
>DEF AP 1
```

Alarm Description	Priority	ACM Slot	ACM Ch
-----	-----	-----	-----
(A) (121) INTERNAL RATE GENERATOR FAILURE	MAJOR	N/A	N/A

Note that the fields related to the ACM module need to be filled only when an ACM module is installed in the Megaplex.

- User-configurable alarm indications. The indications provided at each priority level can be defined by means of the DEF AR command. The reporting options include:
  - Sending of alarm reports to the supervision terminal, and traps to SNMP management stations.
  - Recording in the Megaplex alarm buffer.
  - Activation of the major and minor alarm relays.
  - Lighting or flashing of front-panel ALARM indicator, and ALARM MAJ and ALARM MIN indicators on the CL module.

### Example

To cancel the logging of major alarms, their reporting to the terminal and the generation of associated traps, use the command as follows:

```
>DEF AR
```

Alarm	Report	Log	Relay1	Relay2	Minor Led	Major Led
-----	-----	---	-----	-----	-----	-----
CRITICAL ON	YES	YES	YES	YES	YES	YES
CRITICAL OFF	YES	YES	N/A	N/A	N/A	N/A
MAJOR ON	NO	NO	YES	YES	YES	YES
MAJOR OFF	NO	NO	N/A	N/A	N/A	N/A
MINOR ON	NO	NO	NO	YES	YES	NO
MINOR OFF	NO	NO	N/A	N/A	N/A	N/A
WARNING ON	NO	NO	NO	NO	YES	NO
WARNING OFF	NO	NO	N/A	N/A	N/A	N/A
EVENT	NO	NO	NO	NO	YES	NO

Note that the REPORT and LOG fields for lower priority alarms (e.g., minor, warning and event) have also been changed to NO.

## Alarm Filtering

The Megaplex enables the user to define filtering parameters to reduce the probability of false alarms, and the number of alarm reports generated under marginal conditions.

The filtering is based on an observation window, defined by means of the DEF AW command (the allowed range is 1 to 255 seconds).

- The filtering parameters for event alarms are defined by means of the DEF AT command. This command is used to define threshold values for the *alarm active* and *alarm inactive* states.

The threshold values can be independently defined for each desired module port.

### Example

To enable the reporting of the alarm **004 LOSS OF ALMS FROM HISTORY BUFF:EVENT** only after it appears at least 20 times within a 20-second interval (window), and remove it if it appears 10 or less times in a 20-second interval, use the following commands:

```
>DEF AW
Enter Time Window value (1 to 255) : 20
>DEF AT 4
```

Alarm	Slot	Port	Set Value	Reset Value
-----	----	----	-----	-----
4	IO-2	EX1	020	010

- The filtering parameters for each type of state alarm can be defined by means of the DEF AF command. This command is used to define threshold values for the *alarm active* and *alarm inactive* states. The threshold values can be independently defined for each desired module port.

### Example

To enable the reporting of alarm **007 CL-A & CL-B HAVE DIFF PROGRAM** only if it is active for at least 50% of a 30-second interval, and to remove it if is active for less than 20% of the 30-second interval, use the following commands:

```

>DEF AW
Enter Time Window value (1 to 255) :    30
>DEF AF 7
Alarm      Slot      Port      Set Value      Reset Value
-----
7          IO-1      EX1       050            020

```

## Alarm Processing

The Megaplex supports two alarm processing functions:

- Alarm inversion, controlled by means of the ADD AI command. This command is used to change (invert) the interpretation of any desired alarm condition occurring at a user-specified module or and port with respect to Megaplex visual indications and alarm relay:
  - Normally, an alarm is interpreted as being active when the associated condition is present (*true*).
  - When the alarm is inverted, the normal condition is the presence of an alarm condition, and the condition that requires alerting is the absence of the alarm state.

For example, when a main link is temporarily out of service, the alarm indication related to loss-of-sync on the corresponding main link can be inverted: as a result, the ALARM indicator on the front panel of the Megaplex and the ALARM indicators on the CL panel will be turned off as long as the loss-of-sync condition is present, and will turn on when the main link returns to normal operation. The same is true with respect to the alarm relay: if the alarm relay is to be activated by that alarm, then inverting the alarm returns the alarm relay to its non-alarm state while the alarm state is present.

Alarm inversion does not affect the state of the alarm recorded in the alarm buffer (the alarm buffer shows the true state). Moreover, when an alarm is inverted, it is not masked, even in case it is defined as a masked alarm by means of the ADD AM command.

### Example

To cause alarm **009 CLK IS DIFF FROM MASTER CLK SRC** to appear when the conditions are the inverse of the default conditions, use the following command:

```
ADD AI 9
```

After this command, the ALM indicator lights when the clock source *is* the master clock source.

Alarm inversion is indicated by an I:

```

>DSP AS
(A) (009)          CLK IS DIFF FROM MASTER CLK SRC          MAJOR 1 I
(A) (064)CL-A     DIPSWITCH IN ON STATE                 MAJOR 1

```

- Alarm masking, controlled by means of the ADD AM command.

Each specified alarm can be masked at the level of a module port, at the level of a module, or at the level of the Megaplex system.

A masked alarm does not effect the Megaplex alarm status. The only exception is an event alarm for which a threshold has been defined (see DEF AT command): if the threshold is exceeded, the alarm takes effect even if it is masked.

The masking of alarms defined by means of this command is temporary, therefore if the Megaplex is reset or is turned off and then back on, the masking is automatically canceled. You can use the ADD PERMANENT AM command to cause the mask definition to be stored in the Megaplex non-volatile memory: the masking is then active until it is deleted by means of the DEL PERMANENT AM command.

### Example

To prevent display of the alarm **033 CL-A EX1 MANAGEMENT LINK IS DOWN** when the management link is down, use the command:

```
ADD AM 33 CL-A 1
```

When the alarm condition is present, the alarm will appear in the alarm status display together with the indicator **M**, but the ALM indicator will not light.

>DSP AS						
(A)	(026)	IO-4		MODULE TYPE MISMATCH		MAJOR 1
(A)	(033)	CL-A	EX1	MANAGEMENT LINK IS DOWN		MAJOR 1 M

## 8.12 Saving the Configuration Database

The user can save the edited set of configuration parameters as a database, using the DB UPD command. There are 10 different databases, and the user can specify the desired number.

Before any update, a sanity check is automatically performed, and the database update is performed only if no errors are detected (if sanity warnings exist, the user is asked to confirm the update command, or cancel).

If the new set of parameters is saved, to the currently active configuration database, the specified database will be immediately activated on this Megaplex, unless conditions specified by means of the flip database dictate that another database is to be activated.

When operating in networks, the user can save the edited set of parameters as a specified configuration database, without activating it, by means of the DB NET UPD command. This procedure must be performed on each Megaplex unit in the network. The number assigned to the edited configuration database can be freely selected in each Megaplex unit.

### Example

If you edit the database 1 in the Megaplex unit 28, use the command DB NET UPD 1 for this Megaplex.

The specified database can be activated on all the Megaplex units in the network by means of the DB NET GO command, provided broadcasting has been defined using the DEF FLIP BROADCAST command. This command is then broadcast to all the Megaplex in the network, to select a database for activation. The database that will

be selected for activation is the database that has been selected by the DB NET UPD command.

If the flip database is empty, the selected database will be the last database loaded in the non-volatile memory by means of a DB NET UPD command.

The delay between the reception of the command, and its actual execution in response to the DB NET GO command which results in a configuration change is selected by means of the DEF NET DELAY command. This enables to switch at almost the same time to the new databases in the whole network, thus minimizing service disruptions, and the possible loss of management links during database flipping. For example, this could prevent loss of management when switching from the DEDICATE TS to the DEDICATE FR protocol.

For Megaplex unit 12, you may have edited database 6 to use it together with database 1 of Megaplex 28: therefore, on Megaplex 12 use the command DB NET UPD 6.

Repeat this procedure on each Megaplex unit in the network.

### **Example**

After preparing the desired databases for activation using the DB NET UPD command, enter the command DB NET GO at any one of the Megaplex units in the network. After the specified delay, all the Megaplex units in the network flip to the locally-selected database.



# Chapter 9

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## Application Planning Guidelines

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### 9.1 Introduction

This chapter describes typical applications of Megaplex systems, and presents system planning considerations related to specific applications.

This chapter is organized in 3 sections:

- Section I TDM Applications** – provides application considerations for the functions associated with TDM modules.
- Section II TDMoIP Applications** – provides application considerations for the functions associated with TDMoIP modules.
- Section III System Management** – provides typical topologies and implementation considerations regarding the management of Megaplex systems.

The information appearing in this chapter complements the information appearing in [Chapter 1](#), by providing additional details regarding those characteristics of Megaplex systems which are relevant to specific applications.

For background information on the operating environment of Megaplex systems, refer to [Appendix B](#).

## Section I TDM Applications

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### 9.2 Basic System Application

#### Basic System Structure

The simplest Megaplex system consists of two Megaplex units directly connected by a single link. In this case, the number of payload timeslots available to the user is maximum 24 when using a T1 link, and 31 when using an E1 link.

Since the Megaplex can have several main links, each link can be connected to a different unit, as shown in [Figure 9-1](#) (for simplicity, [Figure 9-1](#) shows only two links). When higher transport capacity is required, two or more links can be connected in parallel between two units. This permits achieving the full Megaplex payload carrying capacity.

Megaplex equipped with 8-port main link modules in conjunction with the 12-port high speed module features a traffic payload capacity of up to 248 DS0 timeslots. This capacity can be carried by 8 E1 links or 10 T1 links, or any equivalent combination of E1 and T1 links. The modules of version 11 and lower still support up to 124 DS0 timeslots (8 Mbps). This capacity can be carried by 4 E1 links or 5 T1links, or any equivalent combination of T1 and E1 links. Note that all the equipment in the system must use a common timing reference.

The system is controlled by an SNMP-based network management station (which may be running on a PC or workstation) or by a supervision terminal (ASCII terminal or PC running a terminal emulation package). The PC can communicate with one or more of the Megaplex units via a V.24/RS-232 link (or inband).

When the PC is near the Megaplex, the V.24/RS-232 link can be obtained by connecting a cable between the PC serial port and the supervision connector on the CL module, however a modem link can also be used to cover longer distances.

When SNMP-based management stations or Telnet hosts are used to manage the system, additional routing options are available, as explained in the System Management Topologies section below.

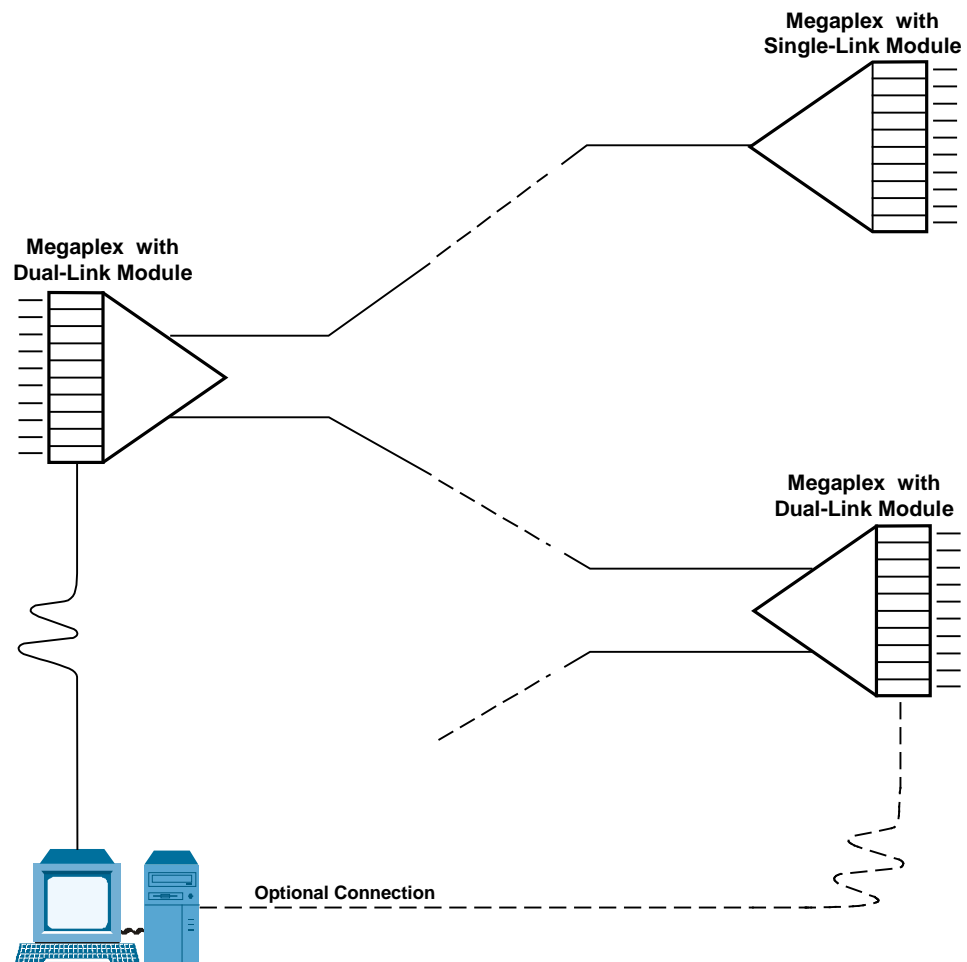


Figure 9-1. Basic System Structure



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## 9.3 Using Redundancy to Increase System Availability

The operation of a Megaplex system depends on three critical types of modules: the power supply, the main link module, and the CL module.

A failure in any one of these modules could disable the whole system, whereas a failure in an I/O module affects only a small part of the system, and can be generally overcome by using alternate routes, putting unused capacity into service, etc. For critical applications, an additional redundant module of each type can be installed in the enclosure.

The Megaplex system is designed to automatically put a redundant module in service in case the corresponding module fails, thereby ensuring continuous system operation in the event of any single module failure. Redundant modules may be inserted or removed even while the system operates, without disrupting the traffic or degrading system performance.

The utilization of the redundant modules is explained below.

### PS Module Redundancy

The PS module supplies the operating voltages to the Megaplex. Normally a single PS module per unit is sufficient.

The Megaplex-2100 supports the installation of an additional, redundant, PS module in the chassis.

With a redundant PS module, both PS modules are connected to power and share the load when the system is operating. If one module fails, the second module automatically takes up the full load.

### CL Module Redundancy

The CL module is also a critical system: during power-up, it determines the configuration of the system, and after power-up, the module provides an interface for management activities, and performs housekeeping functions, such as:

- Initialization of newly-inserted modules.
- Generation of out-of-service (OOS) signaling.
- Replacement of the master clock source with the fallback or internal clock source, in case of clock source failure.
- Replacement of main links, in case of link failure in a system with main link redundancy.

CL modules can be replaced during system operation (except that the replacement module must store the same configuration).

For critical applications, a second, redundant, CL module can be installed in the Megaplex-2100. The two modules then operate as a master/slave pair: only the master module communicates with the management station/terminal and actively manages the Megaplex-2100 system.

**Note**

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*CL redundancy is possible only when both CL modules have the same software version.*

---

The slave module communicates only with the master module. Moreover, its transmit line in the serial port connectors is disabled, to enable connection in parallel (by means of a Y cable) to a management facility.

The master and slave modules are selected as follows:

- If both modules are operational and include valid databases, upon power-up the CL module installed in slot CL-A is automatically selected as the master. If only one of the two modules includes a database (the other module is new), the module with the database becomes the master.
- In case the database stored by the slave module is corrupted, the master CL module automatically loads the system databases into the redundant CL module. The master CL module continuously transmits updates to the slave module for all the system parameters, via a dedicated communication bus.

Such updates are transmitted after each database update command, and in case the master module detects that a “new” slave module is installed (a “new” slave module is a module without a valid database). If the “slave” module uses the same software version as the current master module, the “slave” database is updated after each master database update. The result is that the system information contained in the two modules is essentially synchronized at all times.

The two modules maintain a constant check on each other's integrity. If the master CL module is removed or fails, or another module is installed and does not store a valid database, the slave module takes over the system control.

**Note**

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*After removing a CL module, allow at least 10 seconds before reinserting a CL module in the same slot, to permit the internal processes to complete their normal course.*

---

## Main Link Redundancy

One of the simplest methods to protect against link and hardware failure is to use the main link redundancy function.

Redundancy provides two main advantages:

- Automatically restores service within a short time without user's intervention
- In case of technical failure, allows service to continue while technical staff finds the source of the failure and corrects it.

Moreover, when redundancy is used, planned maintenance for example, updating software versions, or installing modules with enhanced capabilities, can also be performed without disrupting service, provided a few precautions are taken:

- To minimize disruptions to traffic, do not simply pull module out but first check that the module does not serve as the TDM master (use the DSP ST SYS command). If one of the module ports serves as the TDM master, first force redundancy flipping by means of the DEF RDN ST or RESET command.

- After removing a module, wait at least 10 seconds before inserting a module in the same slot.

Three different redundancy approaches are supported: dual-cable redundancy, Y-cable redundancy and E1/T1 ring redundancy.

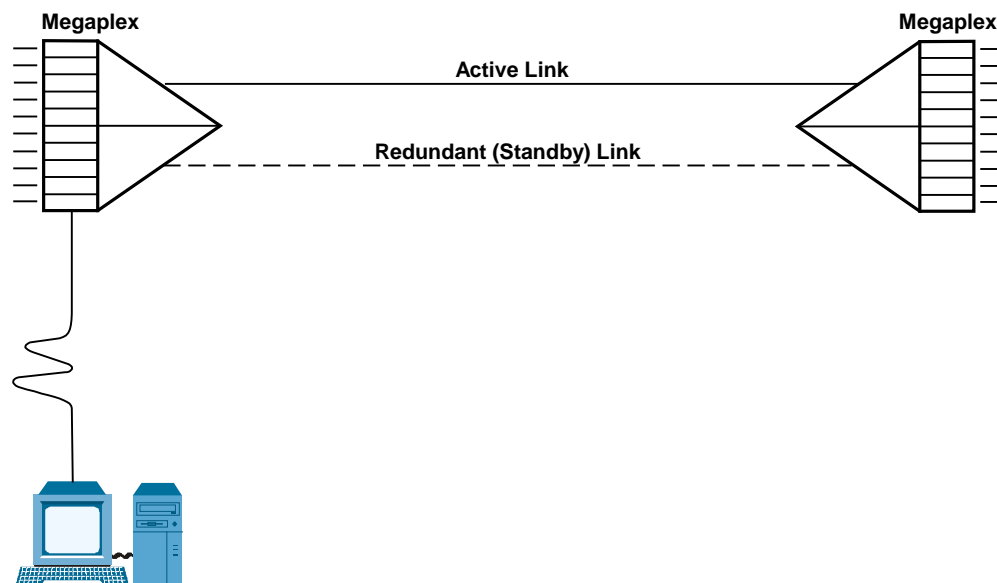
### Dual Cable (Parallel TX) Redundancy

For this type of redundancy, two main link ports of the same type (either E1 or T1) are connected to the remote unit via two parallel links. By defining these two links as a redundant pair, it is possible to ensure that traffic carrying capacity is available even if one of the links fails.

*Figure 9-2* shows a typical system configuration using dual-cable redundancy. The user can select the main link module ports operating as a redundant pair. When operating with dual cable redundancy, the redundant port is configured with basically the same parameters as the primary port (there may be differences in parameters related to the link physical configuration parameters). Both ports process as usual the transmit and receive signals, but the receive output of the redundant port is not connected to the TDM buses.

During normal operation, the operational state of the redundant port is continuously monitored, to ensure that it is operating O.K. If the primary link fails, the corresponding port is disconnected from the TDM buses, and the redundant port takes over.

The switching time between main and backup ports located on the same module is maximum 50 msec, and therefore redundancy switching will ensure essentially uninterrupted service for all the types of applications (in particular, it will not cause the disconnection of voice calls).



*Figure 9-2. Main Link Redundancy Using Dual Cables*

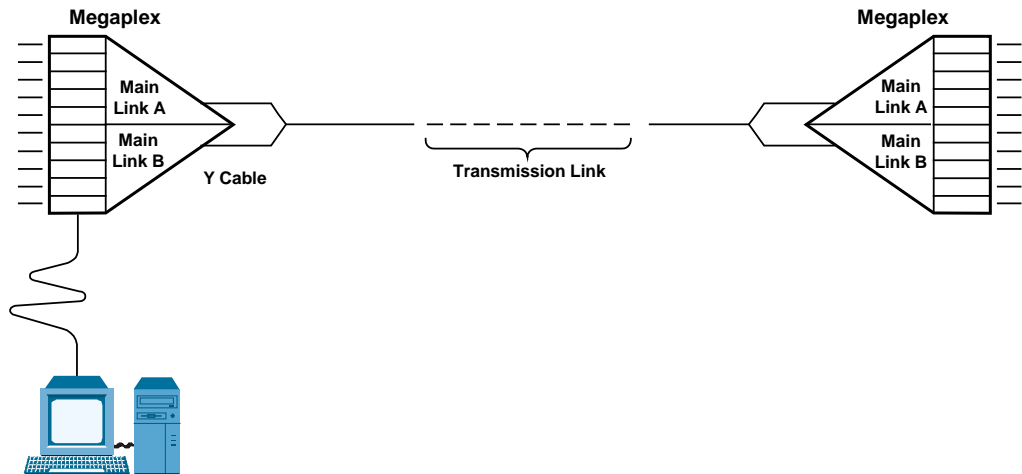
### Y-Cable Redundancy

For Y-cable redundancy, two main link module ports with the same type of physical and electrical interfaces are connected to the same communication link by a single Y cable. For this type of redundancy to be effective, the two ports

must be located on different modules because it provides protection mainly for technical failures in the main link module hardware. A typical configuration is shown in *Figure 9-3*.

When operating with a Y cable, the redundant main link module port must be configured with the same parameters as the primary module port.

During normal operation, the transmit output of the redundant module is electrically disconnected from the link. Nevertheless, its operational state is continuously monitored, to ensure that it is operating O.K. If the primary main link module fails, it is disconnected from the link and from the TDM bus, and the redundant main link module takes over.



*Figure 9-3. Main Link Redundancy Using Y-Cable*

## E1/T1 Ring Redundancy

The E1/T1 ring redundancy is a RAD proprietary topology suitable for Megaplex equipment that provides higher availability for critical applications. This topology is based on the use of two transmission paths, each requiring a single twisted pair or a single optical fiber. Therefore, E1/T1 ring redundancy can use the same cabling infrastructure as a regular point-to-point link.

The two pairs or fibers form a closed dual-ring topology, similar to that implemented in SDH and SONET transmission networks: one path propagates data "clockwise" and the other "counterclockwise". Therefore, each Megaplex can receive data through two different paths, and its CL module selects only the signal received through one of the paths for processing.

The E1/T1 ring redundancy topology can be efficiently implemented by means of dual-port main link modules, such as ML-1E1, ML-2E1, etc. However, any pair of main link ports, even ports located on different modules, can be used as a redundancy pair, because the ring redundancy functions are controlled by the CL module.

To enable handshaking between Megaplex units in an E1/T1 ring, it is necessary to use the RAD proprietary RIP protocol, with inband management carried over a dedicated timeslot.

*Figure 9-4* shows a typical application that uses the ring redundancy topology. In each Megaplex unit, two main link ports (identified as port 1 and port 2) are defined as a redundancy pair. One port of each unit (in this example, port 2) is

configured as primary port: under normal conditions, each Megaplex transmits through the primary port and receives through the secondary port. Therefore, in *Figure 9-4* the primary ring propagates data clockwise.

The payload is handled as follows:

- Primary ring: at each unit, timeslots used by the local unit are dropped from the receive side of the secondary port, and added to the transmit side of the primary port. Timeslots used by the other Megaplex units are bypassed directly between these two ports.
- Secondary ring: all the timeslots received by port 2 are bypassed to the transmit side of port 1.

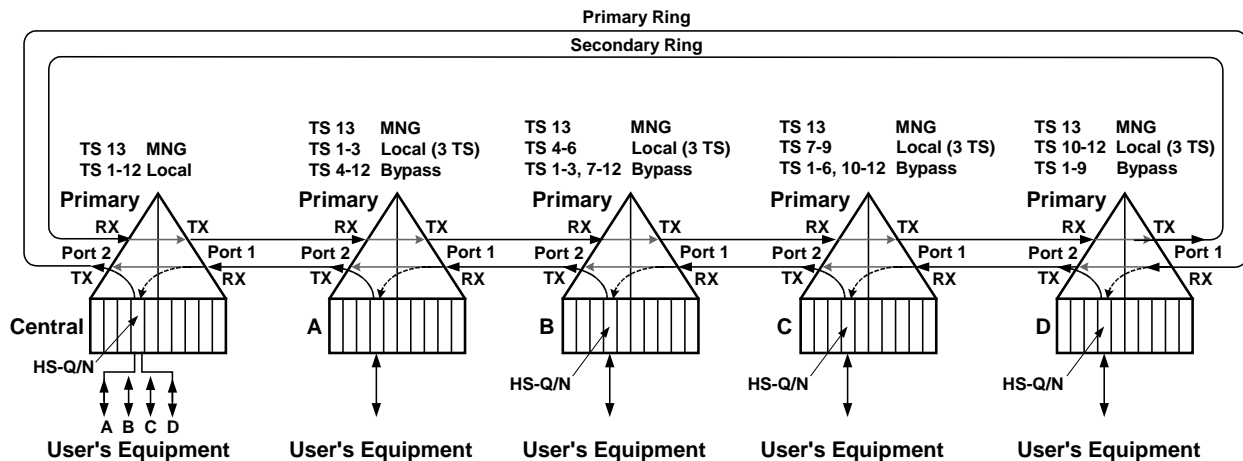


Figure 9-4. E1/T1 Ring Redundancy Topology – Signal Flow during Normal Operation

When one of the segments in the ring fails (see *Figure 9-5*), the CL modules of the two Megaplex units adjacent to the failure point detect the loss of signal and change the signal routing within the corresponding units. Therefore, now each unit receives and transmits only through the synchronized port. Timeslots previously bypassed between the ports are now transferred between the receive and transmit sides of the active port by a connection similar to the remote loopback, thereby preserving transmission path continuity.

Note that all the other Megaplex units do not change their operating configuration: only the units that are connected to the failed segment take action in response to the failure.

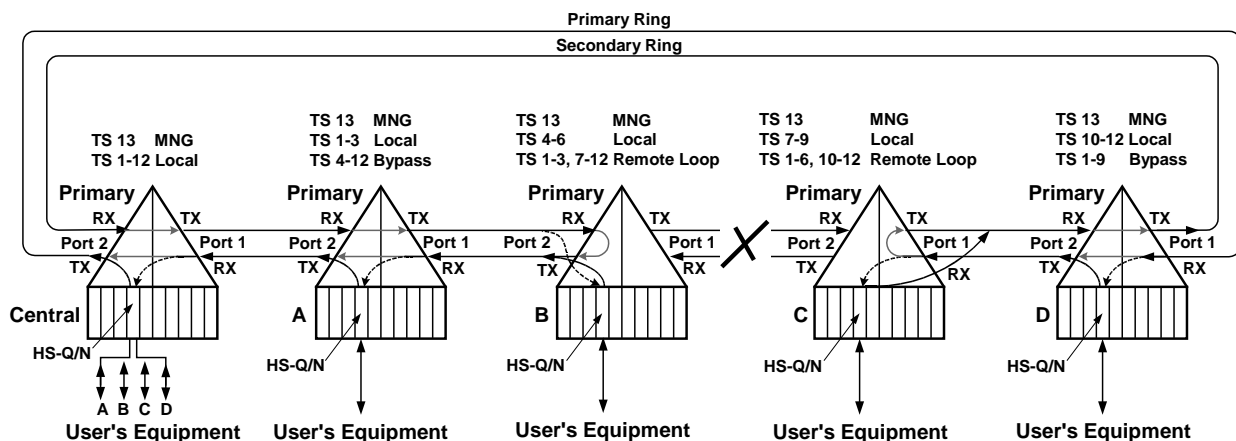


Figure 9-5. E1/T1 Ring Redundancy Topology – Signal Flow after Segment Failure

**Notes**

- *To prevent unnecessary switching to the redundant path, it is not allowed to activate remote loopbacks and loopbacks on timeslots, on the main link ports connected to the ring.*
- *When it is necessary to perform local bypassing (on the same main link module) between a main link port to one of the ports participating in ring redundancy, you can do that only for the primary port; for the redundancy port, you get an error message (ILLEGAL BYPASS CONNECTION).*

**Timing Considerations for E1/T1 Ring Redundancy Applications**

When using ring redundancy, it is necessary to ensure that the same reference timing can always be used at all the units on the ring.

- **Using an External Reference Signal.** At sites where Megaplex equipment is connected through ADMs to the SDH backbone, or at sites using a GPS-based timing reference, a common timing reference is always available.

When this common timing reference is available at all the sites along the ring, it is recommended to use this external signal as the nodal timing reference for all the units on the ring (the connection is then made to the station clock port of a main link module).

The main advantage of this approach is that it is not necessary to change the timing reference when redundancy switching takes place.

- **Using other Timing Reference.** As an alternative, the equipment can be configured so that the timing reference is distributed in a controlled way to all the equipment units, for example, by locking the nodal timing to the clock signal of a main link port. This requires:
  - Selecting appropriate timing reference sources
  - Configuring the main and fallback sources in a way that takes into consideration the change in the direction of timing flow caused by recovery from failure.

For example, in [Figure 9-4](#) the timing flows clockwise through the whole ring (the main timing source is port 1, and the fallback is port 2), whereas after recovery from segment failure ([Figure 9-5](#)), in some parts of the ring the direction of reference timing flow must be reversed. [Figure 9-6](#) and [Figure 9-7](#) show the timing reference flow before and after recovery.

The timing state of the ring is carried by the periodic RIP update messages (part of the RAD proprietary RIP protocol, which is mandatory for ring redundancy to work). Typically, these update messages are sent every 30 seconds.

The ring redundancy function uses a special fault indication message (CLOCK FAILURE IN THE RING) to notify other units in the ring that a fault event occurred on the ring:

- The reception of the NOT OK indication via a link configured as a master timing source causes the receiving unit to switch from master to fallback timing.
- A unit that must switch to fallback will not select as source a link from which NOT OK indications are received.

- The NOT OK indication is ignored when a unit does not use a link as its timing source.

**Note** *The switching of the traffic to the secondary ring takes place as soon as a fault occurs, without requiring any handshaking with other units.*

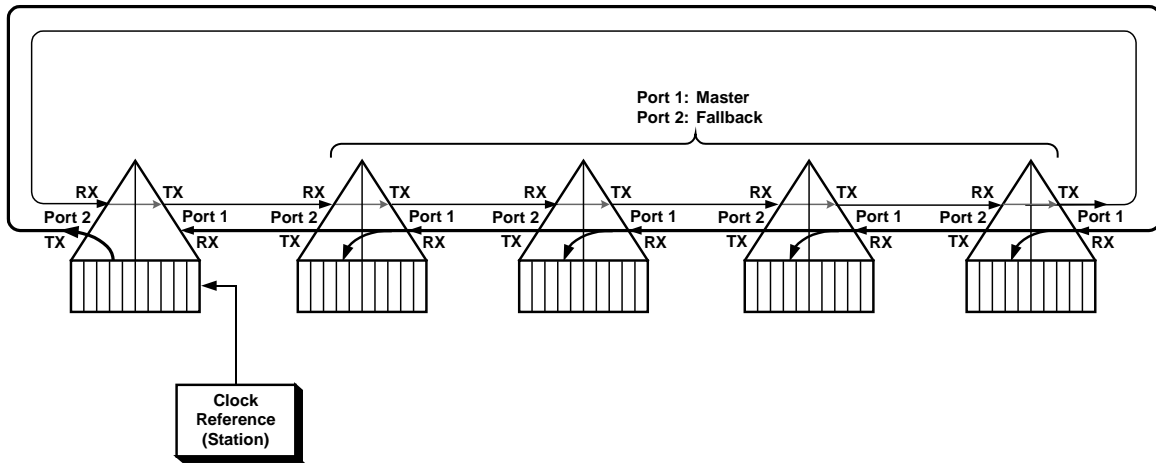


Figure 9-6. E1/T1 Ring Redundancy Topology - Normal Timing Reference Flow

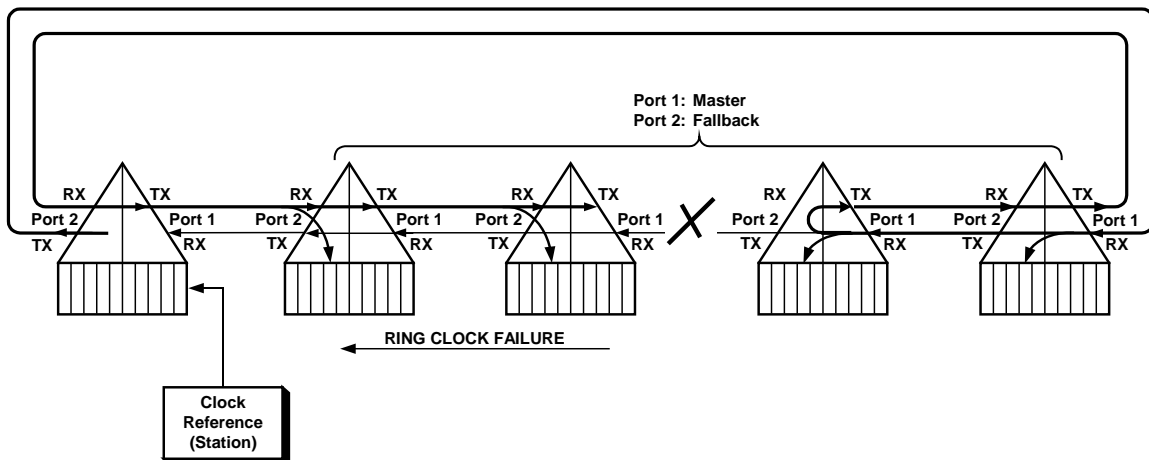


Figure 9-7. E1/T1 Ring Redundancy Topology - Timing Reference Flow after Segment Failure

Since the fault indication is carried by the periodic RIP update messages, it takes time for the fault notification to propagate through the ring. During the propagation time, frame slips may occur.

For long rings including a large number of units, it is possible to reduce the propagation time by distributing the same timing reference in two directions through the ring. Note however that this approach must be analyzed with respect to the maximum accumulating jitter.

Figure 9-8 shows an implementation of this alternative arrangement: the corporate ring uses the PBX as the timing reference for the whole ring. For redundancy, the PBX provides the timing signal to two units, Megaplex 1 and Megaplex 6. The timing sources configured for each unit, as well as the flow of the timing information during normal conditions, are both indicated in the figure. Figure 9-8 also shows how the clock status messages (OK for all the units) reach all the units in the ring.

The recovery from faults is illustrated in *Figure 9-9* and *Figure 9-10*:

- In case a fault occurs on the ring (*Figure 9-9*), Megaplex unit 3 can no longer use its master timing. Therefore, the CLOCK FAILURE ON THE RING alarm state is declared, and the following exchange of messages takes place:
  1. Megaplex unit 2 does not need to report any clock problem (it only switches the traffic).
  2. Megaplex 3 loses the link signal to which its timing is locked, and therefore NOT OK indications are sent by Megaplex 3 to the next unit it can reach, Megaplex 4.
  3. Since Megaplex 4 master timing is also lost when Megaplex 3 cannot provide its reference, Megaplex 4 also sends NOT OK indications to the next unit, Megaplex 5.
  4. Megaplex 5 has a stable timing reference, and therefore, it can continue reporting OK to the other units. Therefore, the counterclockwise propagation of the NOT OK state stops.
  5. Since Megaplex 5 reports OK to Megaplex 4, the latter unit can select its signal as reference (that is, it can switch to its can also be used as reference).
  6. Megaplex 3 now switches to fallback, and uses the Megaplex 4 signal as reference.

At this stage, both the Megaplex 3 and 4 units have reacquired stable timing by switching to their fallback sources. The resulting timing flow is also illustrated in *Figure 9-9*.

After the ring fault is corrected, the timing flow can return to normal: this operation is triggered by the transmission of OK indications instead of NOT OK by Megaplex 3 and Megaplex 4.

- In case the fault occurs in the connection to the PBX (*Figure 9-10*), Megaplex 1 loses its master timing source. Therefore, the CLOCK FAILURE ON THE RING alarm state is declared, and the following exchange of messages takes place:
  1. Megaplex 1 reports NOT OK toward Megaplex 6 (it will not report NOT OK toward Megaplex 2, because this is not relevant: Megaplex 1 uses the RX clock from the PBX as master source, not the timing signal from the link connecting to Megaplex 2).
  2. Megaplex 1 can switch to fallback (the signal from Megaplex 6), because Megaplex 6 reports OK.

At this stage, Megaplex 1 has reacquired stable timing by switching to the fallback sources. The resulting timing flow is also illustrated in *Figure 9-10*.



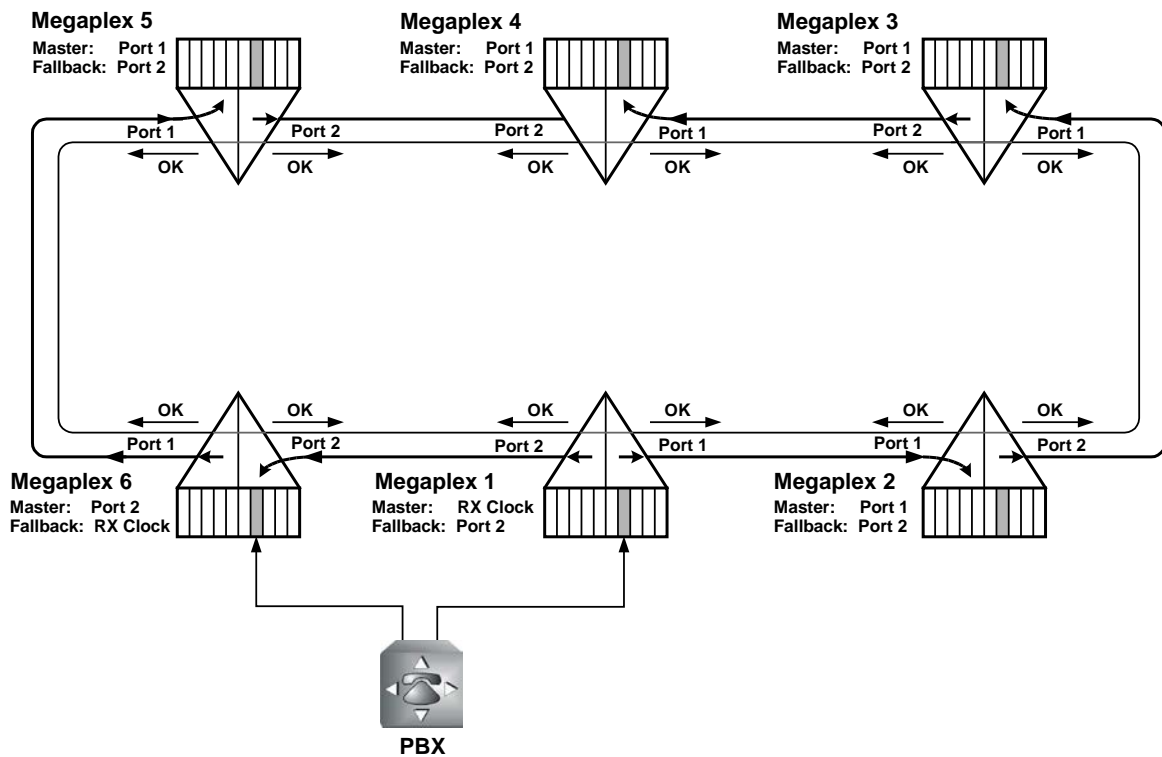


Figure 9-8. E1/T1 Ring Redundancy Topology - Alternative Timing Flow

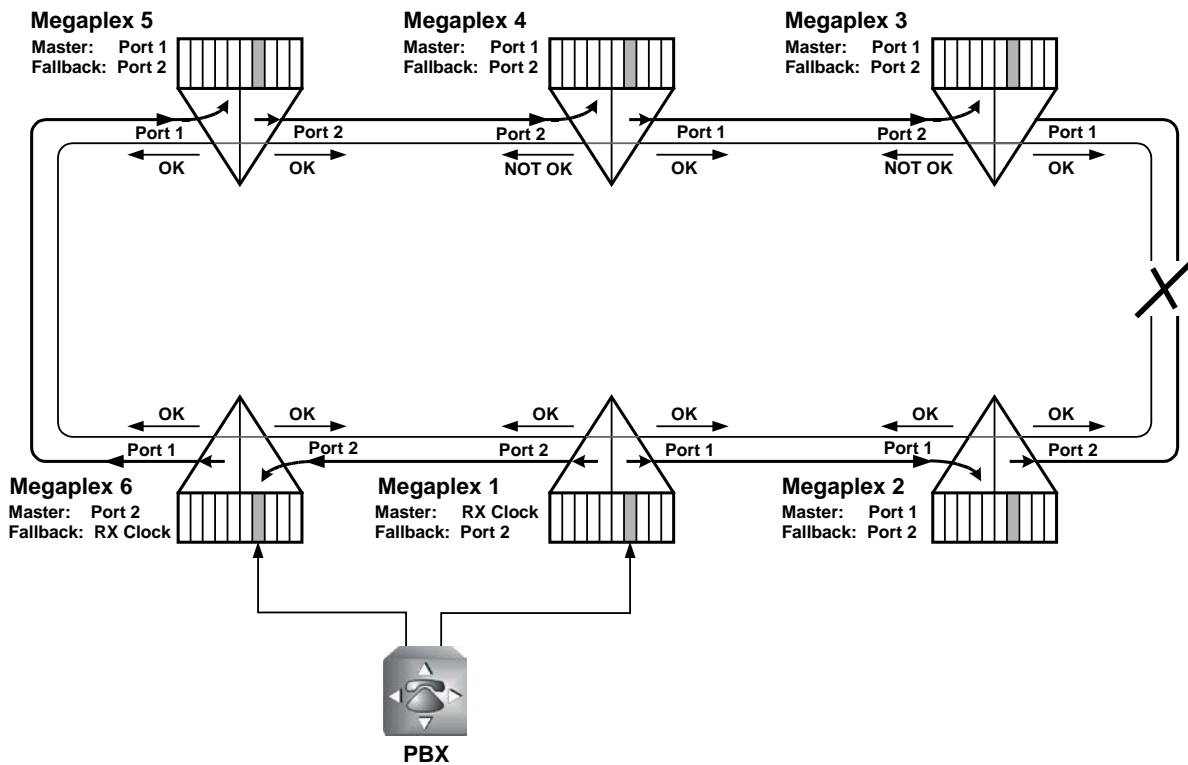


Figure 9-9. Timing Recovery Scenario - after a Ring Fault

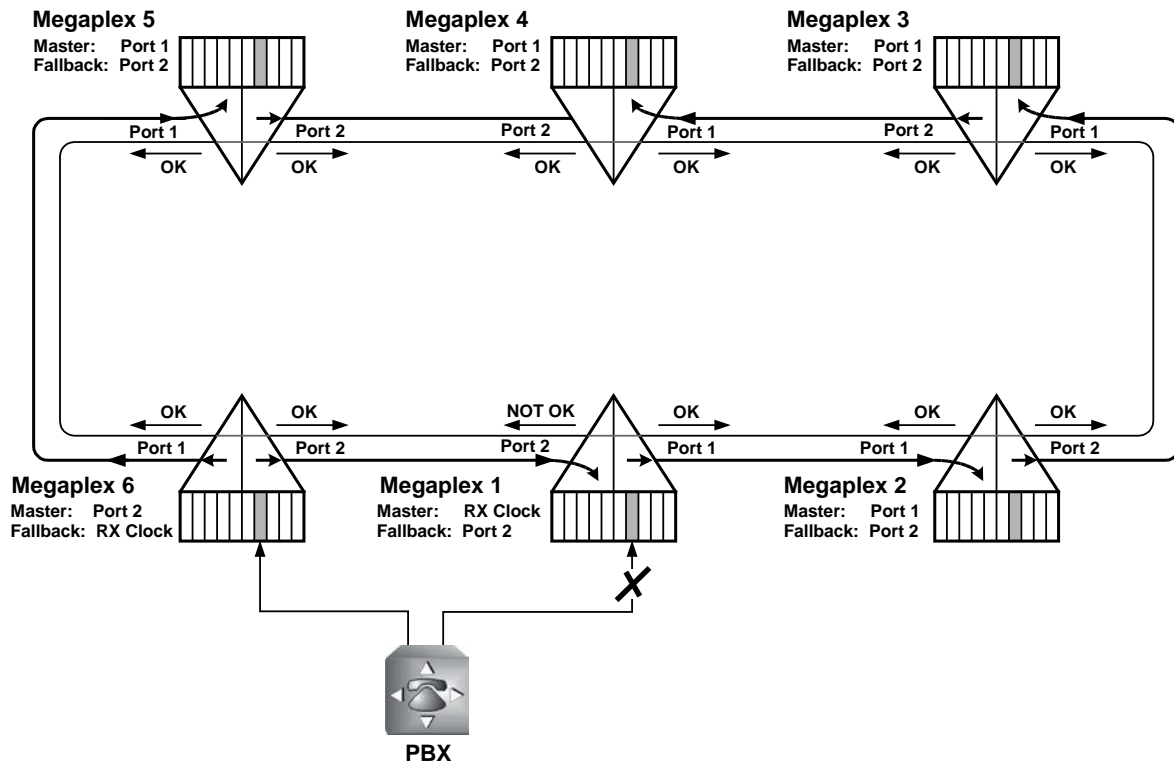


Figure 9-10. Timing Recovery Scenario – after Loss of Master 3 Reference

## 9.4 Drop & Insert (Bypass) Configurations

When two or more independent links are connected to one Megaplex unit, it is possible to bypass the desired timeslots between any pair of links (to *bypass* means “transfer selected timeslots directly from one link to the other”).

Any timeslots that are not bypassed become available to the Megaplex unit which performs the bypassing function, therefore this configuration can also serve for locally dropping and inserting channels.

### Note

*Bypassed timeslots can however be used in the unidirectional and bidirectional broadcast modes.*

### Basic Drop & Insert Configuration

Figure 9-11 illustrates a basic drop & insert configuration, where the bypassing Megaplex unit is unit B, and the bypassing is performed by means of the MAIN LINK module installed in this unit.

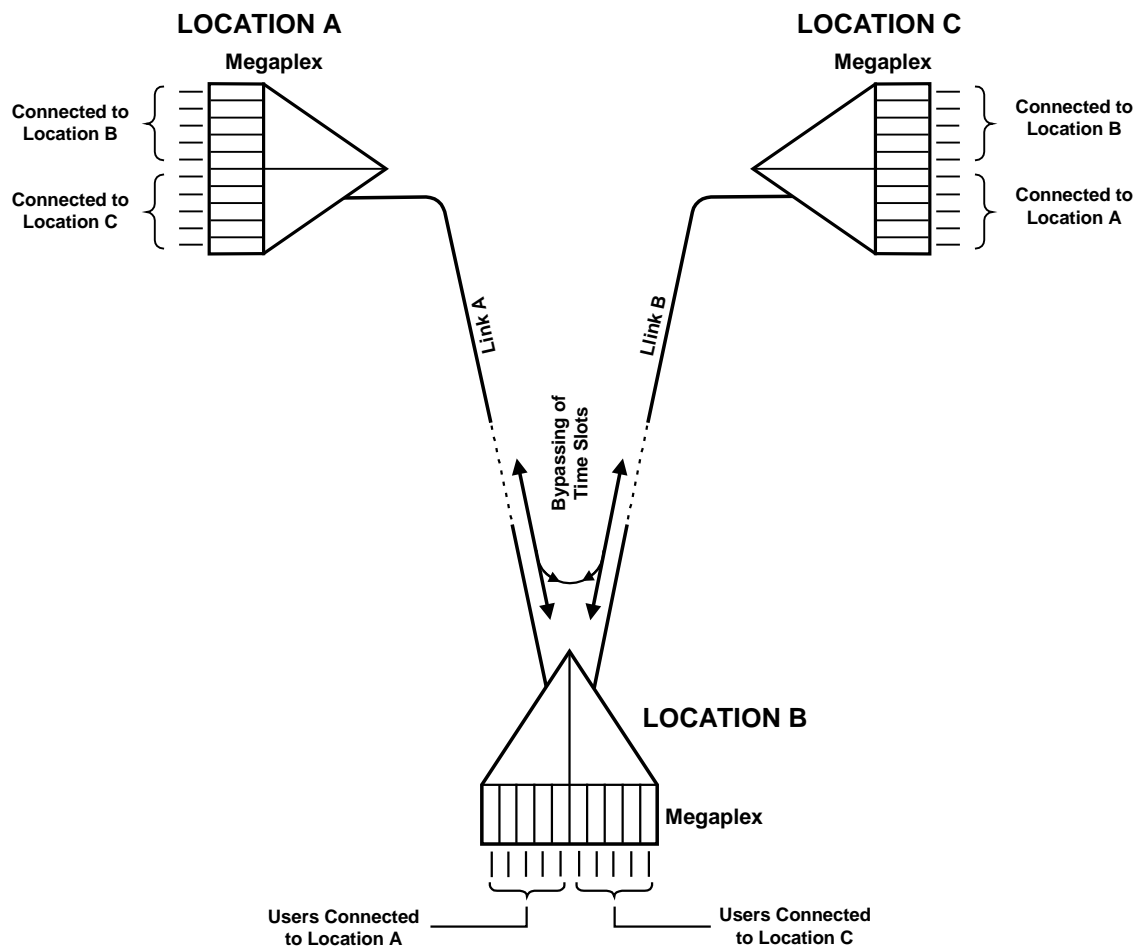


Figure 9-11. Basic Drop & Insert Configuration

The minimal drop & insert configuration (two links per Megaplex, as illustrated in [Figure 9-11](#)) includes three units. When using the G.704 multiframe (G732S) framing mode, it is often necessary to transfer the signaling information (carried by timeslot 16) between the links. In this case, timeslot 16 must also be bypassed.

## Chain Configurations

[Figure 9-12](#) shows an extended drop & insert system configuration (chain configuration), which enables the linking of equipment located at more than three locations by single backbone.

Chain topologies have several advantages:

- Increased flexibility with respect to routing and reconfiguration: the traffic among various sites can be controlled simply by reassigning timeslots on the interconnecting links.
- The inband management capabilities of RAD equipment enables management of the whole system from a single site.
- The number of links required to interconnect several sites is reduced, thus the total communications costs are reduced.

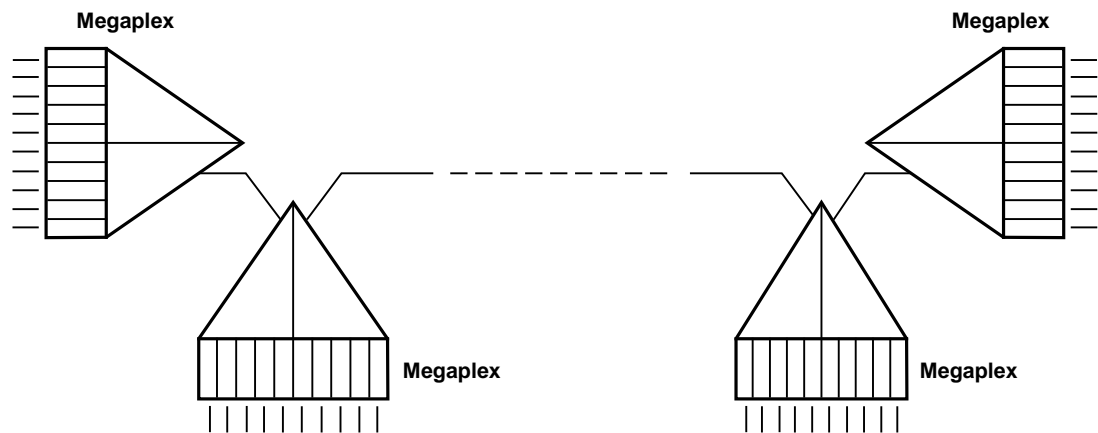


Figure 9-12. Typical Chain Configuration

## Mixing E1 and T1 Links in a Bypass Configuration

A Megaplex chassis can be equipped with both E1 and T1 main link modules, and I/O channels can be freely routed to either type of main link (provided of course that all the links use a common timing reference).

### Note

*When the Megaplex chassis includes both E1 and T1 main link modules, always install an E1 main link module in the I/O slot with the lowest number (at least among the slots to be used for main link modules).*

*For example, in a Megaplex-2100, when E1 main link modules are installed in I/O slots 3 and 5, T1 main link modules can be installed only in I/O slots 4, and 6 to 12.*

You can also bypass timeslots between E1 and T1 ports. This provides full bypassing functionality for data timeslots. For voice timeslots, two limitations apply:

- The signaling information associated with the bypassed channels (timeslots) is not transferred.
- The original voice encoding ( $\mu$ -law and the associated robbed-bit signaling information, or A-law) is not converted, because the voice data stream is transparently passed between the two ports.

---

## 9.5 Broadcast Applications

Megaplex units equipped with two or more main links support two additional modes, called the *unidirectional* and *bidirectional broadcast* modes. Their functionality is described in [Chapter 1](#).

This section describes the features and typical applications of these modes for data and voice modules.

## Modules Supporting Broadcast

The unidirectional broadcast mode (UNI-BRD-TX or UNI-BRD-RX) is supported for all the I/O modules.

The bidirectional broadcast mode (BID-BRD-RX) can be used only with specific types of voice and data modules: currently, the I/O modules which support these modes include the VC-6 (E&M and FXS versions only), VC-6A (E&M and FXS versions only), HS-RN, HS-2, HS-Q/N, HS-6N, HS-12N, LS-6N and LS-12.

## Unidirectional Broadcast Applications for Data Modules

The unidirectional broadcast mode enables a user at a central location to send data to multiple users connected to remote Megaplex units (simplex communication), while using only one timeslot.

In this mode, any message is simultaneously received by all the unidirectional users, but none of them can send back data to the originator.

This capability is achieved by separating the handling of the receive and transmit paths in the timeslot assigned for the unidirectional channels, as shown by the dashed lines within the Megaplex units in *Figure 9-13*.

*Figure 9-13* shows a network that uses the unidirectional broadcast mode to distribute data from a central location (A) to several remote locations (B, C, D, etc.). In *Figure 9-13*, the user at the central location (A) is connected to an HS-RN channel configured for operation in the unidirectional transmit mode. The channels of the remote users (at locations B, C, D) are configured for the unidirectional receive mode.

The timeslot assigned to user A on one of the internal TDM buses is routed to the two main link ports of the Megaplex unit at location A, and can be inserted in timeslots with different numbers.

For simplicity, first the path to the user at location D is described:

- In the forward path (from location A to D), the timeslot assigned to the HS-RN channel configured for unidirectional transmit operation is routed through the desired timeslot of port 1 to the Megaplex unit at location D.

At location D, the timeslot is routed to the HS-RN channel is routed to the receive path of the unidirectional receive HS-RN channel. Therefore, the user D receives data sent by user A.

- In the reverse path (from location D to A), the timeslot is always disconnected. Therefore, the user D cannot transmit data to user A.

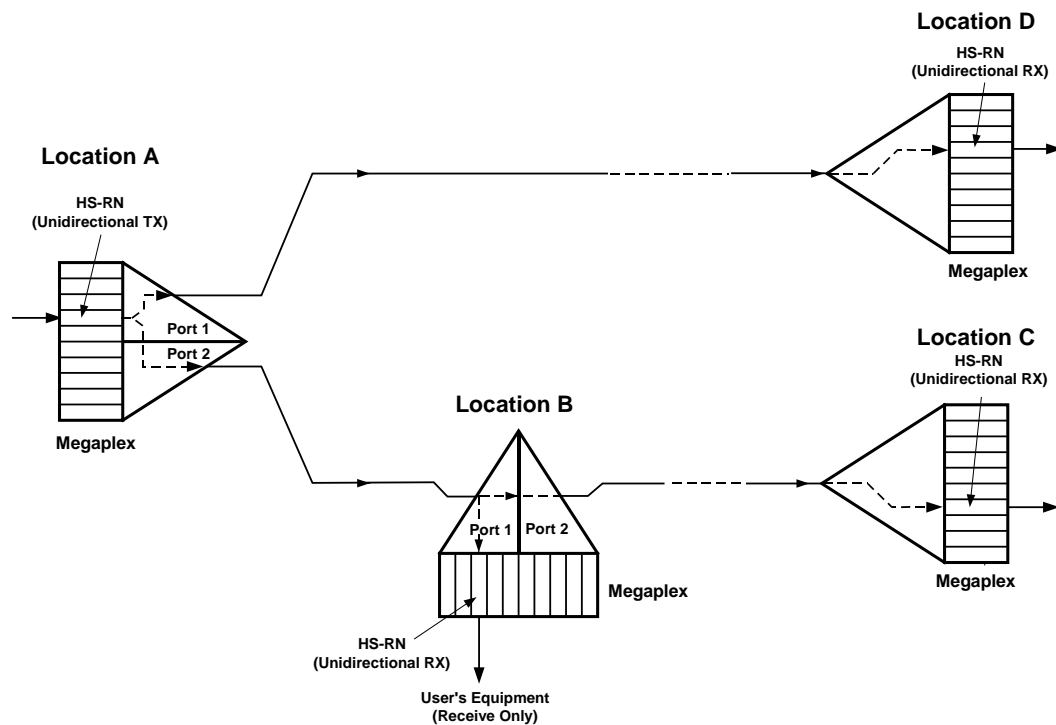


Figure 9-13. Typical Unidirectional Broadcast Application for Data Modules

The path to the users B and C is as follows:

- In the forward path (from location A to B, C, etc.), the timeslot assigned to the HS-RN channel configured for unidirectional transmit operation is routed through the desired timeslot of port 2 to the Megaplex unit at location B.

At location B, the timeslot received at port 1 is routed as follows:

- To the receive path of user B, configured for unidirectional receive operation
- To the desired timeslot of port 3 (bypassing), which is connected to the Megaplex at location C.

Therefore, the transmit signal of user A is relayed to the following units, and the user B receives data sent by user A.

**Note**

*The timeslot can be connected in parallel to any number of channels.*

- In the reverse path (to location A), the timeslot is always bypassed from port 3 to port 1, en route to location A.

To prevent interference from the unidirectional channel, its transmit path is always disconnected from the main link timeslots (at location B, no information is inserted in the timeslot bypassed from port 3 to port 1), and user B cannot transmit data to any other user. The same is true for the user at location C.

Figure 9-14 shows another network configuration, which enables regular (full duplex, or bidirectional) communication between two users (the users at locations A and C), and in addition enables the monitoring of the data sent by the user at location A at location B.

For this configuration, the users A and C are configured as regular users, and the user at location B is configured for unidirectional receive operation.

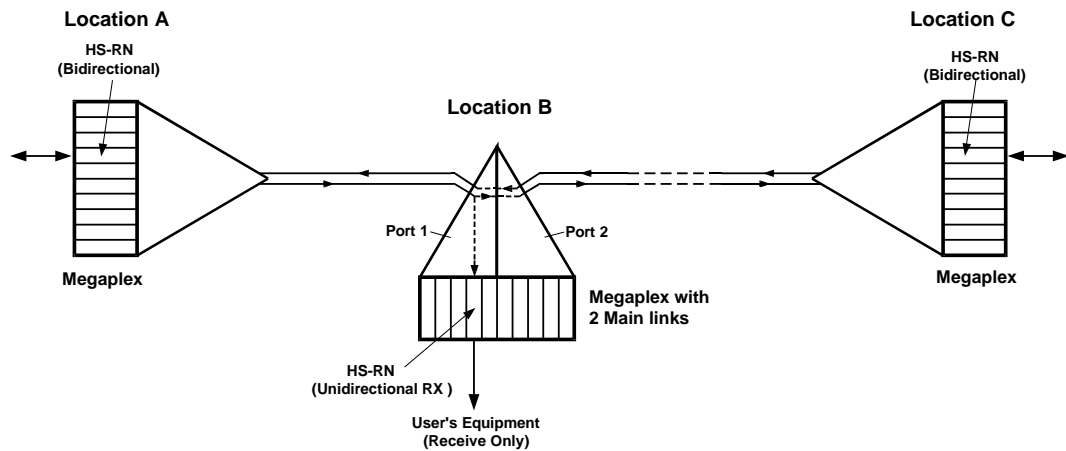


Figure 9-14. Typical Unidirectional Receive Application for Data Modules

### Configuration Example – Unidirectional Broadcast Mode

This section provides a detailed configuration example for the application shown in [Figure 9-13](#).

1. Configure all the main link ports as follows:

```

Module : ML-2/E1
Port EX1 Parameters
-----
Service      Logical Link ID      Interface ID      Startup Mode      Reprovision
-----
LEGACY        N/A                  N/A              N/A               N/A
Connect      Frame                Sig. Profile      Idle Code         CGA               Redundancy
-----
YES          G.732S              (1)              FF                NONE              NONE
Rx Gain      Voice OOS            Data OOS          OOS signaling     Restoration Time
-----
SHORT HAUL   00                  00               FORCED IDLE       CCITT
Inband Management      Inband Management Rate      Routing Protocol
-----
OFF          N/A                 N/A
    
```

2. Configure HS-RN module at location A:

```

Module : HS-R
Connect  Format  Rate
-----
Port EX01 : YES    SYNC  64 KBPS
           CTS  RTS & DTR  Mode
           -----
           ON  LOCAL  DCE
Oper Mode  ML Slot  ML Channel  Map Type  Start Ts
-----
UNI-BRD TX  BRD      BRD         N/A       N/A
    
```

3. Configure timeslot allocation for port 2 of the main link module at location A:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
    
```

```

CH-01 :
      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    --  --  --  B1  --  --  --  --  --  --  --  --
Channel 02    BP  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --
Channel 16    --  --  --  --  --  --  --  --  --  --  --  --
      TS 01    TS 02    TS 03    TS 04    TS 05    TS 06
      04:01    -----
UNI BRD D DATA    DATA    DATA    DATA    DATA    DATA
      TS 07    TS 08    TS 09    TS 10    TS 11    TS 12
      -----
DATA    DATA    DATA    DATA    DATA    DATA
      TS 13    TS 14    TS 15    TS 16    TS 17    TS 18
      -----
DATA    DATA    DATA    DATA    DATA    DATA
      TS 19    TS 20    TS 21    TS 22    TS 23    TS 24
      -----
DATA    DATA    DATA    DATA    DATA    DATA
      TS 25    TS 26    TS 27    TS 28    TS 29    TS 30
      -----
DATA    DATA    DATA    DATA    DATA    DATA
      TS 31
      -----
DATA

```

4. Configure timeslot allocation for port 1 of the main link module at location A:

```

Module : ML-2/E1
Required Timeslots For IO-01 :
CH-02 :
      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    BP  --  --  B1  --  --  --  --  --  --  --  --
Channel 02    --  --  --  --  --  --  --  --  --  --  --  --
Channel 03    --  --  --  --  --  --  --  --  --  --  --  --
Channel 04    --  --  --  --  --  --  --  --  --  --  --  --
Channel 05    --  --  --  --  --  --  --  --  --  --  --  --
Channel 06    --  --  --  --  --  --  --  --  --  --  --  --
Channel 07    --  --  --  --  --  --  --  --  --  --  --  --
Channel 08    --  --  --  --  --  --  --  --  --  --  --  --
Channel 09    --  --  --  --  --  --  --  --  --  --  --  --
Channel 10    --  --  --  --  --  --  --  --  --  --  --  --
Channel 11    --  --  --  --  --  --  --  --  --  --  --  --
Channel 12    --  --  --  --  --  --  --  --  --  --  --  --
Channel 13    --  --  --  --  --  --  --  --  --  --  --  --
Channel 14    --  --  --  --  --  --  --  --  --  --  --  --
Channel 15    --  --  --  --  --  --  --  --  --  --  --  --

```



Channel 16					
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06
04:01	-----	-----	-----	-----	-----
UNI BRD D	DATA	DATA	DATA	DATA	DATA
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 31					
-----					
DATA					

5. Configure HS-RN module at location B:

Module : HS-R

	Connect	Format	Rate				
	-----	-----	-----				
Port EX01 :	YES	SYNC	64 KBPS				
	CTS	RTS & DTR	Mode				
	---	-----	-----				
	ON	LOCAL	DCE				
	Oper Mode	ML Slot	ML Channel	Map Type	Start Ts		
	-----	-----	-----	-----	-----		-----
	UNI-BRD RX	IO-1	EX1	USER	N/A		
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06	TS 07	
YES	NO	NO	NO	NO	NO	NO	
TS 08	TS 09	TS 10	TS 11	TS 12	TS 13	TS 14	
NO	NO	NO	NO	NO	NO	NO	
TS 15	TS 16	TS 17	TS 18	TS 19	TS 20	TS 21	
NO	NO	NO	NO	NO	NO	NO	
TS 22	TS 23	TS 24	TS 25	TS 26	TS 27	TS 28	
NO	NO	NO	NO	NO	NO	NO	
TS 29	TS 30	TS 31					
NO	NO	NO					

6. Configure timeslot allocation for port 1 of the main link module at location B:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-01 :

```

	IO - 01	02	03	04	05	06	07	08	09	10	11	12
Channel 01	--	--	--	--	--	--	--	--	--	--	--	--
Channel 02	BP	--	--	--	--	--	--	--	--	--	--	--
Channel 03	--	--	--	--	--	--	--	--	--	--	--	--
Channel 04	--	--	--	--	--	--	--	--	--	--	--	--
Channel 05	--	--	--	--	--	--	--	--	--	--	--	--
Channel 06	--	--	--	--	--	--	--	--	--	--	--	--
Channel 07	--	--	--	--	--	--	--	--	--	--	--	--
Channel 08	--	--	--	--	--	--	--	--	--	--	--	--
Channel 09	--	--	--	--	--	--	--	--	--	--	--	--
Channel 10	--	--	--	--	--	--	--	--	--	--	--	--
Channel 11	--	--	--	--	--	--	--	--	--	--	--	--
Channel 12	--	--	--	--	--	--	--	--	--	--	--	--
Channel 13	--	--	--	--	--	--	--	--	--	--	--	--
Channel 14	--	--	--	--	--	--	--	--	--	--	--	--
Channel 15	--	--	--	--	--	--	--	--	--	--	--	--
Channel 16	--	--	--	--	--	--	--	--	--	--	--	--

TS 01	TS 02	TS 03	TS 04	TS 05	TS 06
-----	-----	-----	-----	-----	-----
UNI BRD D	DATA	DATA	DATA	DATA	DATA
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 31					
-----					
DATA					

7. Configure timeslot allocation for port 2 of the main link module at location B:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-02 :

```

	IO	01	02	03	04	05	06	07	08	09	10	11	12
Channel 01		BP	--	--	--	--	--	--	--	--	--	--	--
Channel 02		--	--	--	--	--	--	--	--	--	--	--	--
Channel 03		--	--	--	--	--	--	--	--	--	--	--	--
Channel 04		--	--	--	--	--	--	--	--	--	--	--	--
Channel 05		--	--	--	--	--	--	--	--	--	--	--	--
Channel 06		--	--	--	--	--	--	--	--	--	--	--	--
Channel 07		--	--	--	--	--	--	--	--	--	--	--	--
Channel 08		--	--	--	--	--	--	--	--	--	--	--	--
Channel 09		--	--	--	--	--	--	--	--	--	--	--	--
Channel 10		--	--	--	--	--	--	--	--	--	--	--	--
Channel 11		--	--	--	--	--	--	--	--	--	--	--	--
Channel 12		--	--	--	--	--	--	--	--	--	--	--	--
Channel 13		--	--	--	--	--	--	--	--	--	--	--	--
Channel 14		--	--	--	--	--	--	--	--	--	--	--	--
Channel 15		--	--	--	--	--	--	--	--	--	--	--	--
Channel 16		--	--	--	--	--	--	--	--	--	--	--	--

```

    TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  -----  -----  -----  -----  -----
UNI BRD D  DATA      DATA      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
-----  -----  -----  -----  -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----  -----  -----  -----  -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----  -----  -----  -----  -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----  -----  -----  -----  -----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
DATA

```

8. Configure HS-RN module at location C:

```

Module : HS-R
      Connect  Format  Rate
-----
Port EX01 : YES      SYNC   64 KBPS
           CTS  RTS & DTR  Mode
           ---
           ON   LOCAL    DCE
Oper Mode  ML Slot  ML Channel  Map Type  Start Ts
-----
UNI-BRD RX  IO-1    EX1         USER      N/A
TS 01  TS 02  TS 03  TS 04  TS 05  TS 06  TS 07
YES      NO      NO      NO      NO      NO      NO
TS 08  TS 09  TS 10  TS 11  TS 12  TS 13  TS 14
NO      NO      NO      NO      NO      NO      NO
TS 15  TS 16  TS 17  TS 18  TS 19  TS 20  TS 21
NO      NO      NO      NO      NO      NO      NO
TS 22  TS 23  TS 24  TS 25  TS 26  TS 27  TS 28
NO      NO      NO      NO      NO      NO      NO
TS 29  TS 30  TS 31
NO      NO      NO
    
```

9. Configure timeslot allocation for port 1 of the main link module at location C:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-02 :

```

	IO -	01	02	03	04	05	06	07	08	09	10	11	12
Channel 01		BP	--	--	--	--	--	--	--	--	--	--	--
Channel 02		--	--	--	--	--	--	--	--	--	--	--	--
Channel 03		--	--	--	--	--	--	--	--	--	--	--	--
Channel 04		--	--	--	--	--	--	--	--	--	--	--	--
Channel 05		--	--	--	--	--	--	--	--	--	--	--	--
Channel 06		--	--	--	--	--	--	--	--	--	--	--	--
Channel 07		--	--	--	--	--	--	--	--	--	--	--	--
Channel 08		--	--	--	--	--	--	--	--	--	--	--	--
Channel 09		--	--	--	--	--	--	--	--	--	--	--	--
Channel 10		--	--	--	--	--	--	--	--	--	--	--	--
Channel 11		--	--	--	--	--	--	--	--	--	--	--	--
Channel 12		--	--	--	--	--	--	--	--	--	--	--	--
Channel 13		--	--	--	--	--	--	--	--	--	--	--	--
Channel 14		--	--	--	--	--	--	--	--	--	--	--	--
Channel 15		--	--	--	--	--	--	--	--	--	--	--	--
Channel 16		--	--	--	--	--	--	--	--	--	--	--	--

TS 01	TS 02	TS 03	TS 04	TS 05	TS 06
-----	-----	-----	-----	-----	-----
UNI BRD D	DATA	DATA	DATA	DATA	DATA
TS 07	TS 08	TS 09	TS 10	TS 11	TS 12
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 13	TS 14	TS 15	TS 16	TS 17	TS 18
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 19	TS 20	TS 21	TS 22	TS 23	TS 24
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 25	TS 26	TS 27	TS 28	TS 29	TS 30
-----	-----	-----	-----	-----	-----
DATA	DATA	DATA	DATA	DATA	DATA
TS 31					
-----					
DATA					

10. Configure HS-RN module at location D:

```

Module : HS-R
      Connect  Format  Rate
-----
Port EX01 : YES      SYNC   64 KBPS
           CTS  RTS & DTR  Mode
           ---
           ON   LOCAL      DCE
Oper Mode   ML Slot   ML Channel  Map Type   Start Ts
-----
UNI-BRD RX  IO-1      EX1         USER      N/A
TS 01   TS 02   TS 03   TS 04   TS 05   TS 06   TS 07
YES      NO      NO      NO      NO      NO      NO
TS 08   TS 09   TS 10   TS 11   TS 12   TS 13   TS 14
NO      NO      NO      NO      NO      NO      NO
TS 15   TS 16   TS 17   TS 18   TS 19   TS 20   TS 21
NO      NO      NO      NO      NO      NO      NO
TS 22   TS 23   TS 24   TS 25   TS 26   TS 27   TS 28
NO      NO      NO      NO      NO      NO      NO
TS 29   TS 30   TS 31
NO      NO      NO
    
```

11. Configure timeslot allocation for port 1 of the main link module at location D:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-02 :

```

	IO	01	02	03	04	05	06	07	08	09	10	11	12
Channel 01		BP	--	--	--	--	--	--	--	--	--	--	--
Channel 02		--	--	--	--	--	--	--	--	--	--	--	--
Channel 03		--	--	--	--	--	--	--	--	--	--	--	--
Channel 04		--	--	--	--	--	--	--	--	--	--	--	--
Channel 05		--	--	--	--	--	--	--	--	--	--	--	--
Channel 06		--	--	--	--	--	--	--	--	--	--	--	--
Channel 07		--	--	--	--	--	--	--	--	--	--	--	--
Channel 08		--	--	--	--	--	--	--	--	--	--	--	--
Channel 09		--	--	--	--	--	--	--	--	--	--	--	--
Channel 10		--	--	--	--	--	--	--	--	--	--	--	--
Channel 11		--	--	--	--	--	--	--	--	--	--	--	--
Channel 12		--	--	--	--	--	--	--	--	--	--	--	--
Channel 13		--	--	--	--	--	--	--	--	--	--	--	--
Channel 14		--	--	--	--	--	--	--	--	--	--	--	--
Channel 15		--	--	--	--	--	--	--	--	--	--	--	--
Channel 16		--	--	--	--	--	--	--	--	--	--	--	--

```

    TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  -----  -----  -----  -----  -----
UNI BRD D  DATA      DATA      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
DATA

```

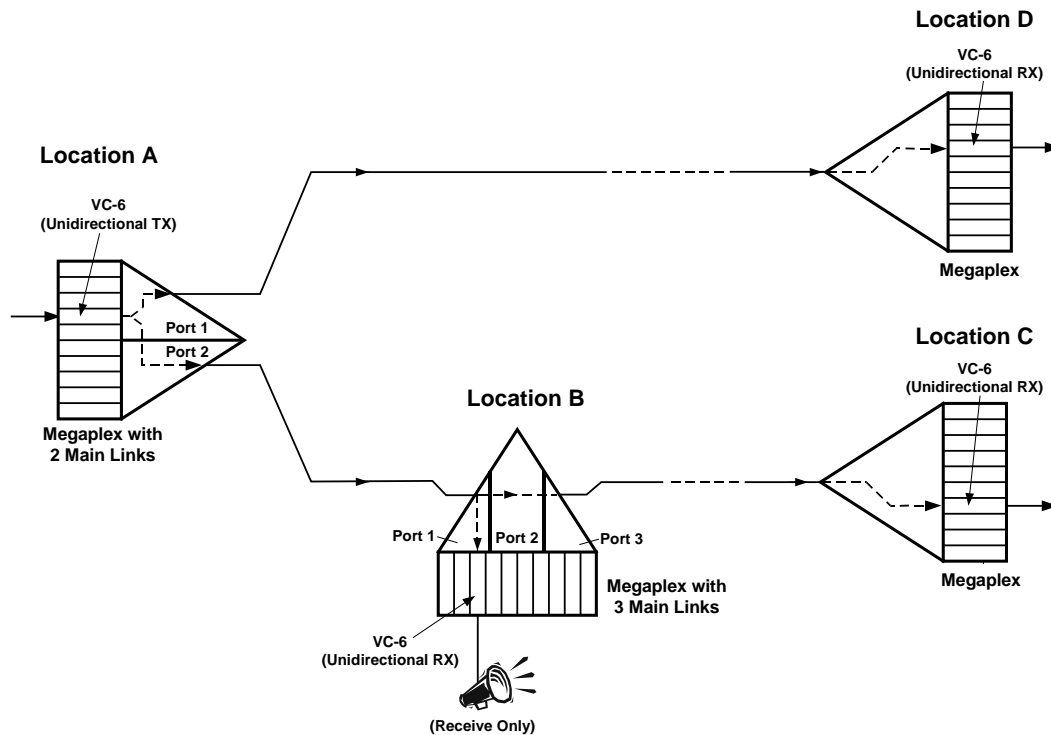
This completes the configuration activities for the unidirectional broadcast application shown in [Figure 9-13](#).



## Unidirectional Broadcast Applications for Voice Modules

The unidirectional broadcast mode enables a user at a central location to send messages to users connected to remote Megaplex units (simplex communication), while using only one main link timeslot. In this mode, any message is simultaneously heard by all the unidirectional users, but none of them can answer.

This capability is achieved by separating the handling of the receive and transmit paths in the timeslot assigned for the unidirectional channels, as shown by the dashed lines within the Megaplex units in *Figure 9-15*.



*Figure 9-15. Typical Unidirectional Application for Voice Modules*

*Figure 9-15* shows a system configuration, similar to the system configuration shown in *Figure 9-13*. Refer to the *Unidirectional Broadcast Applications for Data Modules* section above for a description of the routing process.

## Bidirectional Broadcast Mode Applications – Data Modules

The bidirectional broadcast mode enables a user at a central location to communicate half-duplex with several users connected to remote Megaplex units. *Figure 9-16* shows a network topology which uses the bidirectional broadcast capability.

The broadcast capability is achieved by separating the handling of the receive and transmit paths for the timeslots assigned for the broadcast channels, as shown by the dashed lines within the Megaplex units in *Figure 9-16*.

The user at the central location is configured to use the regular (bidirectional) mode, and therefore it can both transmit and receive. The other users are configured to use the bidirectional broadcast receive (BID-BRD-RX) mode: this mode is similar to the unidirectional receive mode, except that at any time one of

these users (and only one) can transmit to (and be received by) user A. This mode of operation is used in polled applications.

In the application shown in *Figure 9-16*, the handling of the signals generated by user A is similar to that for the unidirectional transmit mode described above. The difference is that each broadcast user can insert its signal in the receive timeslot that reaches user A (instead of the signal bypassed from the other link). The change in routing is controlled by the RTS signal in the data connector of the HS-RN module:

- When the RTS signal is not active (idle state), the receive timeslot is bypassed from link B to link A, and continues toward user A.
- When the RTS signal is asserted, the receive timeslot of link B is disconnected from link A, and the transmit path of the local broadcast user is connected to link A.

Thus, user A can request any user to answer, and that user can assert its RTS line and thus connect to user A. At any time, only one user may transmit toward user A (if more than one user transmits, only the user closest to location A will actually be received). When using the bidirectional broadcast receive mode, it is necessary to instruct each main link port how to handle the traffic flow and signaling information. This is performed by defining the timeslot type, as part of the *DEF TS* command.

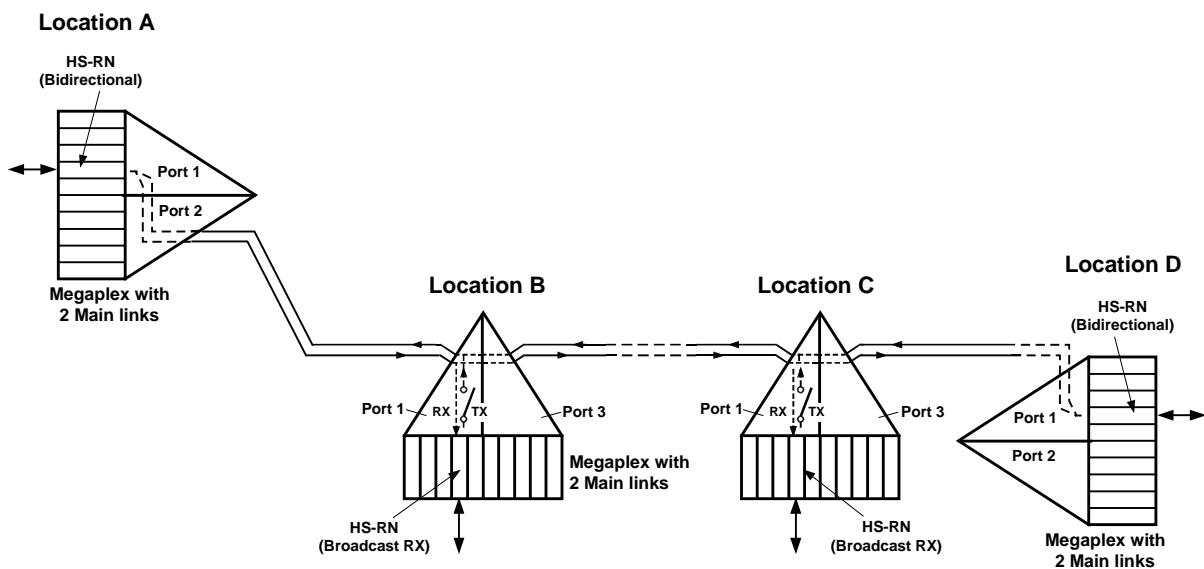


Figure 9-16. Typical Bidirectional Broadcast Application for Data Modules

### Configuration Example – Bidirectional Broadcast Mode

1. Configure all the main link ports as follows:

```

Module : MTML-2/E1

Port EX1 Parameters
-----

Service      Logical Link ID      Interface ID      Startup Mode      Reprovision
-----
LEGACY       N/A                  N/A              N/A              N/A

Connect      Frame                Sig. Profile      Idle Code         CGA                Redundancy
-----
YES          G.732S              (1)              FF                NONE              NONE

Rx Gain      Voice OOS            Data OOS          OOS Signaling     Restoration Time
-----
SHORT HAUL  00                  00              FORCED IDLE       CCITT

Inband Management      Inband Management Rate      Routing Protocol
-----
OFF                    N/A                          N/A
    
```

12. Configure HS-RN module at location A:

```

Module : HS-R

Connect  Format  Rate
-----
Port EX01 : YES    SYNC   64 KBPS
           CTS  RTS & DTR  Mode
           ---
           ON   LOCAL   DCE
Oper Mode  ML Slot  ML Channel  Map Type  Start Ts
-----
BI-DIR    IO-1    EX1         N/A       N/A
    
```

## 13. Configure timeslot allocation for port 1 of the main link module at location A:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-01 :
      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    -- -- -- 01 -- -- -- -- -- -- -- --
Channel 02    -- -- -- -- -- -- -- -- -- -- -- --
Channel 03    -- -- -- -- -- -- -- -- -- -- -- --
Channel 04    -- -- -- -- -- -- -- -- -- -- -- --
Channel 05    -- -- -- -- -- -- -- -- -- -- -- --
Channel 06    -- -- -- -- -- -- -- -- -- -- -- --
Channel 07    -- -- -- -- -- -- -- -- -- -- -- --
Channel 08    -- -- -- -- -- -- -- -- -- -- -- --
Channel 09    -- -- -- -- -- -- -- -- -- -- -- --
Channel 10    -- -- -- -- -- -- -- -- -- -- -- --
Channel 11    -- -- -- -- -- -- -- -- -- -- -- --
Channel 12    -- -- -- -- -- -- -- -- -- -- -- --
Channel 13    -- -- -- -- -- -- -- -- -- -- -- --
Channel 14    -- -- -- -- -- -- -- -- -- -- -- --
Channel 15    -- -- -- -- -- -- -- -- -- -- -- --
Channel 16    -- -- -- -- -- -- -- -- -- -- -- --
      TS 01    TS 02    TS 03    TS 04    TS 05    TS 06
      04:01    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 07    TS 08    TS 09    TS 10    TS 11    TS 12
      -----    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 13    TS 14    TS 15    TS 16    TS 17    TS 18
      -----    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 19    TS 20    TS 21    TS 22    TS 23    TS 24
      -----    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 25    TS 26    TS 27    TS 28    TS 29    TS 30
      -----    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 31
      -----
      DATA

```

14. Configure HS-RN module at location B:

```

Module : HS-R
      Connect  Format  Rate
-----  -----  -----
Port EX01 : YES      SYNC   64 KBPS
          CTS  RTS & DTR  Mode
          ---  ---  ---
          ON   LOCAL    DCE
Oper Mode  ML Slot  ML Channel  Map Type  Start Ts
-----  -----  -----  -----  -----
BID-BRD RX  IO-1      EX1          USER      1
TS 01  TS 02  TS 03  TS 04  TS 05  TS 06  TS 07
YES      NO      NO      NO      NO      NO      NO
TS 08  TS 09  TS 10  TS 11  TS 12  TS 13  TS 14
NO      NO      NO      NO      NO      NO      NO
TS 15  TS 16  TS 17  TS 18  TS 19  TS 20  TS 21
NO      NO      NO      NO      NO      NO      NO
TS 22  TS 23  TS 24  TS 25  TS 26  TS 27  TS 28
NO      NO      NO      NO      NO      NO      NO
TS 29  TS 30  TS 31
NO      NO      NO
    
```

## 15. Configure timeslot allocation for port 1 of the main link module at location B:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-01 :

```

	IO	01	02	03	04	05	06	07	08	09	10	11	12
Channel 01	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 02	BP	--	--	--	--	--	--	--	--	--	--	--	--
Channel 03	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 04	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 05	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 06	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 07	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 08	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 09	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 10	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 11	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 12	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 13	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 14	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 15	--	--	--	--	--	--	--	--	--	--	--	--	--
Channel 16	--	--	--	--	--	--	--	--	--	--	--	--	--

```

      TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
-----
BI BRD D  DATA      DATA      DATA      DATA      DATA      DATA
TS 07     TS 08     TS 09     TS 10     TS 11     TS 12
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13     TS 14     TS 15     TS 16     TS 17     TS 18
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19     TS 20     TS 21     TS 22     TS 23     TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25     TS 26     TS 27     TS 28     TS 29     TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
DATA

```

16. Configure timeslot allocation for port 2 of the main link module at location B:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-02 :
  IO - 01 02 03 04 05 06 07 08 09 10 11 12
Channel 01  BP  --  --  --  --  --  --  --  --  --  --  --
Channel 02  --  --  --  --  --  --  --  --  --  --  --  --
Channel 03  --  --  --  --  --  --  --  --  --  --  --  --
Channel 04  --  --  --  --  --  --  --  --  --  --  --  --
Channel 05  --  --  --  --  --  --  --  --  --  --  --  --
Channel 06  --  --  --  --  --  --  --  --  --  --  --  --
Channel 07  --  --  --  --  --  --  --  --  --  --  --  --
Channel 08  --  --  --  --  --  --  --  --  --  --  --  --
Channel 09  --  --  --  --  --  --  --  --  --  --  --  --
Channel 10  --  --  --  --  --  --  --  --  --  --  --  --
Channel 11  --  --  --  --  --  --  --  --  --  --  --  --
Channel 12  --  --  --  --  --  --  --  --  --  --  --  --
Channel 13  --  --  --  --  --  --  --  --  --  --  --  --
Channel 14  --  --  --  --  --  --  --  --  --  --  --  --
Channel 15  --  --  --  --  --  --  --  --  --  --  --  --
Channel 16  --  --  --  --  --  --  --  --  --  --  --  --
  TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
01:01TS01  -----
BI BRD D   DATA      DATA      DATA      DATA      DATA
TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
-----
DATA      DATA      DATA      DATA      DATA      DATA
TS 31
-----
DATA
    
```

## 17. Configure HS-RN module at location C:

Module : HS-R							
		Connect	Format	Rate			
		-----	-----	-----			
Port EX01 :	YES		SYNC	64 KBPS			
	CTS	RTS & DTR		Mode			
	---	-----		-----			
	ON	LOCAL		DCE			
	Oper Mode	ML	Slot	ML	Channel	Map Type	Start Ts
	-----	-----	-----	-----	-----	-----	-----
	BI-BRD RX	IO-1		EX1		USER	N/A
TS 01	TS 02	TS 03	TS 04	TS 05	TS 06	TS 07	
YES	NO	NO	NO	NO	NO	NO	
TS 08	TS 09	TS 10	TS 11	TS 12	TS 13	TS 14	
NO	NO	NO	NO	NO	NO	NO	
TS 15	TS 16	TS 17	TS 18	TS 19	TS 20	TS 21	
NO	NO	NO	NO	NO	NO	NO	
TS 22	TS 23	TS 24	TS 25	TS 26	TS 27	TS 28	
NO	NO	NO	NO	NO	NO	NO	
TS 29	TS 30	TS 31					
NO	NO	NO					



18. Configure timeslot allocation for port 1 of the main link module at location C:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-01 :
  IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01  --  --  --  --  --  --  --  --  --  --  --  --
Channel 02  BP  --  --  --  --  --  --  --  --  --  --  --
Channel 03  --  --  --  --  --  --  --  --  --  --  --  --
Channel 04  --  --  --  --  --  --  --  --  --  --  --  --
Channel 05  --  --  --  --  --  --  --  --  --  --  --  --
Channel 06  --  --  --  --  --  --  --  --  --  --  --  --
Channel 07  --  --  --  --  --  --  --  --  --  --  --  --
Channel 08  --  --  --  --  --  --  --  --  --  --  --  --
Channel 09  --  --  --  --  --  --  --  --  --  --  --  --
Channel 10  --  --  --  --  --  --  --  --  --  --  --  --
Channel 11  --  --  --  --  --  --  --  --  --  --  --  --
Channel 12  --  --  --  --  --  --  --  --  --  --  --  --
Channel 13  --  --  --  --  --  --  --  --  --  --  --  --
Channel 14  --  --  --  --  --  --  --  --  --  --  --  --
Channel 15  --  --  --  --  --  --  --  --  --  --  --  --
Channel 16  --  --  --  --  --  --  --  --  --  --  --  --
  TS 01      TS 02      TS 03      TS 04      TS 05      TS 06
  -----
  BI BRD D   DATA      DATA      DATA      DATA      DATA
  TS 07      TS 08      TS 09      TS 10      TS 11      TS 12
  -----
  DATA      DATA      DATA      DATA      DATA      DATA
  TS 13      TS 14      TS 15      TS 16      TS 17      TS 18
  -----
  DATA      DATA      DATA      DATA      DATA      DATA
  TS 19      TS 20      TS 21      TS 22      TS 23      TS 24
  -----
  DATA      DATA      DATA      DATA      DATA      DATA
  TS 25      TS 26      TS 27      TS 28      TS 29      TS 30
  -----
  DATA      DATA      DATA      DATA      DATA      DATA
  TS 31
  -----
  DATA
  
```

## 19. Configure timeslot allocation for port 2 of the main link module at location C:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-02 :

```

	IO	01	02	03	04	05	06	07	08	09	10	11	12
Channel 01		BP	--	--	--	--	--	--	--	--	--	--	--
Channel 02		--	--	--	--	--	--	--	--	--	--	--	--
Channel 03		--	--	--	--	--	--	--	--	--	--	--	--
Channel 04		--	--	--	--	--	--	--	--	--	--	--	--
Channel 05		--	--	--	--	--	--	--	--	--	--	--	--
Channel 06		--	--	--	--	--	--	--	--	--	--	--	--
Channel 07		--	--	--	--	--	--	--	--	--	--	--	--
Channel 08		--	--	--	--	--	--	--	--	--	--	--	--
Channel 09		--	--	--	--	--	--	--	--	--	--	--	--
Channel 10		--	--	--	--	--	--	--	--	--	--	--	--
Channel 11		--	--	--	--	--	--	--	--	--	--	--	--
Channel 12		--	--	--	--	--	--	--	--	--	--	--	--
Channel 13		--	--	--	--	--	--	--	--	--	--	--	--
Channel 14		--	--	--	--	--	--	--	--	--	--	--	--
Channel 15		--	--	--	--	--	--	--	--	--	--	--	--
Channel 16		--	--	--	--	--	--	--	--	--	--	--	--

```

TS 01          TS 02          TS 03          TS 04          TS 05          TS 06
01:01TS01     -----
BI BRD D      DATA          DATA          DATA          DATA          DATA
TS 07          TS 08          TS 09          TS 10          TS 11          TS 12
-----
DATA          DATA          DATA          DATA          DATA          DATA
TS 13          TS 14          TS 15          TS 16          TS 17          TS 18
-----
DATA          DATA          DATA          DATA          DATA          DATA
TS 19          TS 20          TS 21          TS 22          TS 23          TS 24
-----
DATA          DATA          DATA          DATA          DATA          DATA
TS 25          TS 26          TS 27          TS 28          TS 29          TS 30
-----
DATA          DATA          DATA          DATA          DATA          DATA
TS 31
-----
DATA

```

## 20. Configure HS-RN module at location D:

```

Module : HS-R

```

	Connect	Format	Rate		
Port EX01 :	YES	SYNC	64 KBPS		
	CTS	RTS & DTR	Mode		
	ON	LOCAL	DCE		
	Oper Mode	ML Slot	ML Channel	Map Type	Start Ts
	BI-DIR	IO-1	EX1	N/A	N/A

21. Configure timeslot allocation for port 1 of the main link module at location D:

```

Module : MTML-2/E1
Required Timeslots For IO-01 :
CH-01 :
      IO - 01  02  03  04  05  06  07  08  09  10  11  12
Channel 01    -- -- -- 01 -- -- -- -- -- -- -- --
Channel 02    -- -- -- -- -- -- -- -- -- -- -- --
Channel 03    -- -- -- -- -- -- -- -- -- -- -- --
Channel 04    -- -- -- -- -- -- -- -- -- -- -- --
Channel 05    -- -- -- -- -- -- -- -- -- -- -- --
Channel 06    -- -- -- -- -- -- -- -- -- -- -- --
Channel 07    -- -- -- -- -- -- -- -- -- -- -- --
Channel 08    -- -- -- -- -- -- -- -- -- -- -- --
Channel 09    -- -- -- -- -- -- -- -- -- -- -- --
Channel 10    -- -- -- -- -- -- -- -- -- -- -- --
Channel 11    -- -- -- -- -- -- -- -- -- -- -- --
Channel 12    -- -- -- -- -- -- -- -- -- -- -- --
Channel 13    -- -- -- -- -- -- -- -- -- -- -- --
Channel 14    -- -- -- -- -- -- -- -- -- -- -- --
Channel 15    -- -- -- -- -- -- -- -- -- -- -- --
Channel 16    -- -- -- -- -- -- -- -- -- -- -- --
      TS 01    TS 02    TS 03    TS 04    TS 05    TS 06
      04:01    -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 07    TS 08    TS 09    TS 10    TS 11    TS 12
      -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 13    TS 14    TS 15    TS 16    TS 17    TS 18
      -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 19    TS 20    TS 21    TS 22    TS 23    TS 24
      -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 25    TS 26    TS 27    TS 28    TS 29    TS 30
      -----    -----    -----    -----    -----
      DATA    DATA    DATA    DATA    DATA    DATA
      TS 31
      -----
      DATA
  
```

This completes the configuration activities for the bidirectional broadcast application shown in *Figure 9-16*.

### Bidirectional Broadcast Mode Applications – Voice Modules

For voice modules, the only difference is in the method used to activate the transmit path, which is controlled by the M signal of the voice channel configured for the bidirectional broadcast mode. For example, at location B in the system configuration shown in *Figure 9-17*:

- When the M signal of the local voice channel is not active (idle, or on-hook, state), the receive timeslot is bypassed from link 2 to link 1, and continues toward user A.

- When the M signal is active (off-hook state), the receive timeslot of link 2 is disconnected from link 1, and the transmit path of the local broadcast user is connected to link A.

Thus, the central user A can request any remote user to answer, and that user can lift the handset and connect to user A. At any time, only one user can speak with user A (if more than one user answers, only the user closest to location A will actually be heard).

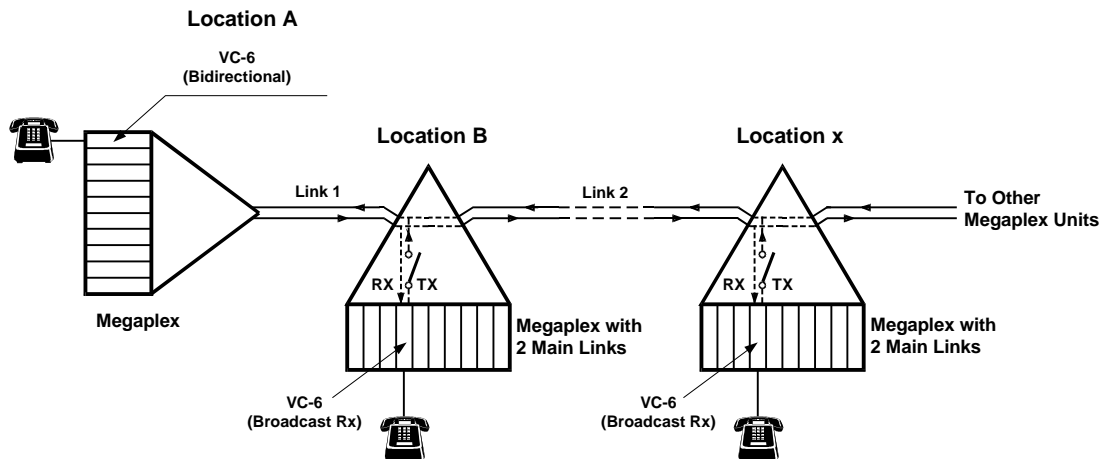


Figure 9-17. Typical Bidirectional Broadcast Application for Voice Modules

The broadcast mode is currently supported only by the E&M and FXS modules.

## Section II TDMoIP Applications

This section provides additional information and considerations which are specific to TDMoIP applications.

The information appearing in this section supplements the information presented in *Section I*.

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### 9.6 TDMoIP Applications

#### TDMoIP Applications

##### Basic TDMoIP Applications

A Megaplex chassis equipped with ML-IP modules is capable of providing external links for the modules installed in it through an IP network, using the TDMoIP (TDM over IP) protocol. Moreover, a Megaplex chassis can simultaneously connect to both TDM and IP networks and therefore can provide a convenient junction node between the two services.

The connection to the IP network is made through 10/100BaseT or 100Base-FX Ethernet ports (in accordance with order). For flexibility, each ML-IP module has three such ports, interconnected through an internal Ethernet switch: two of these ports serve as uplink ports and the third enables other user equipment to connect to the uplink, without requiring additional equipment. Each port can be independently configured with respect to data rate (10 or 100 Mbps) and operating mode (half-duplex or full-duplex).

ML-IP modules provide the same intra-chassis routing flexibility as any other Megaplex main link module. This flexibility is supplemented by fully independent routing of multiple user-programmed timeslot bundles to different IP destinations: up to 24 destinations per ML-IP module without channel-associated signaling (CAS), and up to 14 destinations with CAS. By installing additional ML-IP modules, a Megaplex chassis can support up to 120 bundles.

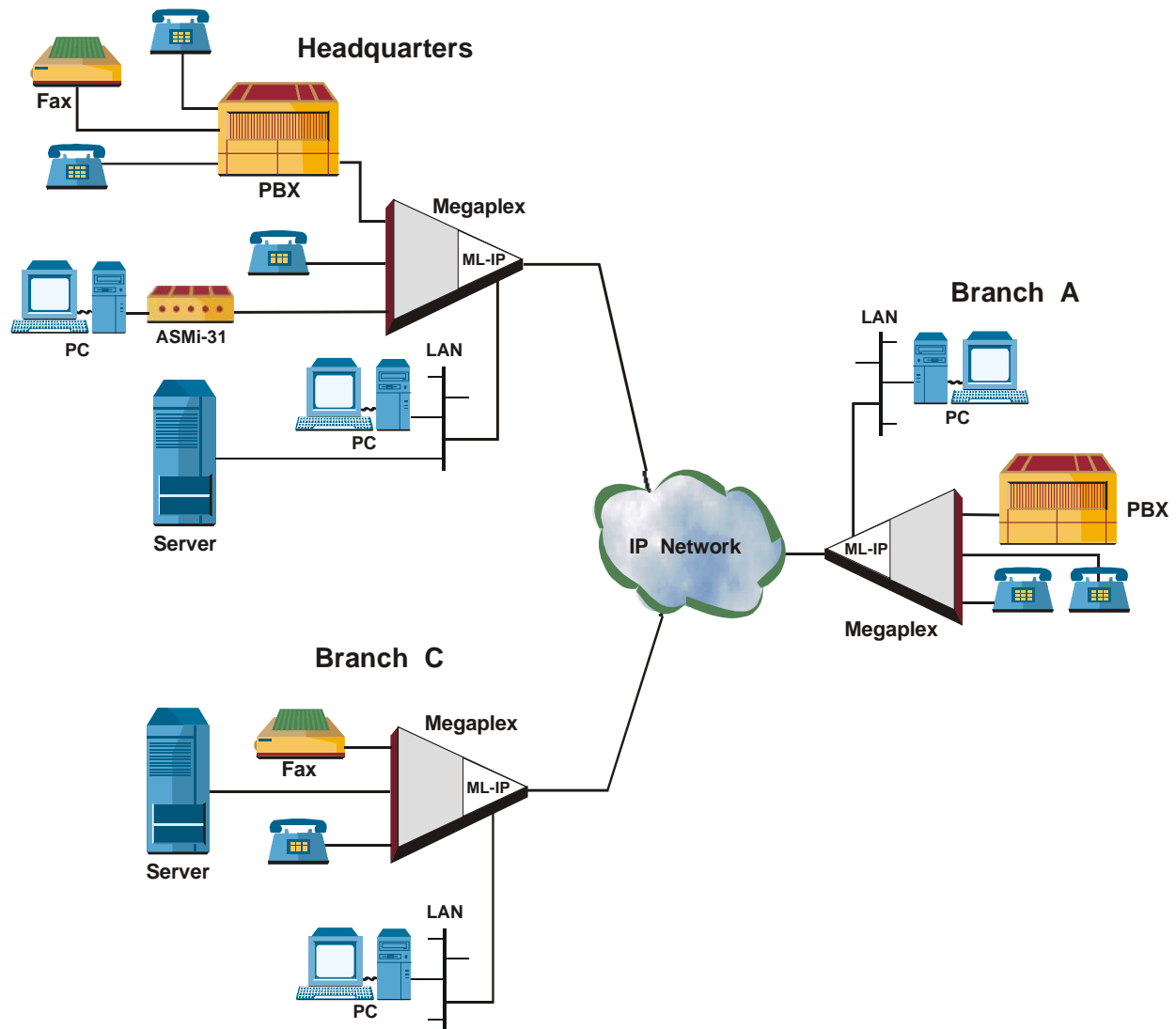
The ML-IP module supports all the types of I/O modules that can be installed in Megaplex units, and can also provide support for the R2 signaling protocol. An internal non-blocking cross-connect matrix provides full control over internal routing.

The ML-IP module can use the nodal chassis clock (derived by other main link modules), but can also provide the chassis clock and timing signals for the other modules installed in the same chassis, using the adaptive timing mode (timing recovered from the IP traffic).

To increase availability for critical services, bundle redundancy can be used between ML-IP modules over the IP network (see *Redundancy* section below). Moreover, ML-IP modules can also operate in the ring redundancy mode, which enhances availability by providing redundant paths between nodes.

*Figure 9-18* shows a basic application for Megaplex units equipped with ML-IP modules, which illustrates their wide range of capabilities.

In the application shown in *Figure 9-18*, Megaplex units are used to build a corporate private network. In this network, the headquarters provides centralized PBX and data services to the branch offices. At each location, the connection to the IP network is made through a single ML-IP uplink port: this port combines the traffic generated by the ML-IP module with the external traffic generated by the office LAN. This is achieved simply by connecting the LAN to the user port of the ML-IP module (even when the LAN rates differ): the external traffic is sent to the network through the internal Ethernet switch of the module.



*Figure 9-18. Basic Application for Megaplex with ML-IP Modules*

### Maximizing Utilization of Connection to IP Network

The Ethernet switch interconnecting the three external Ethernet ports of ML-IP modules permits independent selection of each port operating mode, and can also be used to reduce the infrastructure costs (that is, hardware to be provided for links to the IP network, and operating costs for the links).

*Figure 9-19* illustrates the approach used to maximize the utilization of the link to the IP network: daisy-chaining multiple Megaplex units.

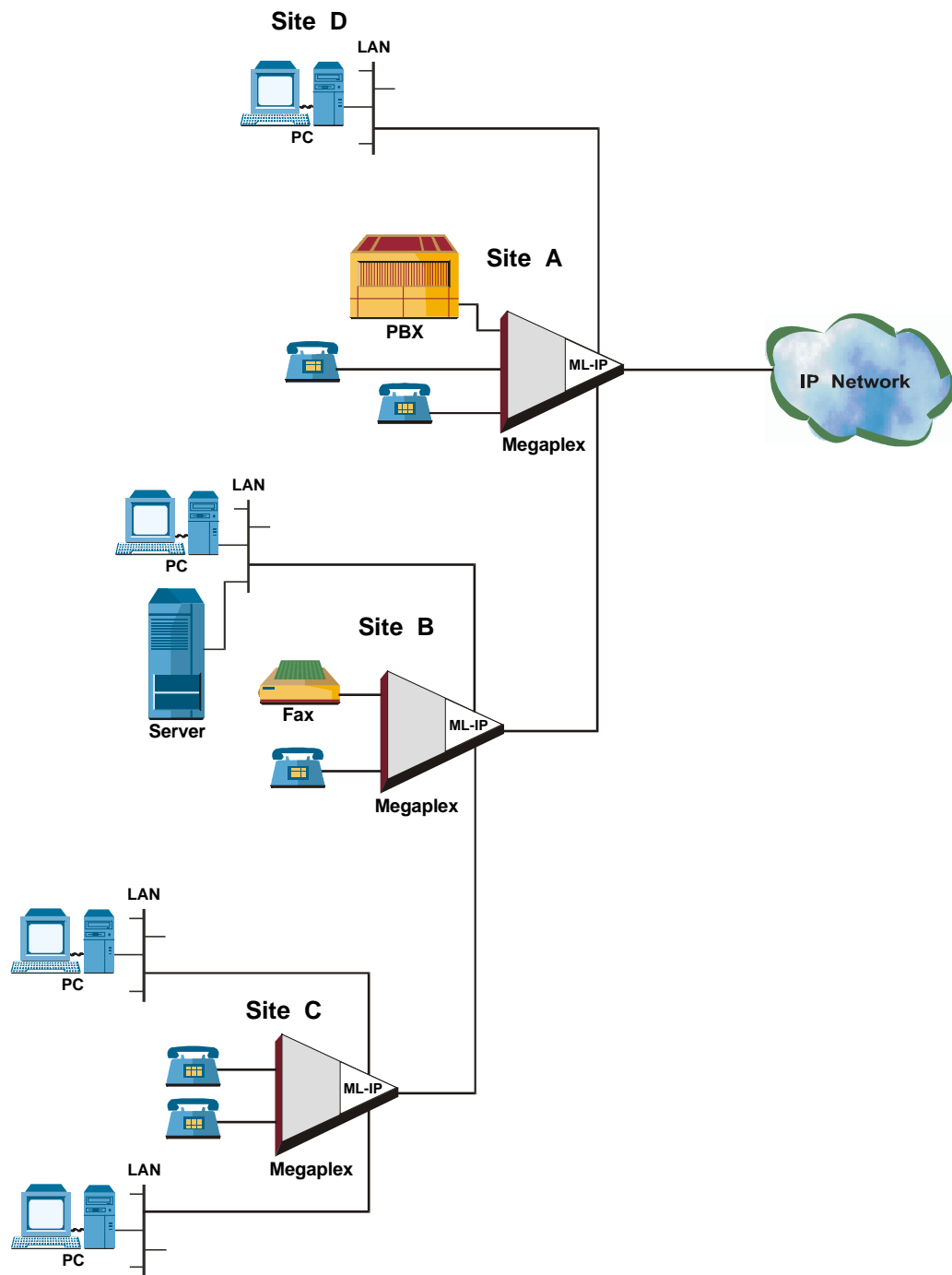


Figure 9-19. Maximizing Utilization of Connection to IP Network

This configuration minimizes the number of independent connections needed to access the IP network: instead of installing separate links from each site to several IP network access points, intra-campus or inter-site links are used to reach a Megaplex unit connected to the IP network through a 100Base-FX link.

To ensure satisfactory performance of the system, it is necessary to evaluate the resulting traffic load on both the LAN (Ethernet) and IP segments of the connection. [Appendix B](#) provides a description of the factors affecting the LAN traffic load generated by TDMoIP users, as well as methods for optimizing the performance.

The discussion in [Appendix B](#) indicates that for any given payload rate (for example, number of channels to be transported over the IP network), the main user-selectable factor is the number of TDM bytes per packet. Other, less significant factors, are CAS support, and the use of VLAN tagging. The maximum transport capacity requirements for the minimum and maximum numbers of TDM bytes per frame are given in [Table 9-1](#).

*Table 9-1. Maximum Transport Capacity Requirements*

TDM Bytes per Frame	Maximum Required IP Capacity		Maximum Required LAN Transport Capacity			
			Without VLAN Tagging		With VLAN Tagging	
	TDM Port	Module	TDM Port	Module	TDM Port	Module
48	3126 kbps	6252 kbps	4815 kbps	9630 kbps	4995 kbps	9990 kbps
384	2175 kbps	4350 kbps	2380 kbps	4760 kbps	2402 kbps	4804 kbps

[Table 9-1](#) provides two types of information:

- The maximum LAN transport capacity required to support a single internal TDM port.  
When considering the LAN capacity needed to support both internal ports of an ML-IP module, the values are doubled.
- The maximum IP transport and processing capacity needed to support a single TDM internal port, and the values for both internal ports. These values are useful for planning the maximum load on IP routers handling TDMoIP traffic.

The values appearing in [Table 9-1](#) should be used for conservative design, which means that full flexibility in changing bundle configuration is available without having to reconsider the LAN transport capacity.

Other factors that must be considered when evaluating the ML-IP LAN transport capacity requirements are:

- Bandwidth needed for transferring the traffic received from other sources (that is, the traffic received through the other ML-IP NET port and/or USER port).  
In particular, it is necessary to take into consideration the bandwidth needed by other equipment connected to the same LAN, when the LAN to which the ML-IP ports are connected is shared with additional users.
- Bandwidth needed for management traffic, when the CL module uses the link provided by the ML-IP module.

## Redundancy

The ML-IP module supports redundancy at the bundle level, i.e., two bundles defined on the same module, or on different ML-IP modules, can operate as a redundant pair. To use this capability for traffic protection, the same timeslot (or group of timeslots) are grouped and transmitted on two different bundles simultaneously. This provides a functionality similar to the parallel transmit redundancy used for TDM fractional E1 and T1 links: if the active bundle stream fails, Megaplex will start using the other bundle stream.



Moreover, it is possible to provide redundancy between ML-IP modules and other TDM main link modules: this enables using ML-IP modules to backup the traffic carried by circuit-switched E1 and T1 links by means of the packet-switched IP network.

The ML-IP modules also support the RAD proprietary ring redundancy mode.

The available redundancy options are as follows:

- **Path redundancy** – the two bundles are on the same module, and the packets take different paths on the IP network. On the receive direction, the ML-IP converts only one of the packet streams into a TDM stream.
- **Link+Path redundancy** – the two bundles are on the same module, but on the different ports. The packets take different paths on the IP network. On the receive direction, the ML-IP converts only one of the packet streams into a TDM stream.
- **Module+Path redundancy** – the two bundles reside on different modules in the same chassis, and may or may not take different paths on the IP network. On the receive direction, each module converts the packet stream into a TDM stream, and the CL is responsible for forwarding only one of those streams to the Megaplex backplane.
- **Chassis/Site+Module+Path redundancy** – the two bundles reside on different modules installed in different chassis, possibly located at different sites. On the receive direction, if choosing one of the recovered TDM streams is required, it is performed by another module, depending on the specific application.

It is possible (and sometimes necessary) to combine two application types at the two ends of the IP link. Below are some possible combinations:

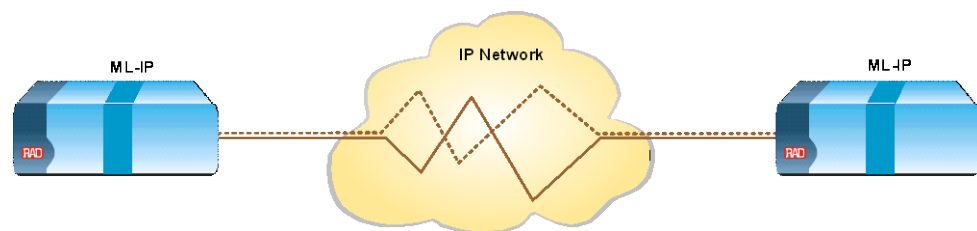
- Module+path redundancy at the central site versus path redundancy at the remote site
- Chassis redundancy at the central site versus module+path redundancy at the remote site (see [Figure 9-23](#)).

The available redundancy options (applications) are described below.

## IP Connection (Path) Redundancy

Although IP networks are generally robust, congestion and faults can cause the IP network performance to vary widely, to the point that it no longer enables transmission of TDMoIP traffic.

[Figure 9-20](#) shows the equipment configuration used to overcome IP network transmission problems with minimal investment.



*Figure 9-20. Use of IP Connection (Path) Redundancy*

In the configuration shown in *Figure 9-20*, two bundles are defined as a redundancy pair on the same ML-IP module. The two bundles are routed through the same Ethernet uplink port to the network, and therefore share the same path up to the edge switch providing access to the IP network.

Since both bundles are routed to the same destination, they both have the same IP address, but are tagged with different VLAN ID numbers or have different next-hop addresses. Therefore, they follow different routes within the IP network up to the exit switch, at which the other Megaplex is connected (in *Figure 9-20*, the two paths are represented by different line types). Obviously, for this redundancy approach to be effective, it is necessary to ensure that VLAN support is available within the whole IP network, or that the network includes multiple routers.

During normal conditions, the ML-IP module receives both bundles, but connects to the receive path only one of them.

In case a fault is detected, the ML-IP module automatically selects the other bundle. The decision to switch takes place within 50 msec, thereby rapid restoration of service is possible, even without disconnecting voice calls. Note however that the actual switching time cannot be shorter than the jitter buffer size; therefore, to permit fast (50 msec) redundancy switching, the jitter buffer size must be less than 50 msec.

The flip occurs if the system meets the following criteria:

- The active bundle has failed
- No alarms have been registered on the standby bundle
- The recovery period since last flip has elapsed.

These criteria are valid for the Path, Link+Path, and Module+Path redundancy types.

### **Physical Link and IP Connection (Link+Path) Redundancy**

The basic protection conferred by the configuration shown in *Figure 9-20* can be extended to include the whole transmission path between the two Megaplex units. This is achieved by connecting the two uplink ports of the same ML-IP module, via different links, to the IP network access point, as shown in *Figure 9-21*.

As in the previous configuration, both bundles have the same IP address, but are tagged with different VLAN ID numbers or have different next-hop addresses. The operation and protection characteristics of this redundancy configuration are similar to those described above.

Note that to prevent packet storming, this option requires the network be based on switches supporting VLAN tagging that can block untagged frames.

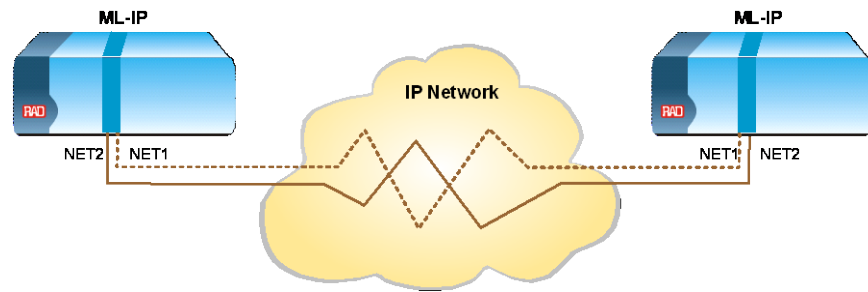


Figure 9-21. Physical Link and IP Connection (Link+Path) Redundancy

**Note**

To prevent the creation of loops, the external Ethernet switch to which the ML-IP Ethernet ports are connected must support either the spanning tree algorithm or use VLANs. If the switch does not support this algorithm, only one of the Ethernet ports can be connected to the external switch. This is sufficient for all the applications in which the additional ports are used for connecting user's equipment through other ML-IP modules (daisy-chaining configuration) and for connecting other user's equipment to the network through one of the ML-IP network Ethernet ports.

### Module, Link and IP Connection (Module+Path) Redundancy

The configuration shown in [Figure 9-21](#) can be extended to include protection for both the transmission paths and the ML-IP hardware. For this purpose, two ML-IP modules must be installed in the Megaplex units, in accordance with the configuration shown in [Figure 9-22](#).

**Note**

When two independent IP networks can be accessed, better protection is achieved by connecting, at each end, each ML-IP module to a different network.

In the configuration shown in [Figure 9-22](#), two different uplink ports, located on different ML-IP modules, are used. One of the bundles configured as a redundancy pair is defined on one ML-IP module, and the other bundle of the pair is defined on the other module.

The two modules are assigned different IP addresses. The traffic of each bundle is independently routed and processed within each ML-IP module, however at any time only one module applies the received payload on the TDM buses.

If a problem that requires redundancy switching is detected, a report is sent to the CL module installed in the same Megaplex chassis. The CL module then instructs the failed module to disconnect its traffic from the TDM buses and the other module to connect to the buses. This process takes place within a few seconds.

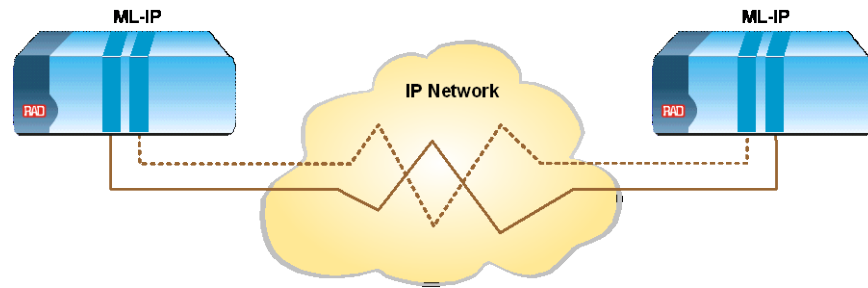


Figure 9-22. Module, Link and IP Connection (Module+Path) Redundancy

## Chassis (Site), Module, Link and IP Connection Redundancy

In these applications, the ML-IP modules must be installed in different chassis, possibly located at different sites. This type of redundancy is usually combined with another redundancy option. For example, in the configuration shown in [Figure 9-23](#), central site with chassis redundancy is operating opposite the remote sites with path+module redundancy.

The chassis redundancy is configured by setting "Redundancy"=Yes and "Redundancy Bundle"=None.

In the configuration shown in [Figure 9-23](#), two different ML-IP uplink ports, located on different chassis/sites, are used. One of the bundles configured as a redundancy pair is defined on one ML-IP module located on Site A, while the other bundle of the pair is defined on the another ML-IP module located on Site B.

In the case of 1+1 redundancy, no special behavior is required from the modules at sites A and B. In the case of 1:1 redundancy, the active bundle is determined at site C according to redundancy application used at this site. In the case of 1:1 redundancy (see below) the Site C module(s) transmits OAM messages to sites A and B indicating the standby site not to transmit data.

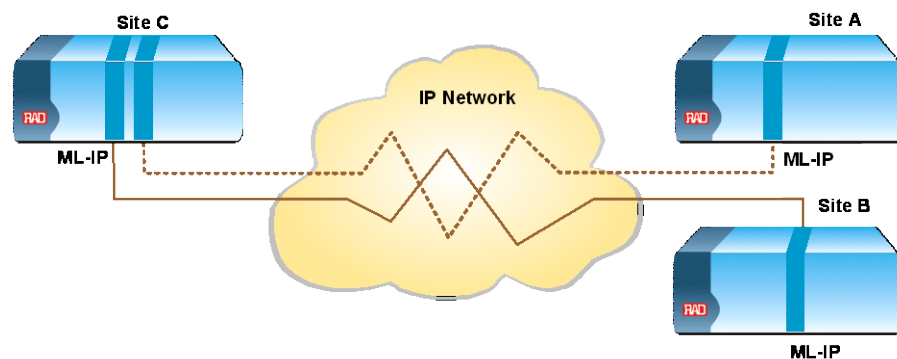


Figure 9-23. Chassis (Site), Module, Link and IP Connection Redundancy

## Redundancy Type

In each of the above applications, two types of redundancy are available:

- **1+1 Redundancy.** When this redundancy type is enabled, both bundles transmit data packets all the time, offering potentially faster recovery at the expense of doubling the bandwidth. This provides a functionality similar to the parallel transmit redundancy used for TDM fractional E1 and T1 links.

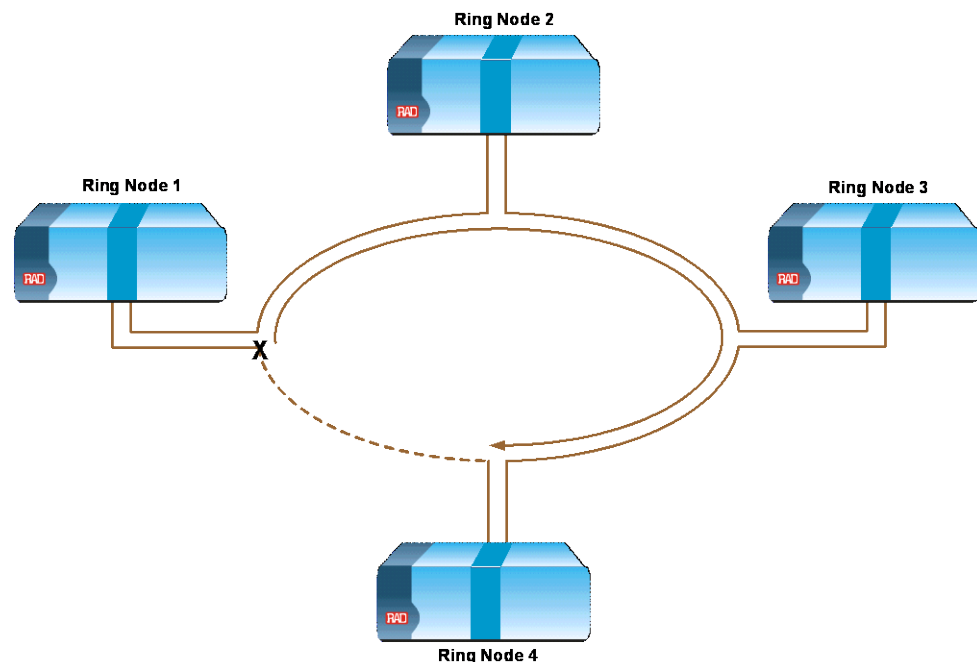
- **1:1 Redundancy.** When this redundancy type is enabled, only one of the bundles transmits and receives data packets. The other bundle transmits OAM packets to verify connectivity.

## Ring Redundancy

Ring redundancy, implemented by means of the RAD-proprietary RFER (resilient Fast Ethernet ring) protocol, provides protection for the Ethernet transmission path, and is especially suited for MAN and dark fiber applications.

When ring redundancy is enabled, the network topology is similar to that of a ring, and therefore it can propagate data either "clockwise" or "counterclockwise". Because of the Ethernet protocol characteristics, actually the ring cannot be closed: a pair of adjacent nodes on the ring keep the ring open by disconnecting an arbitrary ring segment, thereby preventing frames from making a full round trip.

*Figure 9-24* shows a basic ring topology; the arrow shows the path followed by frames exchanged between ring nodes 1 and 4 during normal operation, assuming that the blocked segment is between nodes 1 and 4.



*Figure 9-24. Basic Ring Redundancy Topology – Data Flow during Normal Operation*

If a segment, for example, the segment between nodes 2 and 3, breaks (fails), the RFER protocol automatically moves the blocking nodes to the ends of the failed segment and reconnects the previously disconnected segment.

The new path of the frames is shown in *Figure 9-25*. Therefore, full connectivity is restored for any single point of failure. For TDMoIP traffic, the RFER protocol ensures that this change takes effect within 50 msec; for other Ethernet traffic, it takes longer (approximately 20 seconds) because of the time needed by the switch to unlearn existing MAC addresses and learn new ones.

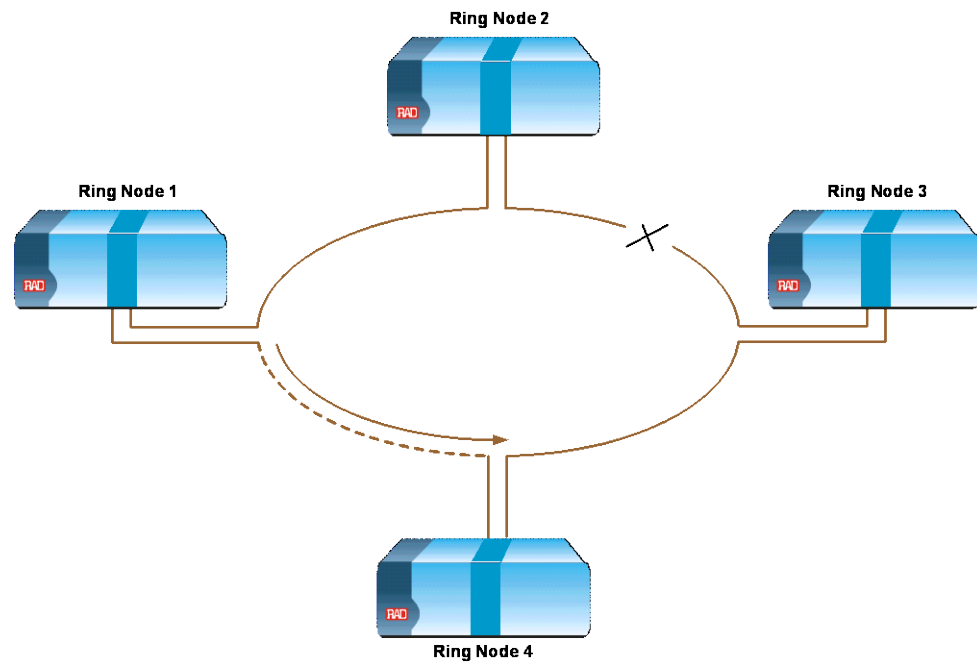


Figure 9-25. Basic Ring Redundancy Topology – Data Flow after Recovery from Segment Failure

The method used to achieve fast recovery is based on the use of VLAN tagging. This approach enables adjacent nodes on the ring to exchange protocol messages that check the connectivity, and broadcast *ring open* messages to all the nodes in case a fault is detected on a segment. Note however that this means VLAN tagging cannot be used for other traffic.

The fast redundancy protection available to the TDMoIP traffic within the ring can be extended to other equipment: such equipment is connected to the USER port of the ML-IP modules, and therefore its traffic is not processed by the ML-IP module: it only passes to the network through the ML-IP NET ports.

The extended protection can be provided to up to 32 IP addresses, which are specifically defined by the user. The protected addresses are destination addresses for traffic connected to the ML-IP module through the USER port: this may be traffic from another ML-IP module (when the chained topology is used – see [Figure 9-19](#)), or from any other type of equipment using the ML-IP module to connect to remote sites.

### Redundancy between ML-IP and TDM Main Link Modules

Redundancy between ML-IP modules and TDM main link modules can be provided by configuring different databases: one for transferring the traffic through TDM main link modules, and the other for using the ML-IP modules to transmit the same traffic through IP networks.

In this case, appropriate flipping conditions can be specified to switch between the two databases. Therefore, when a fault condition that requires switching is detected, the CL module loads the alternative database and reconfigures the Megaplex unit for using the alternative transmission path. Other Megaplex units, after detecting the loss of traffic from the first Megaplex unit that flips to the backup database, also perform flipping, and therefore after a short interval the network traffic flow is automatically restored.

This enables using ML-IP modules to backup the traffic carried by circuit-switched PDH E1 and T1 links by means of the packet-switched IP network.

## Delay and Jitter Considerations

Packet transmission methods often introduce significant delays. The delays relevant to TDMoIP traffic are explained below.

### Packetizing Delay Considerations

As explained in [Appendix B](#), the bandwidth utilization efficiency increases when using a large payload size per frame (determined by the **TDM Bytes per Frame** parameter). However, there are additional aspects that must be considered when selecting this parameter:

- **Filling time:** the filling time, which is the time needed to load the payload into an Ethernet frame, increases in direct proportion to the **TDM Bytes per Frame** parameter. This is particularly significant for bundles with few timeslots; for example, a voice channel could be carried by a single-timeslot bundle. Considering the nominal filling rate (approximately one byte every 0.125 msec), the time needed to fill a single-timeslot bundle is as follows:
  - At 48 TDM bytes per frame: 5.5 msec with CAS support and 5.9 msec without CAS support
  - At 384 TDM bytes per frame: 44 msec with CAS support and 47 msec without CAS support.

Therefore, before considering any other delays encountered along the end-to-end transmission path, the round-trip (or echo) delay for a single voice channel presented above is 92 msec at 384 TDM bytes per frame (including the additional intrinsic delay of module – see below).

Such long delays may also cause time-out in certain data transmission protocols.

- **Intrinsic jitter:** the transmission of packets to the network is performed at nominally equal intervals of 1 msec. This means that every 1 msec the packet processor of the ML-IP module sends to the network (through the appropriate Ethernet interface) all the frames ready for transmission. As a result, the actual payload transmission intervals vary in an apparently random way whose peak value depends on the bundle size, an effect called *delay variance* (or jitter).

For example, a bundle with 6 timeslots will fill a 48-byte payload field of an Ethernet frame every 1 msec. If the sending instants are not perfectly synchronized with the filling instants, the sending time will sometimes occur just in time and sometimes will be delayed by 1 msec relative to the ideal, creating a peak delay variance of 1 msec at the transmitting side.

The intrinsic jitter in other cases is lower, therefore the delay variance generated by the ML-IP module cannot exceed 2 msec.

## Use of Jitter Buffers

Any network designed for reliable data transmission must have a negligibly low rate of data loss, to ensure that essentially all the transmitted frames reach their destination. Under these circumstances, the rate at which frames are received from the network is equal to the rate at which frames are transmitted by their source (provided that the measurement is made over a sufficiently long time). This means that it is possible to compensate for transmission delay variations by using a large enough temporary storage. This storage, called *jitter buffer*, serves as a first-in, first-out buffer that operates as follows:

- At the beginning of a session, the buffer is loaded with dummy frames until it is half full.
- After reaching the half-full mark, the read-out process is started. The frames are read out at an essentially constant rate. To prevent the buffer from either overflowing or becoming empty (underflow), the read-out rate must be equal to the average rate at which frames are received from the network.

The buffer stores the frames in accordance with their arrival order.

For reliable operation, the jitter buffer must be large enough to ensure that it is not emptied when the transmission delay increases temporarily (an effect called *underflow*, or *underrun*), nor fills up to the point that it can no longer accept new frames when the transmission delay decreases temporarily (an effect called *overflow*).

You can configure the jitter buffer size separately for each timeslot bundle. The minimum size of the jitter buffer depends on the intrinsic jitter: for the ML-IP module, the minimum value is 3 msec. The maximum size is 300 msec. Note that jitter buffers are located at both ends of a link, and therefore the delay added by the buffers is twice the selected value.

The theoretically correct value for the size of the jitter buffer of any given bundle is slightly more than the maximum variation in the transmission delay through the network, as observed on the particular link between the bundle source and the destination. For practical reasons, it is sufficient to select a value that is not exceeded for any desired percentage of time: for example, a value of 99.93% means that the jitter buffer will overflow or underflow for an accumulated total of only one minute per day.

## System and Network Timing Considerations

This section deals only with the selection of nodal timing sources in networks in which the Megaplex units equipped with ML-IP modules are interconnected by both TDM and packet-switched (IP) links, or by packet-switched (IP) links only.

If no packet-switched (IP) links are used, the only consideration with respect to timing is to use the timing source having the highest quality available, as the network timing reference. Given the characteristics of the Megaplex TDM main link modules, reliable, hierarchical timing distribution is possible throughout the whole network.

When packet-switched (IP) links are also used, additional factors must be taken into consideration. In particular, when IP links are used, some of the Megaplex units in the network may have to switch to the adaptive timing mode. The quality



of the timing signals generated in the adaptive timing mode is less predictable than timing reference quality in the other timing modes, because it depends on the transmission performance of the packet-switched network. Therefore, whenever other alternatives as available, avoid using the adaptive timing mode.

The considerations involved in the selection of an optimal timing reference and its distribution in networks that include packet-switched (IP) links are presented below.

### Timing Source Selection in Networks with Mixed Link Types

In networks that include both TDM and packet-switched (IP) links, it is often possible to avoid using adaptive timing. The preferred approach is to use the same timing distribution approach as in TDM-only networks:

- Select one Megaplex unit as the network timing reference (the master unit with respect to timing). The nodal timing of this unit may be one of the following, depending on the particular applications:
  - Timing locked to a station clock signal, supplied to one of the TDM main link modules. The station clock signal is usually derived from high-quality timing sources, and therefore it is the preferred timing source.
  - Timing locked to the receive clock of an ISDN channel, a station clock provided by a local exchange or PBX, or a data channel connected to a data transmission network having its own high-quality timing reference (for example, an atomic clock).
  - Internal timing: this is practical for stand-alone networks.
- Configure the other Megaplex units in the network to lock their nodal timing to the timing of the master Megaplex unit. For this purpose, at each of the other Megaplex units, select the clock recovered from the TDM link leading toward the master Megaplex unit as the nodal timing reference.

*Figure 9-26* shows the resultant timing flow in a network with mixed links (both TDM and packet-switched (IP)):

- The timing of the transmit-to-network path is determined by the nodal timing of the Megaplex unit in which the module is installed. As a result, all the ML-IP modules in the network shown in *Figure 9-26* transmit data at a rate derived from a common timing source – that used by the master Megaplex unit.
- The timing source used to read the contents of the jitter buffers (located in the receive-from-network path) is also derived from the nodal timing. Therefore, the read-out rate is equal to the transmit rate, a condition that supports normal operation.

### Timing Source Selection in Networks with IP Links Only

In applications that use only ML-IP modules to provide connectivity to Megaplex units through the IP network, it is not always cost-effective or technically feasible to provide a legacy timing reference for each unit.

The same situation occurs when the only way to connect to a Megaplex unit, which is part of a network using mixed link types (see for example *Figure 9-26*), is through an IP network.

Moreover, in applications of the type described above, each Megaplex often serves as the network termination unit for all the equipment connected to its channels, and therefore there is no alternative source that can be used as a reliable timing reference.

For such applications, the only solution is to use the adaptive timing mode at all these Megaplex units. To use adaptive timing for timing distribution, configure the Megaplex units in the network as follows:

- Select one Megaplex unit as the network timing reference (the master unit with respect to timing). The nodal timing mode of this unit may be any of the modes listed above for the master unit in a network with mixed links, however in most cases the internal timing mode would be used.
- Configure the other Megaplex units in the network to lock their nodal timing to the timing of the master Megaplex unit. For this purpose, at each of the other Megaplex units, select the adaptive clock recovered from a timeslot bundle connected directly to the master Megaplex unit as the nodal timing reference.

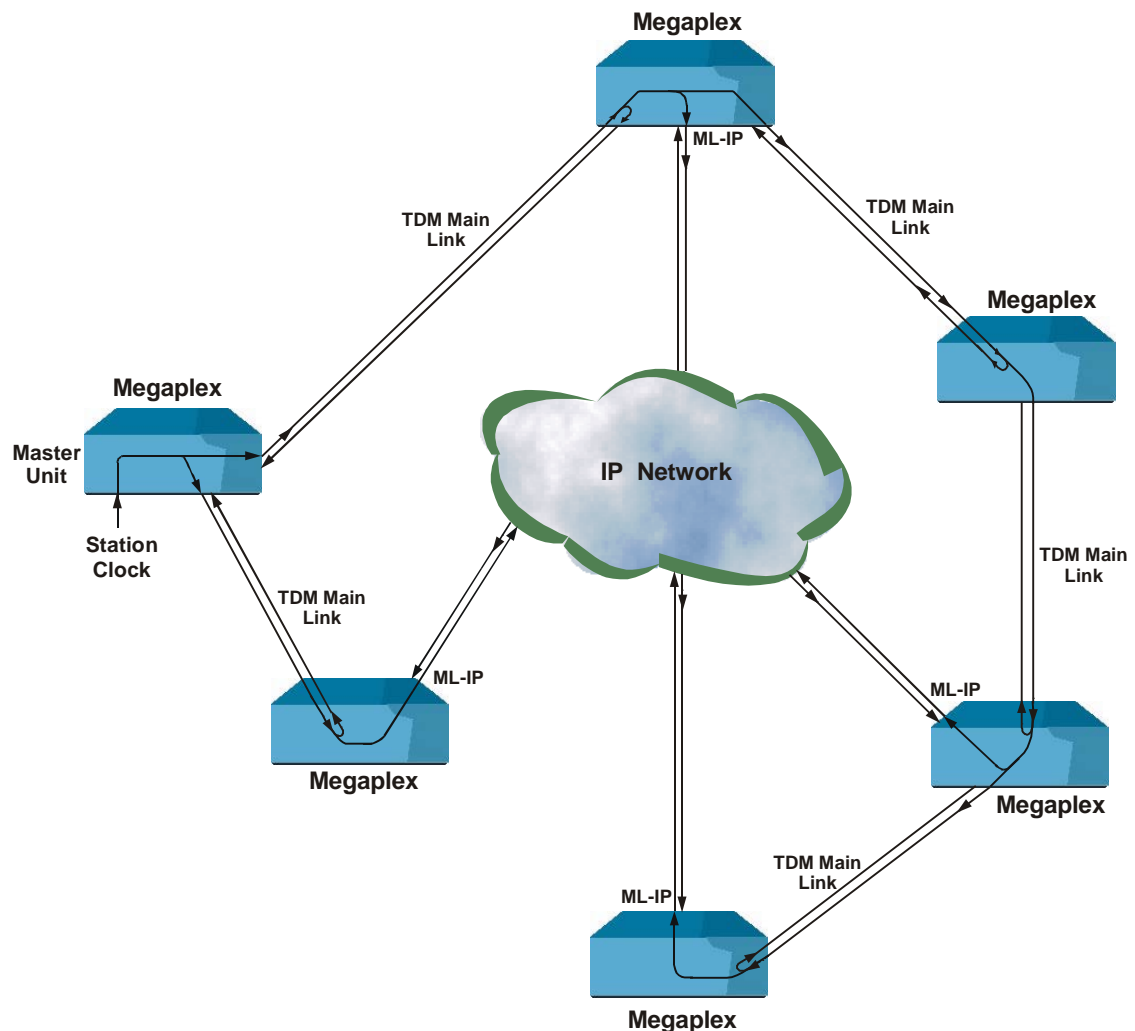


Figure 9-26. Timing Flow in a Typical Network with Mixed Link Types

Figure 9-27 shows the resultant timing flow in a network with IP links that is configured in accordance with these recommendations.

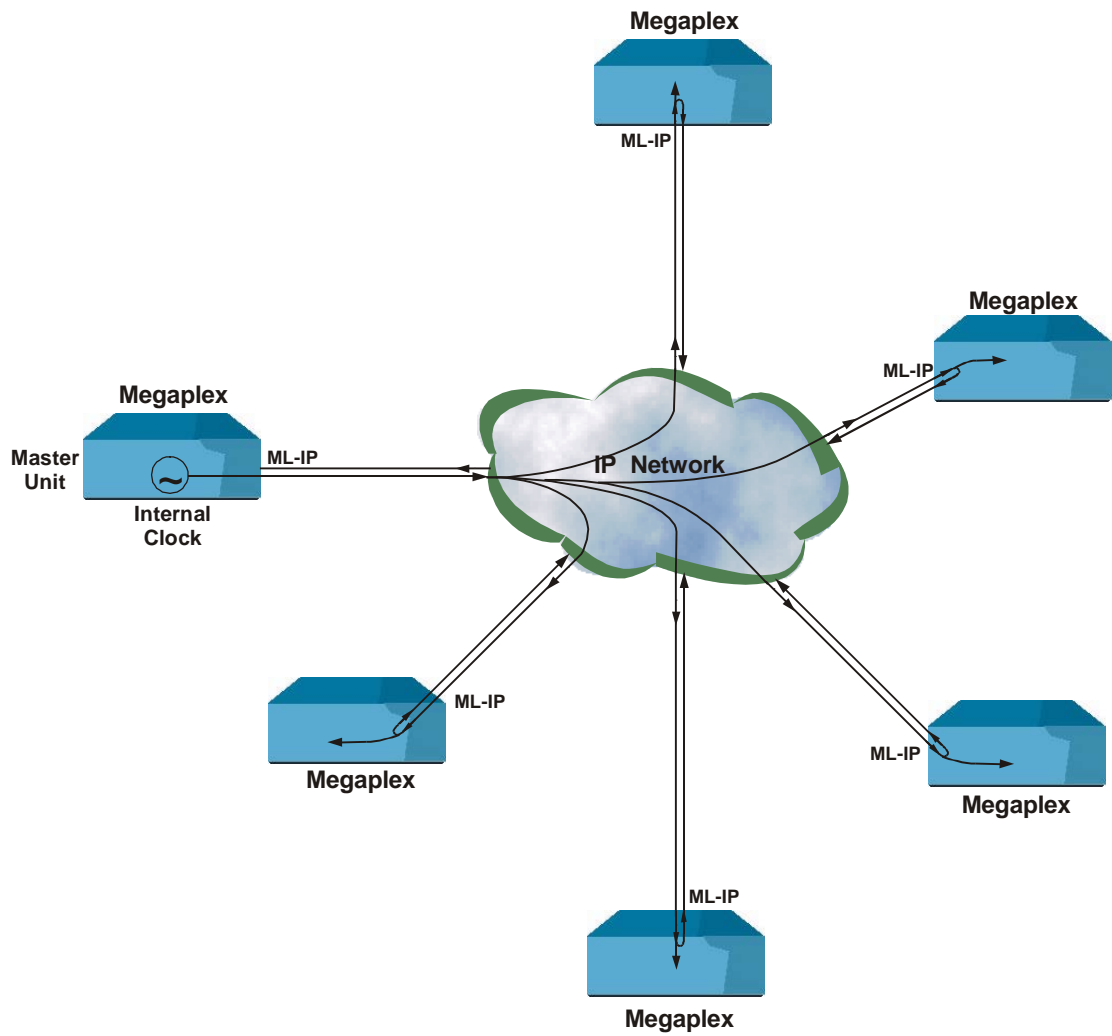


Figure 9-27. Timing Flow in a Typical Network Based on IP Links

## Section III System Management

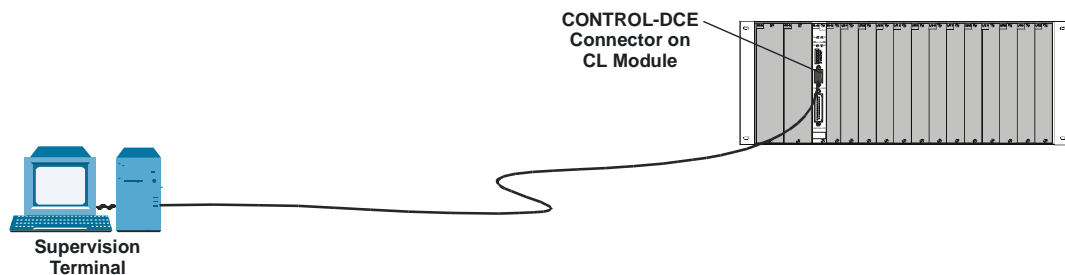
### 9.7 System Management Topologies

This section describes the various topologies that can be used for Megaplex system management.

#### Supervision Terminal Connection

For direct connection, it is necessary to connect a straight cable between the RS-232 serial port of the supervision terminal and the CONTROL-DCE connector of the desired Megaplex system, as shown in *Figure 9-28*.

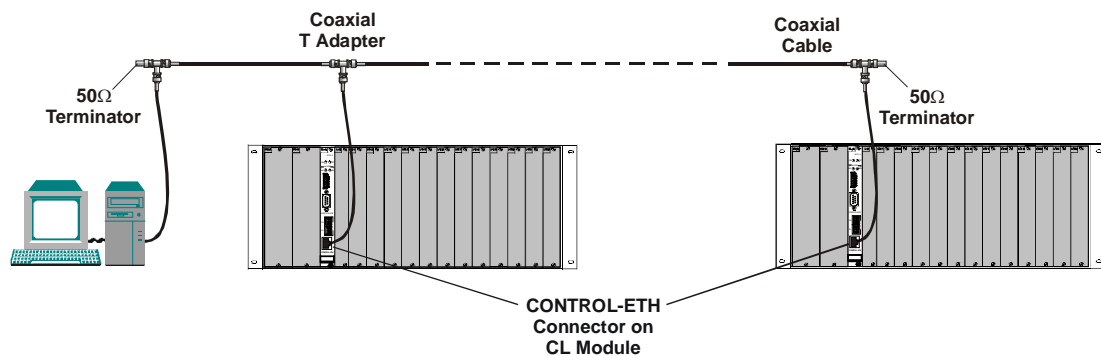
The communication data rate of each Megaplex port can be independently selected in accordance with system requirements (300, 1200, 2400, 4800, 9600, 19200, 38400, or 57600 bps). Data word format is configurable (one start bit, seven or eight data bits, selectable parity (odd, even, or none), and 1, 1.5, or 2 stop bits).



*Figure 9-28. Typical Direct Connection of Supervision Terminal*

#### Management via Megaplex Ethernet Port

*Figure 9-29* shows the connecting of a management station to the Ethernet management port, CONTROL-ETH.



*Figure 9-29. Connecting Management Stations to Megaplex Ethernet Management Interface*

## Connections for Out-of-Band Telnet Management

Telnet enables managing the Megaplex using either inband or out-of-band communication.

The Telnet protocol requires establishing IP communication between the PC host and the Megaplex. To enable the Megaplex unit to use IP communication, it is necessary to configure both the Ethernet and supervisory port parameters, and the parameters of Megaplex SNMP agent.

A Telnet host needs to be connected to only one Megaplex unit, because the IP router function of the Megaplex SNMP agent enables the transfer of the management traffic through any Megaplex port, using inband or out-of-band communication, to all the other Megaplex units that can communicate with that Megaplex unit. Thus, connection to one Megaplex unit actually provides management access to all the interconnected Megaplex units.

Note that the SNMP management communication is also carried over IP, and therefore the connections explained in this section also enable out-of-band management by SNMP-based network management stations.

### Connecting a Telnet Host to Individual Megaplex Systems

This section explains how to connect a PC host running Telnet to the Megaplex through the Megaplex supervisory ports, to enable out-of-band management using the Serial Link Interface Protocol (SLIP) or the Point-to-Point Protocol (PPP). For inband management topologies, refer to the *Topologies for Connection to Network Management Stations* section below.

The physical connection of a remote PC host running Telnet to a single Megaplex unit can be made as explained in the *Supervision Terminal Management Topologies* section above (*Figure 9-28*).

In general, however, a PC host is attached to a LAN:

- When the Megaplex includes a CL module with Ethernet port, that port can be directly connected to the LAN media (see *Figure 9-29*).
- When the Megaplex includes a CL module with serial ports, it is necessary to provide a physical path between the LAN as well as conversion to SLIP or PPP. RAD offers two types of equipment which are well suited for performing these functions for both Ethernet and Token Ring LANs: the Ethernet IP/IPX Router/Bridge, MBE, and the Token Ring LAN Extender, TRE.

*Figure 9-30* shows a typical connection of a PC host attached to an Ethernet LAN to the Megaplex serial supervisory port, using the multiple serial port version of the MBE, MBE/RAS/A. Note that the connection between the LAN and the MBE/RAS/A could also be made through a WAN.

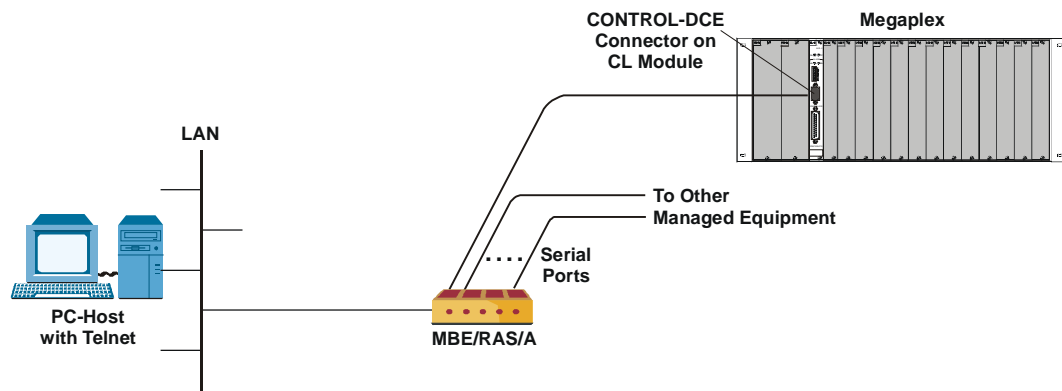


Figure 9-30. Connection of PC Host Attached to LAN to Megaplex Serial Supervisory Port

## Topologies for Connection to Network Management Stations

SNMP enables the management Megaplex systems using either inband or out-of-band communication. This section explains the topologies used for inband network management. For out-of-band management topologies, refer to the [Management via Megaplex Ethernet Port](#) section above.

Megaplex supports inband transmission of management traffic through E1 and T1 interfaces (the Megaplex main links).

### Inband Management through E1 and T1 Interfaces

Inband management can be carried in the housekeeping overhead of E1 and T1 data streams (national bits in timeslot 0 of E1 frames, or by the FDL in T1 data streams using ESF framing). In addition, it is also possible to assign a dedicated timeslot for the management traffic.

#### Note

*T1 links using the B7 line code do not support inband management.*

The recommended management method is through a dedicated timeslot. By assigning a whole timeslot to management traffic, it is possible to enable the routing of management traffic by standard routers, as well as by routers which support frame relay connections. This approach enables frame relay access to the SNMP agent over a fixed DLCI (DLCI 100), but does not support the frame relay management protocols (see also the [Support for Routers](#) section below).

Each SNMP agent recognizes the messages addressed to its own IP address. Megaplex SNMP agents also include a proprietary built-in IP router, which is able to route management messages in accordance with the network topology determined by its routing algorithm without requiring the user to provide a priori topology information on the network.

The router of each SNMP agent determines the network topology by periodically exchanging update messages with the other SNMP agents in the network.

This automatic learning capability enables using any network topology, including topologies with closed loops. Moreover, this also enables automatic recovery from management communication failures by finding alternatives to failed paths.

Using the advanced capabilities of the Megaplex SNMP agents, it is possible to support any practical communication network topology,

## Support for Routers

In large networks, the using organizations often have SNMP-based network management stations that access a wide variety of managed equipment through WANs. In this case, standard routers are used to provide connectivity for the management network. These routers usually connect to the managed units through dedicated timeslots, using the frame relay or HDLC PPP protocols, and support RIP2 (or compatible protocols). The Megaplex can be configured to use these protocols in a selected timeslot, or on a selected DLCI.

To integrate Megaplex systems within these organizational management networks, it is necessary to provide access to the internal management routing information of the CL modules. For this purpose, the SNMP agents of the Megaplex systems can be configured to transmit routing tables in the format required by the RIP2 protocol. Using the RIP2 protocol has the advantage of dynamic learning, while requiring minimal configuration procedures.

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**Note**

*In addition to the use of user-specified manager lists, Megaplex also provides a tool that permits preventing the learning of unnecessary addresses via the RIP2 protocol. This tool functions as a filter for RIP2 learning: you can specify the IP addresses (up to a maximum of 30) for which routing information can be learned via the RIP2 protocol. RIP2 routing information for unlisted addresses is ignored.*

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The routing information learned from the RIP2 routing tables transmitted by the Megaplex unit permits routers to establish connections to the various access ports of the Megaplex SNMP agents. [Figure 9-31](#) shows a typical inband management system configuration.

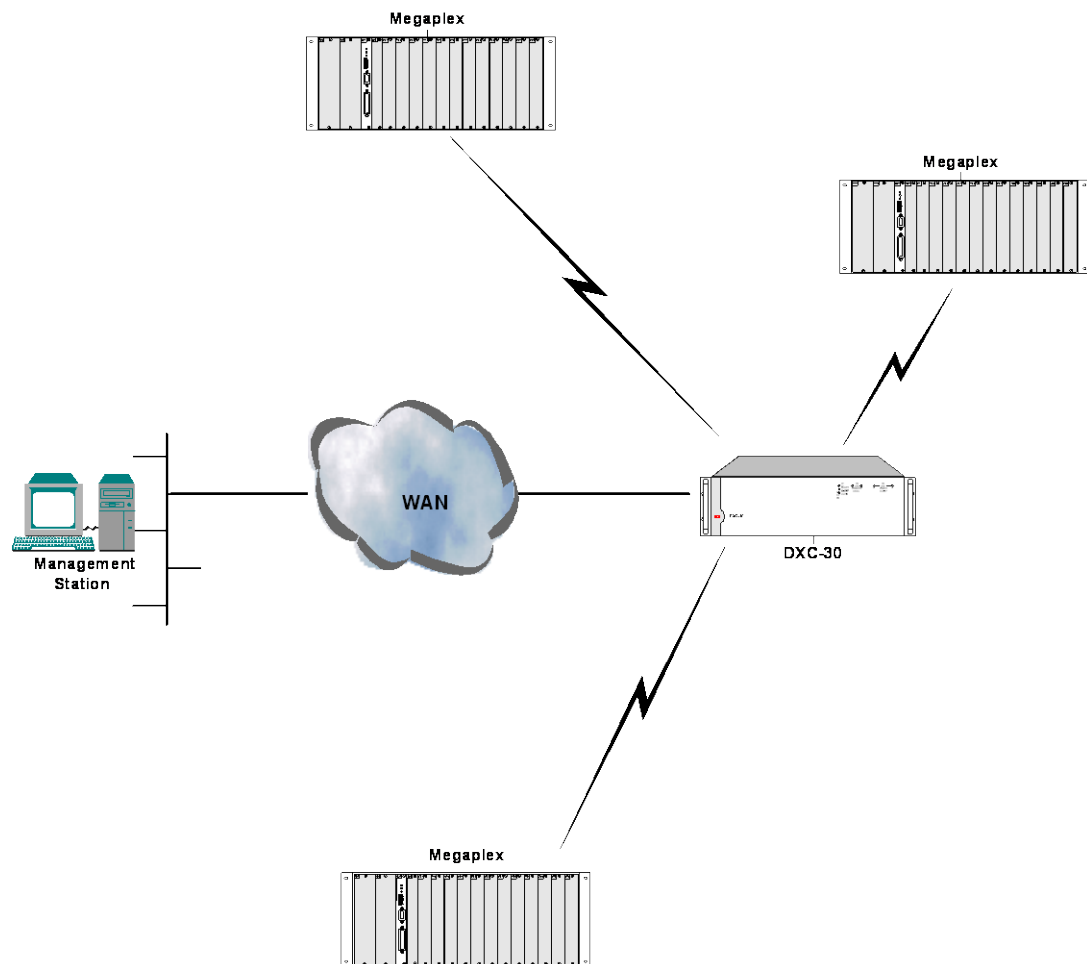


Figure 9-31. Providing Access to Network Management Station through Routers

In the management topology shown in [Figure 9-31](#), the network management station is routed through the WAN and the DXC-30 to the timeslots dedicated for management on the links connecting to Megaplex systems.

The router can connect either through a serial data link using the PPP protocol, or can communicate through a frame relay network:

- In the transmit direction, the SNMP agent encapsulates the management messages in frames with a fixed DLCI (always DLCI 100), and sends them at the selected rate through the selected main link timeslot.
- In the receive direction, the SNMP agent monitors the specified timeslot and analyzes packets received with DLCI 100, and analyzes the received data to detect management messages (any such messages are then processed as usual).

Note that the SNMP agent does not support frame relay management protocols (ANSI T1.617 Annex D, LMI, etc.).



## Connection through ML-IP Links

As explained in [Chapter 1](#), an ML-IP module can provide the management communication link for CL modules with Ethernet interface installed in the same chassis, provided the management station can be reached through the same WAN or IP network used to carry the TDMoIP traffic.

In this case, the CL Ethernet ports can be disabled and their management traffic can be routed through the external ports of the IP main link module. This saves the costs associated with providing an independent connection between the CL module and the management stations.

The ML-IP module will also provide the routing services that would otherwise be performed by the CL management subsystem. For this purpose, the CL module downloads a copy of its routing table to the IP main link module, thereby providing the IP main link module with the management routing information.

The ML-IP module will also handle ARP requests for the CL management subsystem. Therefore, the ML-IP module serves as a proxy server for the CL management subsystem.

## Connection through HS-ETH/SW Ports

As an alternative to the services provided by the ML-IP module, the CL module can also use ports of the HS-ETH/SW module. See the [HS-ETH/SW Installation and Operation Manual](#) for details.



# Appendix A

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## Pinouts

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### A.1 Connection Data for CL.2 Modules

The CL.2 module panel has the following connectors:

- A 9-pin female connector designated CONTROL-DCE, which is identical to the CONTROL-DCE connector described in [Table A-1](#).
- An RJ-45 connector designated CONTROL-ETH, which provides access to the Ethernet interface of the CL.2 module.
- R1 and R2 connectors, which contain the contacts of the two alarm indication relays.

#### CONTROL-DCE Connector

The CONTROL-DCE connector is a 9-pin female connector intended for direct connection to a supervision terminal, wired in accordance with [Table A-1](#):

- The connection of the CONTROL-DCE connector to a supervision terminal having a 9-pin connector is made by means of a straight cable (a cable wired point-to-point).
- The connection to a terminal with 25-pin connector is made by means of a cable wired in accordance with [Figure A-1](#).

*Table A-1. CONTROL-DCE Connector Wiring*

Pin	Line	Direction
1	Data Carrier Detect (DCD)	From CL.2
2	Receive Data (RD)	From CL.2
3	Transmit Data (TD)	To CL.2
4	Data Terminal Ready (DTR)	To CL.2
5	Signal Ground (SIG)	Common reference and DC power supply ground
6	Data Set Ready (DSR)	From CL.2
7	Request to Send (RTS)	To CL.2
8	Clear to Send (CTS)	From CL.2
9	Ring Indicator (RI)	To CL.2

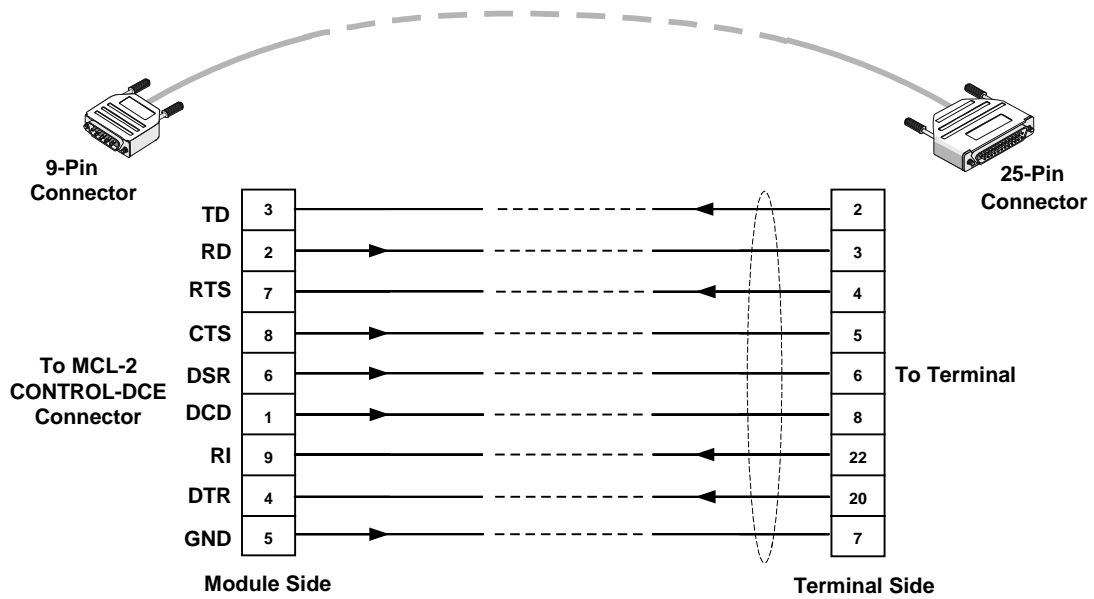


Figure A-1. 9-Pin/25-Pin Cable Wiring – Connection to CONTROL-DCE Connector

## CONTROL-ETH Connector

The Ethernet interface is configured as a station port. CONTROL-ETH connector wiring is given in [Table A-3](#).

Table A-2. RJ-45 CONTROL-ETH Connector Wiring

Pin	Designation	Function
1	TX+	Transmit + wire
2	TX-	Transmit - wire
3	RX+	Receive + wire
4, 5	N.C	Not connected
6	RX-	Receive - wire
7	N.C	Not connected
8	N.C	Not connected

## R1 and R2 Connectors

The R1 and R2 connectors include the contacts of the alarm relay. The wiring of each connector is given in [Table A-4](#).

**Caution** To prevent damage to relay contacts, it is necessary to limit, by external means, the maximum current that may flow through the contacts (maximum allowed current through closed contacts is 1 A). The maximum voltage across the open contacts must not exceed 60 VDC.

The mating connector is RIACON Cat. No. 31169103.

*Table A-3. R1 and R2 Connector Wiring*

Pin	Designation	Function
1	Relay F	Common contact for corresponding alarm relay
2	Relay M	NO (normally open) contact, provides an open-circuit to pin 1 in the absence of alarm conditions
3	Relay B	NC (normally closed) contact, connected to pin 1 in the absence of alarm conditions

## A.2 Connection Data for Megaplex-2100 PS Modules

The AC-powered PS module have one standard IEC three-pin socket, with integral fuse, for the connection of the AC power.

In addition, the AC-powered modules include a three-pin connector, designated RINGER-IN or VDC-IN, for the connection of external DC feed and ringer voltages. Connector wiring is listed in [Table A-5](#).

*Table A-4. RINGER-IN/VDC-IN Connector, Pin Functions*

Pin	Function
1	Common Ground (0)
2	+60/+72 VDC
3	-24/-48 VDC

The DC-powered PS modules have a single three-pin DC-IN connector, for the connection of the -24 or -48 VDC operating voltage input, as well as +60/+72 VDC input for ringer and phantom feeding purposes. Connector wiring is listed in [Table A-5](#).

**Note** *RAD supplies mating connectors for the DC power connectors.*

All PS modules are equipped with a grounding screw on the module panel for the grounding connection.

## A.3 Connection Data for Megaplex-2104 Power Supply

AC-powered Megaplex-2104 units have a single standard IEC three-pin socket, with integral fuse, for the connection of the AC power.

DC-powered Megaplex-2104 units have a single three-pin DC power connector for the connection of the -24 or -48 VDC operating voltage input. Connector wiring is listed in [Table A-6](#).

*Table A-5. Megaplex-2104 DC Connector Pin Functions*

<b>Pin</b>	<b>Function</b>
1	Ground (0)
2	Chassis (Frame) Ground
3	-24/-48 VDC

**Note** *RAD supplies mating connectors for the DC power connectors.*

# Appendix B

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## Operation Environment

This appendix presents a concise description of the operating environment of Megaplex systems, to provide the background information required for understanding the Megaplex configuration and performance monitoring parameters.

This Appendix covers the following issues:

- E1 environment – [Section B.1](#).
- T1 environment – [Section B.2](#).
- IP environment – [Section B.3](#).
- Ethernet transmission technology – [Section B.4](#).
- TDMoIP environment – [Section B.5](#).

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### B.1 E1 Environment

#### E1 Line Signal

The E1 line signal uses the High-Density Bipolar 3 (HDB3) code.

The HDB3 coding format is an improvement of the alternate mark inversion (AMI) code. In the AMI format, "1" are alternately transmitted as positive and negative pulses, whereas "zeros" are transmitted as a zero voltage level. The AMI format cannot transmit long strings of "zeros", because such strings do not carry timing information.

The HDB3 coding rules restrict the maximum length of a "0" string to three pulse intervals. Longer strings are encoded at the transmit end to introduce non-zero pulses. To allow the receiving end to detect the artificially-introduced pulses and enable their removal to restore the original data string, the encoding introduces intentional bipolar violations in the data sequence.

The receiving end detects these violations and when they appear to be part of an encoded "0" string – it removes them. Bipolar violations may also be caused by transmission errors. Therefore, any bipolar violations which cannot be interpreted as intentional coding violations can be separately counted, to obtain information on the transmission link quality.

#### E1 Signal Structure

The E1 line operates at a nominal rate of 2.048 Mbps. The data transferred over the E1 line is organized in frames. Each E1 frame includes 256 bits.

The E1 frame format is shown in [Figure B-1](#).

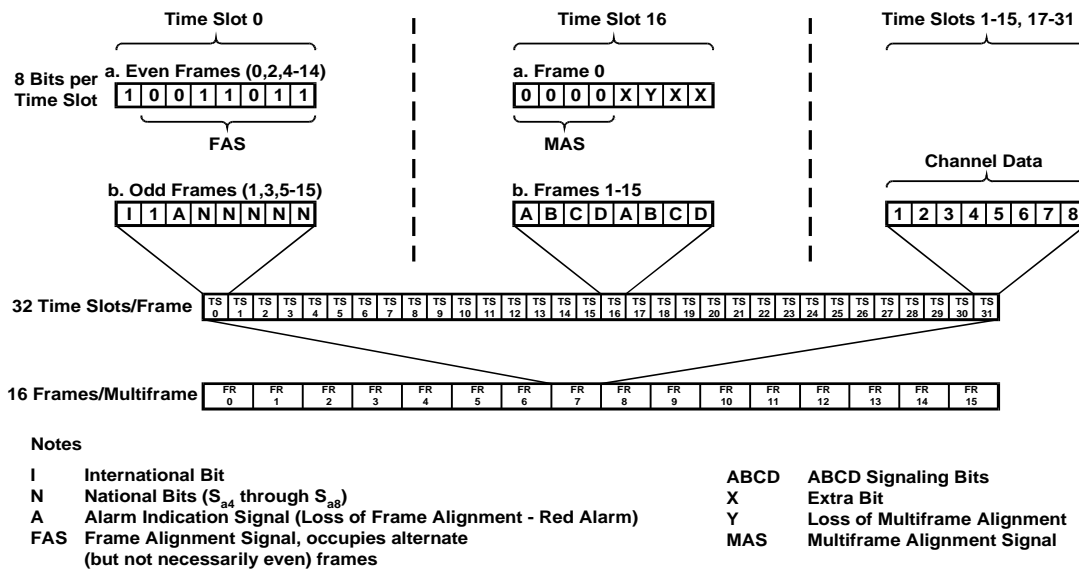


Figure B-1. E1 Frame Format

The 256 bits included in a frame are organized of 32 timeslots of eight bits each. The frame repetition rate is 8,000 per second, therefore the data rate supported by each timeslot is 64 kbps.

## Timeslot 0

Timeslot 0 of E1 frames is used for two main purposes:

- **Delineation of frame boundaries.** For this purpose, in every second frame, timeslot 0 carries a fixed pattern, called frame alignment signal (FAS). Frames carrying the FAS are defined as even frames, because they are assigned the numbers 0, 2, 4, etc. when larger structures (multiframes) are used.

The receiving equipment searches for the fixed FAS pattern in the data stream using a special algorithm, a process called frame synchronization. Once this process is successfully completed, the equipment can identify each bit in the received frames.

- **Interchange of housekeeping information.** In every frame without FAS (odd frames), timeslot 0 carries housekeeping information. This information is carried as follows:
  - Bit 1 – this bit is called the international (I) bit. Its main use is for error detection using the optional CRC-4 function (CRC-4 stands for Cyclic Redundancy Check, using a fourth-degree polynomial). This function is described below.
  - Bit 2 is always set to 1, a fact used by the frame alignment algorithm.
  - Bit 3 is used as a remote alarm indication (RAI), to notify the equipment at the other end that the local equipment lost frame alignment, or does not receive an input signal.
  - The other bits, identified as Sa4 through Sa8, are designated national bits, and are actually available to the users, provided agreement is reached as to their use. RAD equipment with SNMP agents can use the Sa



bits for inband management traffic. The total data rate that can be carried by each national bit is 4 kbps.

## Multiframes

To increase the information carrying capacity without wasting bandwidth, the frames are organized in larger patterns, called multiframes. ITU-T Rec. G.704 recommendation defines the following types of multiframes:

- Basic G.704 framing
- G.704 framing with timeslot 16 multiframe.

### Basic G.704 Framing

The basic G.704 multiframe structure consists of two frames, which are identified by means of the information included in timeslot 0:

- The even frame of the pair includes the frame alignment signal (FAS).
- The odd frame includes an 1 in bit position 2, and housekeeping information in the other bits.

The number of timeslots available for user's data is 31, and therefore the maximum payload rate is 1984 kbps.

To enable the transmission of network management information, a separate timeslot may have to be assigned within the frame. This procedure is called common channel signaling (CCS). The CCS information is often transmitted in timeslot 16.

### G.704 Framing with Timeslot 16 Multiframe ("G.704 Multiframe")

The G.704 multiframe structure includes 16 frames, which are identified by means of a separate multiframe alignment signal (MAS) contained in timeslot 16 of each frame.

The G.704 multiframe structure is generally used when timeslot 16 serves for the end-to-end transmission of channel-associated signaling (CAS). A typical application in which timeslot 16 serves for the transmission of signaling is the transfer of voice channels by means of voice modules, using the standard E1 PCM format based on channel-associated signaling.

Since timeslot 16 must be reserved for the transmission of the MAS and system signaling, only 30 timeslots are available for the user's payload, and the maximum payload rate is 1920 kbps.

When using the G.704 multiframe format, timeslot 16 of each of the 16 frames in each multiframe carry the following information:

- The first four bits of timeslot 16 in multiframe 16 always carry the multiframe alignment sequence, 0000.
- Bit 6 in timeslot 16 in multiframe 16 is used to notify the equipment at the other end of the link that the local equipment lost multiframe alignment.
- The other bits of this timeslot are not assigned mandatory functions.

## Channel Associated Signaling

When using the G.704 multiframe format, timeslots 16 in frames 1 through 15 of each multiframe are available for carrying user's information. In general, this information is the signaling information for the 30 payload timeslots (channels).

As shown in *Figure B-1*, four signaling bits, designated A, B, C, and D, are available for each channel, thereby enabling end-to-end transmission of four signaling states. Note that each frame in the multiframe carries the signaling information of two channels.

## CRC-4 Error Detection

The Megaplex system supports the CRC-4 function in accordance with ITU-T Rec. G.704. The CRC-4 function is used to detect errors in the received data, and therefore can be used to evaluate data transmission quality over E1 links.

This function can be enabled or disabled by the user, independently for each link.

To enable error detection, additional information must be provided to the receiving equipment. The additional information is transmitted to the receiving equipment by using a multiframe structure called *CRC-4 multiframes*. A CRC-4 multiframe is an arbitrary group of 16 frames. This group is not related in any way to the G732S 16-frame multiframe structures explained above.

- A CRC-4 multiframe always starts with an even frame (a frame that carries the frame alignment signal). The CRC-4 multiframe structure is identified by a six-bit *CRC-4 multiframe alignment signal*, which is multiplexed into bit 1 of timeslot 0 of each odd-numbered (1, 3, 5, etc.) frame of the CRC-4 multiframe (i.e., in frames 1 through 11 of the CRC-4 multiframe).
- Each CRC-4 multiframe is divided into two submultiframes of 8 frames (2048 bits) each. The detection of errors is achieved by calculating a four-bit checksum on each 2048-bit block (submultiframe). The four checksum bits calculated on a given submultiframe are multiplexed, bit by bit, in bit 1 of timeslot 0 of each even-numbered frame of the next submultiframe.
- At the receiving end, the checksum is calculated again on each submultiframe and then compared against the original checksum (sent by the transmitting end in the next submultiframe). The results are reported by two bits multiplexed in bit 1 of timeslot 0 in frames 13, 15 of the CRC-4 multiframe, respectively. Errors are counted and used to prepare statistic data on transmission performance.

## E1 Line Alarm Conditions

- **Excessive bit error rate.** The bit error rate is measured on the frame alignment signal. The alarm threshold is an error rate higher than  $10^{-3}$  that persists for 4 to 5 seconds. The alarm condition is canceled when the error rate decreases below  $10^{-4}$  for 4 to 5 consecutive seconds.
- **Loss of frame alignment** (also called loss of synchronization). This condition is declared when too many errors are detected in the frame alignment signal (FAS), e.g., when 3 or 4 FAS errors are detected in the last 5 frames. Loss of frame alignment is cleared after no FAS errors are detected in two consecutive frames.

The loss of frame alignment is reported by means of the A bit (*Figure B-1*).

- **Loss of multiframe alignment** (applicable only when G732S multiframes are used). This condition is declared when too many errors are detected in the multiframe alignment signal (MAS) (same conditions as for loss of frame alignment).

The loss of multiframe alignment is reported by means of the Y bit (*Figure B-1*).

- **Alarm indication signal (AIS)**. The AIS signal is an unframed “all-ones” signal, and is used to maintain line signal synchronization in case of loss of input signal, e.g., because an alarm condition occurred in the equipment that supplies the line signal. Note that the equipment receiving an AIS signal loses frame synchronization.

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## B.2 T1 Environment

### T1 Line Signal

The basic T1 line signal is coded using the alternate mark inversion (AMI) rules, explained in *Section B.1*

The AMI format cannot transmit long strings of “zeros”, because such strings do not carry timing information. Therefore, the AMI signal source must generate a signal with guaranteed minimum “1” density. The minimum average “1” density required by the applicable standards is 1:8. Therefore, when a T1 signal is transmitted over an AMI line, each frame timeslot must include at least one “1” bit. This effectively reduces user data rate to 56 kbps per timeslot, and precludes the provision of clear channel capability (CCC).

To circumvent this problem, modified line codes are used, that perform zero suppression by substituting special codes for long “0” strings. The generally accepted zero suppression methods are B7 and B8Z5.

- With B7, the maximum length of “0” strings in the user data must not exceed seven zeros (when a longer string is detected, the seventh bit is changed to “one”, to meet the minimum “1” density requirement and thus ensure that the remote end can properly recover the clock signal). Although this requirement can be fulfilled in many applications, it does not provide 64 kbps clear channel capability. Therefore, when the B7 line code is used, inband management is not supported.
- Only the B8Z5 zero suppression method provides clear channel capability, and the “1” density requirement no longer restricts user data characteristics. This means that each T1 frame timeslot can support the full 64 kbps.

Since the AMI coding does not affect the signal transmitted to the line, it is also called *transparent* coding. This emphasizes the fact that although the other methods are also transparent to user’s data, perfect transparency is achieved only when the zero-string substitution sequences are correctly recognized. Thus, the other methods are more sensitive to transmission errors (transmission errors may affect the decoding of zero-string substitution sequences).

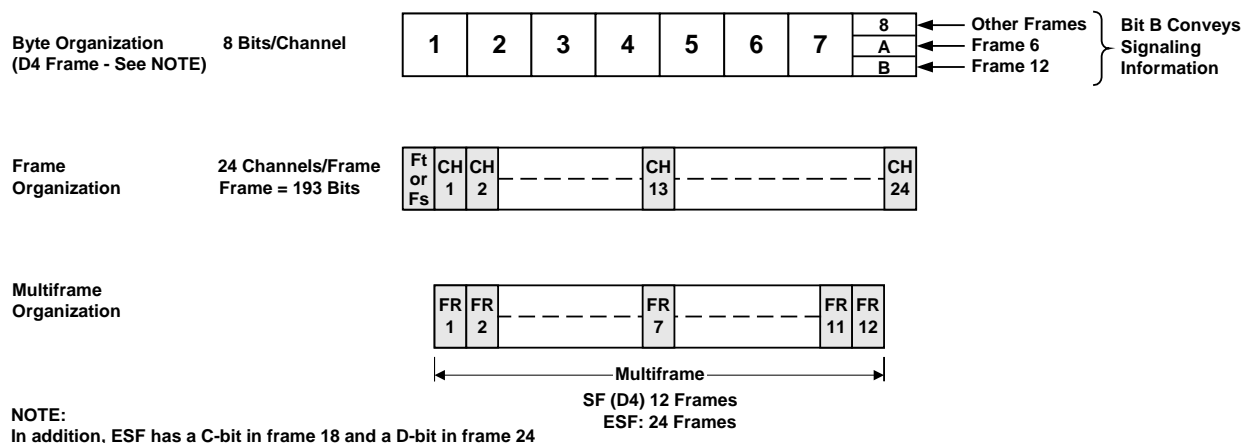
## T1 Signal Structure

The T1 line operates at a nominal rate of 1.544 Mbps. The data transferred over the T1 line is organized in frames.

The T1 frame format is shown in *Figure B-2*.

Each T1 frame includes 193 bits. 192 bits are organized in 24 timeslots of eight bits each, that carry the payload data. An additional timeslot, including one bit (the F-bit) carries framing and supervision information. As a result, the data rate supported by each payload timeslot is 64 kbps. The data rate of the framing slot is 8 kbps.

The T1 frame does not include a dedicated timeslot for the transfer of channel signaling. When end-to-end transfer of signaling is necessary, a technique called "robbed-bit signaling" is used. The robbed-bit is the least significant bit (bit 8) of the channel byte, and is actually "robbed" only once in every six frames.



*Figure B-2. T1 Frame Format*

In order to enhance link/system supervision capabilities, the frames are organized in larger patterns, called super-frames. Two types of super-frames are used:

- SF (also called D4), consists of 12 T1 frames.
- Extended SF (ESF), consists of 24 T1 frames.

The SF format provides limited supervision capabilities, such as end-to-end reporting of local loss-of-signal (yellow alarm), and line loopback.

The ESF format provides improved supervision capabilities, and allows better utilization of the 8 kbps framing timeslots. The major advantage of the ESF format is that it supports on-line link performance monitoring (by means of a 2 kbps Cyclic Redundancy Check (CRC) channel) and in addition provides a 4 kbps end-to-end supervision and control data link. The data link can be used for performance monitoring and failure reporting, for activation of maintenance loopbacks, and for transmission of various commands to the far end equipment.

The implementation of the multiframe format is based on the use of various F-bit patterns. The F-bit pattern is used to perform three functions:

- Framing Pattern Sequence (FPS), defines frame and multiframe boundaries.
- Facility Data Link (FDL), allows transfer of supervisory data, e.g. alarms, error performance, test loop commands, etc. to be passed through the T1 link.

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**Note** *RAD equipment with SNMP agents can use the FDL to carry inband management traffic. The management data rate is then 4 kbps.*

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- Cyclic Redundancy Check (CRC), allows the measurement of the bit error rate and enhances the reliability of the framing algorithm.

The F-bit pattern defines the structure of frames and multiframes. In the D4 (SF) frame format, the F-bit of consecutive frames is alternately interpreted as an  $F_t$  bit (terminal framing bit) or  $F_s$  bit (frame signaling bit).

- **$F_t$  pattern:** alternating 0's and 1's, defines the frame boundaries.
- **$F_s$  pattern:** fixed 001110 pattern, defines the multiframe boundaries, so that one frame may be distinguished from another. In particular, the  $F_s$  pattern is needed so that frames 6 and 12 may be identified for the recovery of signaling bits.

In the ESF frame format, the multiframe structure is extended to 24 frames, but the frame and channel structure are the same as in the D4 (SF) format.

## T1 Alarm Conditions

The basic alarm conditions are the red alarm and the yellow alarm. Note that with the ESF format, the FDL link can be used for more sophisticated status transmissions, in accordance with the ANSI Standard T1.403-1989 and AT&T Pub. 54016.

- **Red Alarm.** A red alarm is generated when the local unit has lost frame synchronization for more than 2.5 consecutive seconds, or the bit error rate exceeds  $10^{-2}$  for 2.5 consecutive seconds. Loss of frame synchronization may be caused either by  $F_s$  or  $F_t$  errors, by the reception of an AIS signal, or by the loss of the input signal (receive data remains zero for 31 consecutive bits). In accordance with AT&T TR-62411, a system automatically recovers synchronization when there has been a period of 10 to 20 consecutive seconds free of the loss of sync condition.

Since in many system applications this is an overly conservative specification, the Megaplex system offers faster frame synchronization algorithms, which allow the user to select a "fast" mode. In the "fast" mode, the time necessary to declare synchronization is reduced to approximately one second free of the loss of sync condition.

- **Yellow Alarm.** A yellow alarm is sent from the remote unit to inform the local unit that a red alarm exists at the remote end.
- **Alarm Indication Signal (AIS).** The AIS signal is an unframed "all-ones" signal, and is used to maintain line signal synchronization when an alarm condition occurs in the equipment that supplies the line signal.

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## B.3 IP Environment

This section describes the IP environment, to provide background information for configuring the parameters that control the routing of TDMoIP and management traffic.

The information presented in this section refers to Version 4 of the IP protocol (IP4), currently the most widely used protocol version.

### Introduction to IP

IP means “Internet Protocol”. The term *IP protocol* is often used to indicate a standardized set of rules and procedures that enable data exchange through a packet-switched network.

Accordingly, the term *Internet* indicates the set of networks that use the IP protocol and are interconnected in a way that, at least in principle, permits any entity on one network to communicate with any entity on another network.

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**Note** *The term “suite of IP protocols” is also often used, in recognition of the fact that the operation of the Internet is actually defined by many related protocols.*

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### IP Networks, IP Hosts and IP Ports

Any entity that can communicate using the IP protocol is called an *IP host*.

The connection point between an IP host and an IP network is called *IP port*.

An *IP network* forms when a number of IP ports can communicate directly (peer to peer) using the IP protocol, without any intermediaries.

An IP host can have any number of IP ports. Moreover, the ports may be located on different IP networks.

### IP Addresses

To enable IP communication between two IP hosts, it is necessary to find a route between their IP ports. For this purpose, each IP port is assigned an IP address.

An IP address is a number selected in accordance with the IP protocol. The only purpose of an IP address is to permit unambiguous identification of an IP port. Therefore, each IP port must be assigned a distinct and unique IP address.

The IP protocol does not require the IP port to be related in an unambiguous way to a physical (communication) port. This has two main implications:

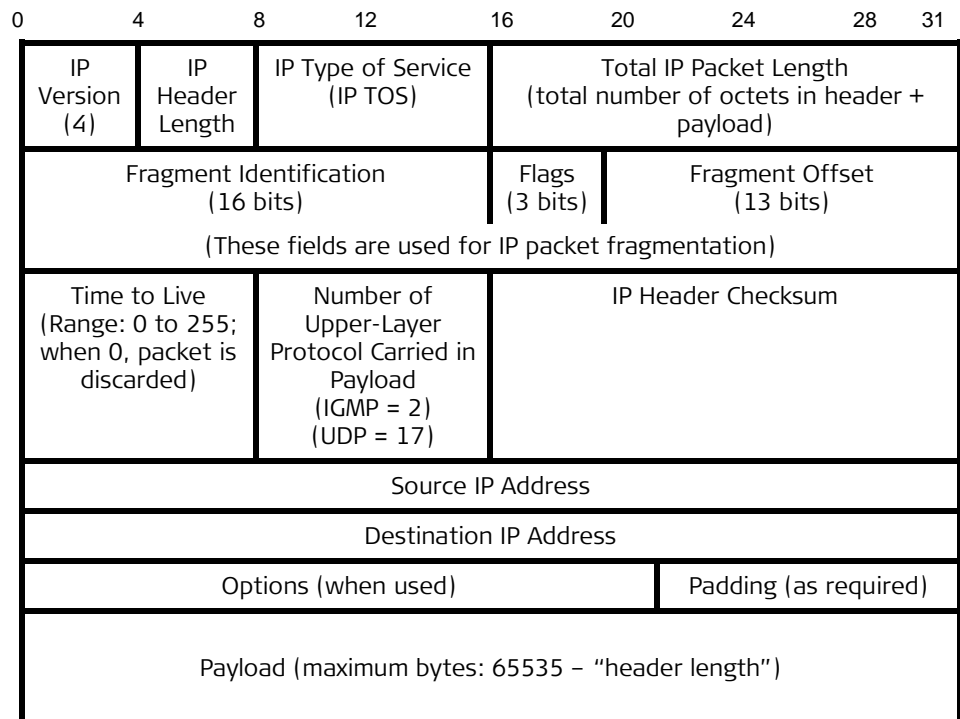
- Since the IP port is actually a connection to an IP network, any number of IP ports can share a given physical port. For example, a single external (physical) port of an ML-IP module can support both the CL IP router, which handles the management traffic, and the internal TDM ports of the ML-IP module.
- An IP port may be reached through several physical ports. For example, the CL IP router can be reached inband, through a dedicated timeslot and through its out-of-band port.

**Note** *By convention, the scope of IP addresses has been extended in two ways:*

- *To permit identification of IP networks*
- *To permit simultaneous addressing of all the ports connected to a IP network (this operation is called broadcasting).*

## IP Packet Structure

The information exchanged through IP networks is organized in packets. The structure of an IP packet, as specified by IP protocol Version 4, is as follows (the numbers are byte numbers):



## IP Address Structure

An IP address is a 32-bit number, represented as four 8-bit bytes. Each byte represents a decimal number in the range of 0 through 255.

The address is written in decimal format, with the bytes separated by decimal points, e.g., 164.90.70.47. This format is called *dotted quad notation*.

An IP address is logically divided into two main portions:

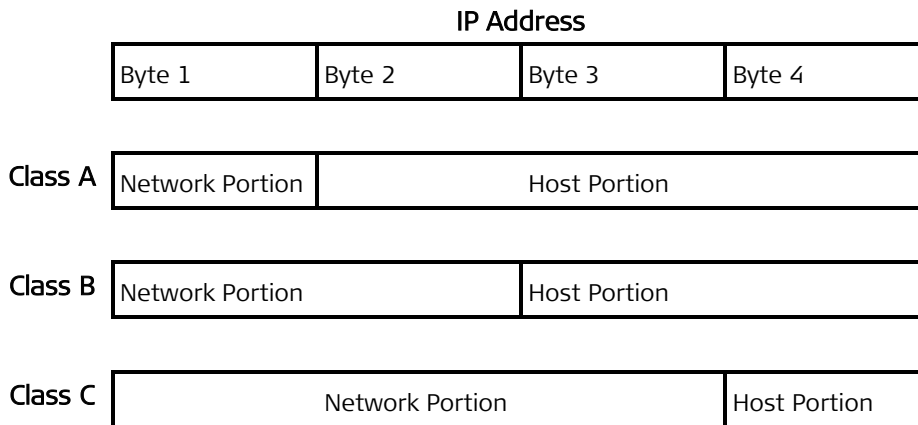
- Network portion
- Host portion.

### Network Portion

In general, the network portion is assigned by the Internet Assigned Numbers Authority (IANA), and its main purpose is to identify a specific IP network. For exceptions, see the *Global vs. Private IP Addresses* section below.

There are five IP address classes: A, B, C, D, and E. However, only the A, B and C classes are used for IP addressing. Consult your network manager with respect to the class of IP addresses used on your network.

The network portion of an IP address can be one, two, or three bytes long, in accordance with the IP address class. This arrangement is illustrated below:



The class of each IP address can be determined from its leftmost byte, in accordance with the following chart:

Address Class	First Byte	Address Range
Class A	0 through 127	0.H.H.H through 127.H.H.H
Class B	128 through 191	128.N.H.H through 191.N.H.H
Class C	192 through 223	192.N.N.H through 223.N.N.H

where:

N – indicates bytes that are part of the network portion

H – indicates bytes that are part of the host portion.

## Host Portion

In general, the host portion is used to identify an individual host connected to an IP network. For exceptions, see [Subnetting](#) section below.

After obtaining an IP network address, the using organization is free to assign host identifiers in accordance with its specific needs.

### Note

*The following host identifiers have special meanings, and must not be assigned to an actual host:*

- *The “all-zeros” host identifier is interpreted as a network identifier.*
- *The “all-ones” host identifier is interpreted as a broadcast address. Therefore, a message with an “all-ones” host identifier is accepted by all the hosts in the network.*

## Global vs. Private IP Addresses

Given the current number of users already having access to the Internet, and the rapid increase in this number, the 32-bit IP space address available in Version 4 of the IP protocol is rather limited.



On the other hand, an IP address must permit unambiguous identification of any host in the Internet. That is the reason the allocation of IP addresses to networks is globally controlled by a universally-accepted IP registry organization (IANA).

Although any address used on the Internet must be unique, there are many IP networks, called private networks, which are not connected to the Internet. A private network is also created when the access of hosts to the Internet is controlled by protocols and procedures that do not permit an outsider to find and use directly the actual address of the hosts connected to that network. A typical example of a private network is the internal IP network of an enterprise (such networks are often called *intranets*).

In recognition of this fact, IANA permits using two types of addresses:

- **Global addresses**, i.e., addresses that are unique in the whole Internet
- **Private addresses**, i.e., addresses allocated for internal use only and therefore cannot be used on the Internet.

Although no restrictions need to be imposed on private addresses except for conforming to the structure specified in the *Network Portion* section above, the following address spaces have been specifically put aside by IANA for use as private addresses:

- The Class A addresses in the range of 10.0.0.0 to 10.255.255.255 (this group of addresses is formally referred to as **10/8**). This address space is actually one Class A network number.
- The Class B addresses in the range of 172.16.0.0 to 172.31.255.255 (this group of addresses is formally referred to as **172.16/12**). This address space defines 16 contiguous Class B network numbers.
- The Class C addresses in the range of 192.168.0.0 to 192.168.255.255 (this group of addresses is formally referred to as **192.168/16**). This address space defines 256 contiguous Class C network numbers.

## Subnetting

Given the scarcity of IP network addresses, for organizations operating several relatively small, physically separated, IP networks, e.g., several departmental networks, it is advantageous to enable several physical networks to share a common IP network address. *Small* in this context means that the number of IP ports connected to each of these networks is small relative to the host address space for the corresponding IP address class.

The approach taken to enable the sharing of an IP network address by two or more networks is called *subnetting*, which means *use of subnets*. The subnetting is relevant only within the using organization, and therefore can be freely selected to meet its specific needs.

To enable subnetting, the meaning of the bits in the host portion of the IP address is further sub-divided into two portions:

- **Subnet number**. For example, subnet numbers can be used to identify departmental subnets. The subnet number follows the network identifier.
- **Host number** – the last bits of the IP address.

This subdivision is illustrated below:

Net Number	Subnet Number	Host Number
------------	---------------	-------------

For example, when the subnet includes 16 IP hosts, only the last four bits need to be reserved for the host number. For an organization which obtained one global Class C network address, this means that four bits are available to identify subnets. Therefore, this organization can implement 16 IP subnets, each comprising up to 16 hosts (except for two subnets that are limited to 15 hosts).

### Subnet Masks

Subnet masks are used to indicate the division of the IP address bits between the net and subnet portion and the host portion.

The mask is a 32-bit word that includes "*ones*" in the positions used for net and subnet identification, followed by "*zeros*" up to the end of the IP address.

For example, the default subnet mask for any Class C address (i.e., all the eight bits in the host address space are used for hosts in the same net) is 255.255.255.000.

However, if the same address is used in a subnet comprising up to 16 hosts and for which the host numbers range is 00 to 15, the subnet mask changes as follows:

IP Address (Dotted-Quad)	192	70	55	13
IP Address (Binary)	1011 1111	0100 0110	0011 0111	0000 0111
Subnet Mask (Binary)	1111 1111	1111 1111	1111 1111	1111 0000
Subnet Mask (Dotted-Quad)	255	255	255	240

In most applications, the binary subnet mask is built as a contiguous string of "*ones*", followed by a number of "*zeros*" (the number of "*zeros*" is selected as needed, to complete the number of subnet mask bits to 32). Therefore, when this conventional approach is used, the subnet mask can also be specified simply by stating the number of "*ones*" in the mask. For example, the subnet mask shown above is specified by stating that it comprises 28 bits.

## IP Routing Principles

The exchange of information between IP hosts is made in packets using the structure specified by the IP protocol. As explained in the *IP Packet Structure* section above, IP frames carry, within their header, the IP addresses of the destination and source hosts.

In accordance with the IP protocol, an IP host checks the addresses of all the received frames, and accepts only frames carrying its own IP address as the destination. The source address is then used to enable the destination to respond to the source.

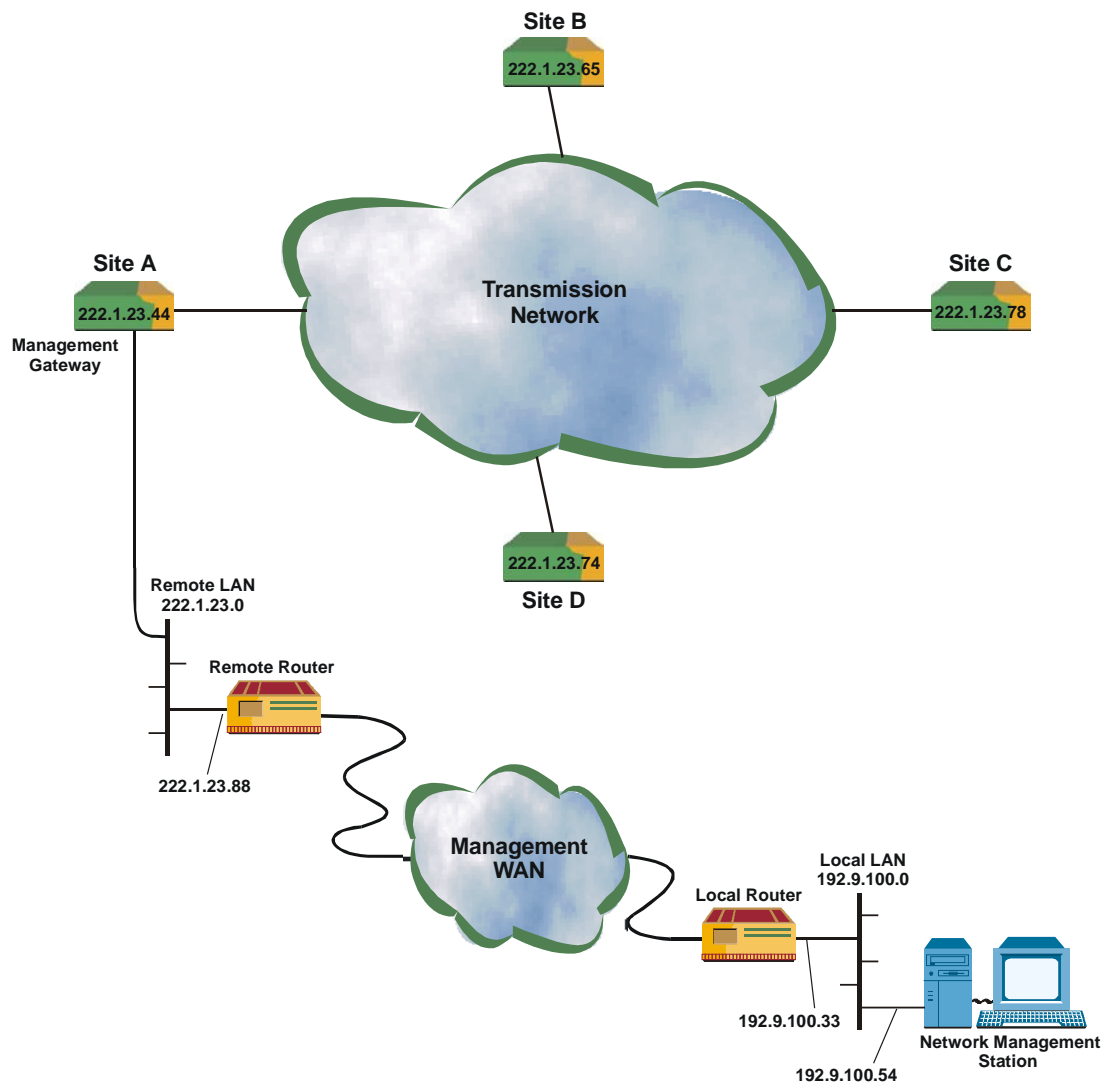
An IP host will also respond to broadcasts (frames whose destination host identifier is "*all-ones*").

**Note** *IP hosts support additional protocols within the IP suite, e.g., protocols used for connectivity checking, maintenance, etc. Therefore, IP hosts will accept additional types of messages, which are beyond the scope of this description.*

When checking the destination address of an IP frame, an IP host starts by checking the network identifier. If the network identifier is different, the host will immediately reject the frame. Therefore, IP hosts can communicate only if they have the same network identifier.

For example, this means that when a management station managing the Megaplex is connected directly, through a LAN, to the Megaplex Ethernet management port, the network identifier part of the IP address assigned to the Megaplex Ethernet port must be identical to the network identifier of the management station.

*Figure B-3* illustrates the use of IP routing. For example, the network shown in *Figure B-3* can be used to manage several Megaplex units from a remotely located network management station, e.g., from the network operator's headquarters.



*Figure B-3. Management of Megaplex Units from a Remote Location*

In *Figure B-3*, the network management station is connected to the Ethernet port of a Megaplex unit (the unit at site A) through a WAN. This Megaplex unit serves as the management gateway for the Megaplex network.

The allocation of IP addresses and subnet masks is explained below:

- **Local LAN.** The Ethernet port of the network management station is connected to the local LAN, which may be shared by many other PCs in the same building. The equipment connected to the local LAN forms an IP network, whose IP address is 192.9.100.0.

The Ethernet NIC of the network management station is assigned the IP address 192.9.100.54.

The local LAN may have several routers connected to it, but a specific router (designated as the local router in *Figure B-3*), has been configured to handle the management traffic. The local LAN port of this router has been assigned the address 192.9.100.33.

The Megaplex Ethernet management port is connected to a remote network (LAN) that has been assigned the IP address 222.1.23.0.

To enable connecting the management station to the inband management network, the following routing data must be configured at the management station:

- Destination address: the remote management network, 222.1.23.0. The associated default subnet mask is 255.255.255.000.
- Gateway address: the LAN port of the local router, 192.9.100.33. The associated default subnet mask is 255.255.255.000.

As a result of this configuration, an IP frame sent by the management station to the remote Megaplex unit is accepted by the local router, which handles the routing to the remote LAN.

- **Remote LAN.** The remote LAN is assigned the IP address 222.1.23.0. The remote router LAN port has the address 222.1.23.88, and the Megaplex Ethernet port has the address 222.1.23.44.

The routing table of the remote router must include an entry that specifies the Ethernet port of the management gateway as the next hop toward the inband management network:

- Destination address: the inband management network, 200.1.2.0. The associated default subnet mask is 255.255.255.000.
- Next hop address: the Ethernet port of the Megaplex unit, 222.1.23.44. The associated default subnet mask is 255.255.255.000.

- **Management gateway and Megaplex management network.** All the managed Megaplex units must be configured to recognize the network management station. This is done by including the IP address of the management station, 192.9.100.54 (and the associated subnet mask, 255.255.255.000), in the list of management stations using the ADD MANAGER LIST command.

In addition, the internal routing table of all the managed Megaplex units (defined with the DEF AGENT command) must point to the remote router LAN port as the gateway for communication with the management station:

- Destination address: the management station address, 192.9.100.54. The associated default subnet mask is 255.255.255.000.
- Default gateway address: the LAN port of the remote router, 222.1.23.88. The associated default subnet mask is 255.255.255.000.

The IP addresses of the CL modules of the Megaplex units are all in the same network, 222.1.23.0. Therefore, management traffic reaching the CL module of the Megaplex unit at site A is transferred to the other Megaplex units via the transmission network. The same is true for traffic sent by any of the other Megaplex units to the network management station.

Within the Megaplex management network, two options can be used to interconnect the various units with respect to management traffic:

- When the transmission network shown in *Figure B-3* consist of circuit-switched links (for example, is based on E1 links), inband management is normally used by configuring the Megaplex units to transmit management traffic through a dedicated timeslot.
- When the Megaplex units included in the network shown in *Figure B-3* include ML-IP modules and the transmission network is an IP-based packet-switched network that carries TDMoIP traffic, the management traffic flowing between the Megaplex unit at site A and all the other units (that is, sites B, C and D) can also be transmitted through the IP network. for this purpose, it is necessary to configure the units at sites B, C and D to route the traffic to the ML-IP network ports.

## Tools for Checking IP Connectivity

The IP protocol is referred to as an unreliable connectionless packet delivery protocol, because each packet transmitted by an IP host travels on its own through the network until it eventually reaches its destination. To ensure reliable delivery, higher layer protocols are used, for example, the widely-used TCP protocol.

However, using higher layer protocols cannot provide an answer to the need to check that it is indeed possible to reach the desired IP destination address, because configuration errors or a network fault, for example, temporary congestion or failure of critical communication links, may still prevent the establishment of an IP connection. Therefore, it is often necessary to check for IP connectivity.

The IP protocol suite includes a special protocol, the Internet Control Message Protocol (ICMP), that enables IP hosts connected to the Internet to report a wide range of errors and provide information about the conditions that caused the errors. Support for this protocol is mandatory on every IP host.

ICMP includes a dedicated connectivity test procedure, implemented by means of two types of ICMP messages: *echo request* and *echo reply*. This procedure is often referred to as *pinging*: the host wanting to check IP connectivity to a destination sends one or more *ping* (echo request) messages, and the destination returns an echo reply message for each request. By comparing the number of *pings* sent to the number received and the time needed for each reply to reach the *ping* source, the source host can obtain useful information regarding the transmission conditions.

## B.4 Ethernet Transmission Technology

### Introduction to Ethernet Transmission

The IP protocol described in [Section B.3](#) defines a method for packet communication, without specifying means for packet transfer. Therefore, IP communication can be supported by a wide range of transmission technologies.

One of the most successful transmission technologies is referred to by the generic term *Ethernet*. The Ethernet technology is suitable for a wide range of physical media: coaxial cable, twisted pairs and optical fibers. The current standards for Ethernet transmission cover rates from 10 Mbps to 10 Gbps. In many office LANs, Ethernet runs at 10 Mbps and 100 Mbps; network interface cards (NICs) for PCs usually support both of these rates (this is also true for the HS-ETH I/O modules offered for the Megaplex systems).

The basic standard covering Ethernet LANs is IEEE Standard 802.3, which is very similar to the original Ethernet V2.0 specification (ISO/IEC also have a similar standard). In addition to the aspects covered by IEEE 802.3 standards, there is a wide range of LAN standards (the IEEE 802 family) that cover other aspects of LAN transmission, for example, bridging, with particular emphasis on Ethernet LANs.

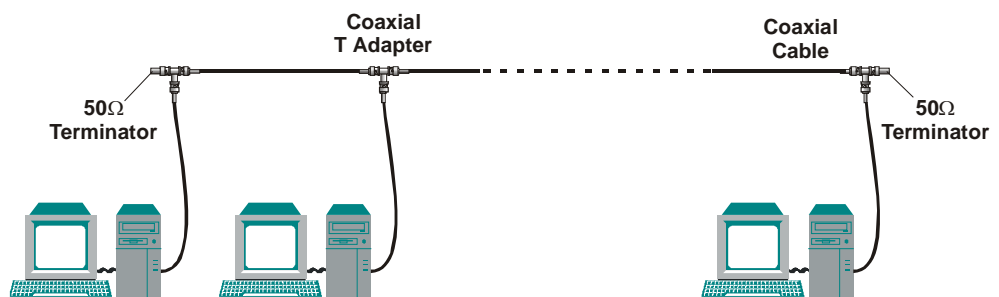
Ethernet standards (in their broadest interpretation) cover the physical and data link control layers (layers 1 and 2 in the OSI model; IP is a layer 3 protocol). The data link control layer is split into two sublayers: media access control (MAC) and logical link control (LLC).

### Ethernet LAN Topologies

Ethernet LANs use a multidrop topology. The LANs can be implemented either in bus or star (hub-based) topology.

#### LANs Using the Bus Topology

[Figure B-4](#) shows the general structure of a LAN using the bus topology.



*Figure B-4. Ethernet LAN Using the Bus Topology*

The bus usually consists of a coaxial cable that runs between the users' stations. All the connectors are BNC. The Ethernet interfaces of the stations connected to the LAN (this type of interface is designated *10Base2*) connect directly to a

coaxial cable, by means of T adapters. Matched terminations are connected to both ends of the cable, to prevent reflections.

The nominal operating rate of this interface is 10 Mbps. 10Base2 interfaces operate only in the half-duplex mode.

## Star (Hub-Based) LAN Topology

Figure B-5 shows the general structure of a LAN using the star topology.

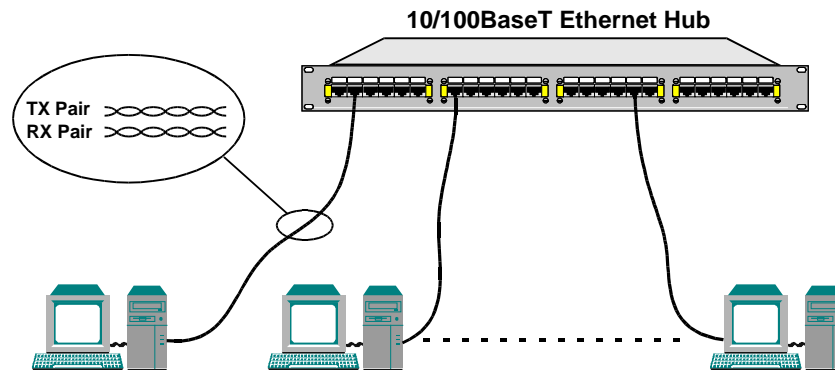


Figure B-5. Star (Hub-Based) Ethernet LAN Topology

In the star topology, all the nodes on the LAN are connected to a common unit, which serves as the hub of the LAN. The hub can be implemented in two ways:

- Simple Ethernet hub, which detects the transmitting node and transparently distributes its signal to all the other nodes. A hub supports only half-duplex communication (the same as in a bus topology).
- Ethernet switch: the switch includes more sophisticated circuits that enable both half-duplex and full-duplex operation and prevent collisions.

In a star topology, the LAN cables are usually made of two twisted pairs (one transmit pair and one receive pair). The standard connector type is RJ-45, and its pin assignment has also been standardized. However, because of the need to use separate transmit and receive pairs, two types of port pin assignments have developed: station ports and hub ports (the difference is interchanging of the transmit and receive pins in the connector).

This permits to interconnect connectors of different types by a cable wired pin-to-pin (straight cable). To interconnect ports of same type, a crossed cable (a cable wired to interconnect the transmit pair at one end to the receive pair at the other end) is necessary.

Interfaces operating on twisted pairs are designated in accordance with data rate: 10Base-T (10 Mbps) or 100Base-TX (100 Mbps, where X is the number of pairs). Interfaces that support both rates are identified as 10/100BaseT. 100 Mbps fiber optic interfaces are identified as 100Base-FX (where X is the number of fibers).

## Ethernet Communication Protocol

Today, Ethernet is used as a generic term for a LAN transmission technology that uses Carrier Sense and Multiple Access with Collision Detection (CSMA/CD) to enable the transmission of short bursts of data (called *frames*) between two or

more stations (*nodes*). The simplest way to visualize the transmission technology is to use the bus analogy: as shown in *Figure B-4*, the bus runs between all the users.

Therefore, all the users have permanent access to the full bandwidth of the transmission medium but can only use it for short times, by transmitting short data bursts. Each data burst has a fixed structure, called a frame. The frame structure is explained below. The connection point of each user to the transmission media is called a node. For identification purposes, each LAN node is assigned a unique number, called address.

## Media Access Method

Media access is performed by means of the carrier sense, multiple access protocol (CSMA) with collision detection (CD), defined by IEEE Standard 802.3. The protocol defines three basic steps:

- A node that wants to transmit checks that the LAN is free. If another node is already transmitting, the node waits until the LAN is free.
- When the LAN is free, the node starts transmission and sends its frame. Each node has equal access rights, therefore the first node that starts transmitting is the one that seizes the LAN.
- When two nodes start transmitting at the same instant, a collision occurs. In this case, the transmitting nodes will continue to transmit for some time, in order to ensure that all transmitting nodes detected the collision (this is called “jamming”). After the jamming period, all transmitting nodes stop the transmission and wait for a random period of time before trying again.

The delay times are a function of collision numbers and random time delay, therefore there is a good chance that an additional collision between these nodes will be avoided, and the nodes will be able to transmit their messages.

The basic procedure described above has been developed for half-duplex communication, because it declares a collision whenever data is received during a local transmission. However, when using twisted pairs, separate pairs are used for the transmit and receive directions. Therefore, each node is capable of simultaneously transmitting and receiving (full-duplex operation), thereby doubling the effective data rate on the LAN.

Modern Ethernet interfaces, designated 10/100BaseT, are also capable of operation at the two basic rates, 10 Mbps and 100 Mbps. Therefore, the rate and operating mode (half-duplex or full-duplex) are user-configurable options.

When connecting equipment from different vendors to a common LAN, four operating modes are possible. These modes are listed below in ascending order of capabilities:

- Half-duplex operation at 10 Mbps.
- Full-duplex operation at 10 Mbps.
- Half-duplex operation at 100 Mbps.
- Full-duplex operation at 100 Mbps.

To ensure interoperability (which practically means to select the highest transport capability supported by all the equipment connected to the LAN), two approaches



can be used: manual configuration of each equipment interface, or automatic negotiation (auto-negotiation) in accordance with IEEE Standard 802.3.

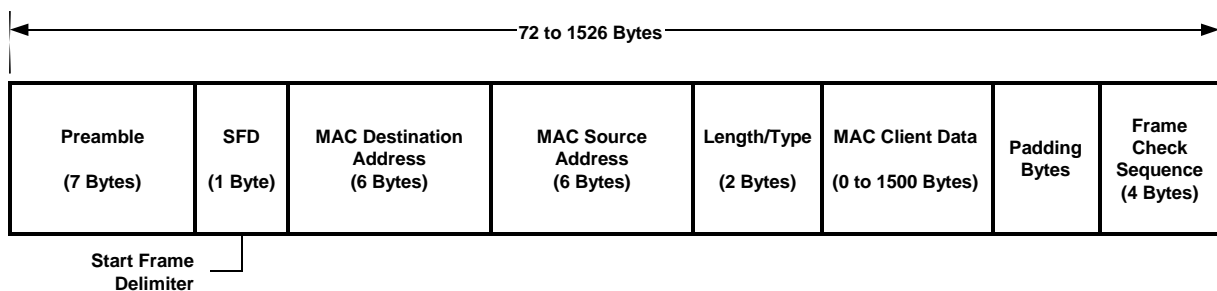
The auto-negotiation procedure enables automatic selection of the operating mode on a LAN, and also enables equipment connecting to an operating LAN to automatically adopt the LAN operating mode (if it is capable of supporting that mode).

When auto-negotiation is enabled on all the nodes attached (or trying to attach) to a LAN, the process is always successful. However, even if the nodes on an operating LAN are manually configured for operation in a fixed mode, a late-comer node with auto-negotiation capability can still resolve the LAN operating rate can be resolved, thereby enabling it to adopt the LAN rate. Under these conditions, an auto-negotiating node cannot detect the operating mode (half or full duplex), and therefore they will default to half-duplex. Therefore, as a practical configuration rule, do not enable the full-duplex mode without enabling auto-negotiation, except when all the nodes have been manually configured for the desired operating mode (which may of course be full duplex).

## Basic Ethernet Frame Structure

The frame transmitted by each node contains routing, management and error correction information. For Ethernet LANs, the characteristics of frames are defined by IEEE Standard 802.3.

Basic frame lengths can vary from 72 to 1526 bytes and have the typical structure shown in *Figure B-6*.



*Figure B-6. Basic Ethernet Frame Structure*

- **Preamble.** Each frame starts with a preamble of seven bytes. The preamble is used as a synchronizing sequence for the interface circuits, and helps bit decoding.
- **Start-Frame Delimiter (SFD)** field – consists of one byte. The SFD field indicates where the useful information starts.
- **Medium-Access (MAC) Destination Address (DA)** field – consists of six bytes. The MAC DA field carries the address of the destination node.
- **Medium-Access (MAC) Source Address (SA)** field – consists of six bytes. The MAC SA field carries the address of the source node.

**Note** *In writing, MAC addresses are represented as 6 pairs of hexadecimal digits, separated by dashes, for example, 08-10-39-03-2F-C3.*

- **Length/Type** field – consists of two bytes that indicate the number of bytes contained in the logical link control (LLC) data field. In most Ethernet protocol

versions, this field contains a constant indicating the protocol type (in this case, this field is designated **EtherType**).

- **MAC Client Data** field. The MAC client data field can contain 0 to 1500 bytes of user-supplied data.
- **Padding** field. The optional padding field contains dummy data, that is used to increase the length of short frames to at least 64 bytes.
- **Frame Check Sequence (FCS)** field – contains four check bytes generated by a cyclic redundancy check (CRC) code. The FCS field is used to detect errors in the data carried in the frame.

## Bridging

### Communication between Nodes on Same LAN

Unlike IP addresses, a MAC address is unique and identifies a single physical port. Therefore, two Ethernet nodes attached to the same LAN exchange frame directly, by specifying the desired MAC destination address, together with the source MAC address. The node that identifies its MAC address in the destination field can send a response by copying the source address of the frame to the destination address field.

### Communication between Nodes on Different LANs

To enable nodes on different LANs to communicate, it is necessary to transfer frames between the two LANs. The device used for this purpose is called **MAC bridge**, or just **bridge**. Two types of bridges are used:

- Local bridges, which have Ethernet ports attached to the two LANs. The bridge control mechanism learns the nodes attached to each LAN by reading the source MAC addresses of the frames generated by the nodes. When the destination address of a frame is not on the LAN from which it was received, the bridge transfers it to the other LAN.
- Remote bridges, which are used in pairs. A basic remote bridge has one LAN port and one WAN port. The WAN port communicates through a link with the WAN port of the remote bridge connected to the desired remote LAN. In this case, the traffic addressed to destinations not located on the local LAN is transferred through the WAN link to the remote bridge.

### Using Virtual Bridged LANs

VLAN can be used to provide separation between traffic from different sources sharing the same physical transmission facilities, and provide information on the relative priority the user assigns to each frame. The characteristics and use of virtual LANs (VLANs) and of the MAC bridges capable of handling tagged frames are defined in IEEE Standard 802.1Q.

VLANs are made possible by a slight modification to the Ethernet frame structure shown in [Figure B-6](#).

The structure of an Ethernet frame with VLAN support is shown in [Figure B-7](#) (for simplicity, the figure does not include the preamble and SFD fields).

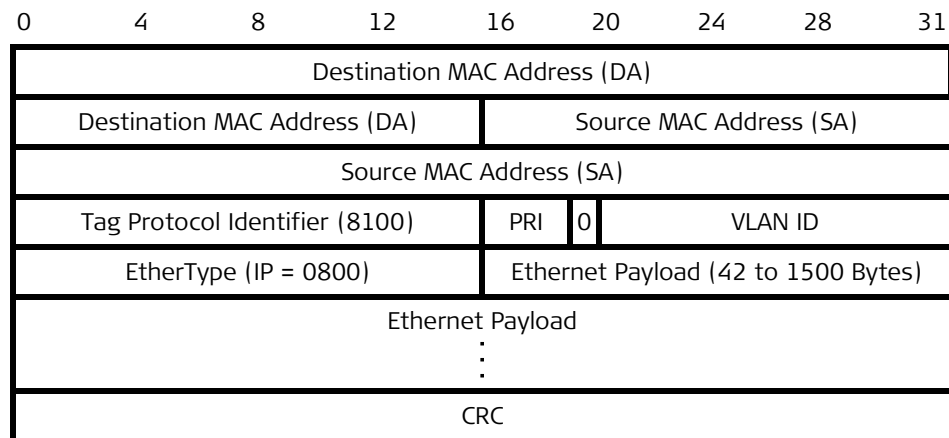


Figure B-7. Structure of Ethernet Frame with VLAN Support

Ethernet frames with VLAN support include a tag header immediately after the source MAC address (therefore, such frames are also referred to as *tagged frames*).

The tag header comprises 4 bytes:

- Two bytes for the tag protocol identifier. For Ethernet-encoded tags in accordance with IEEE802.1Q (these are the tags used by ML-IP modules), these bytes carry the equivalent of 8100.
- Priority (PRI) specified by the user (3 bits: 7 is the highest priority and 0 is the lowest priority).
- One bit for the canonical format indicator (always 0 as shown in [Figure B-7](#)).
- VLAN ID (12 bits), used to indicate the VLAN to which the frame belongs.

## Transporting IP Traffic over Ethernet

### Encapsulation in Ethernet Frames

IP traffic is carried in the LLC data field of the Ethernet frame (see [Figure B-6](#)). This is called *encapsulation*. The EtherType value for the IP protocol is 0800.

Whenever possible, the whole IP packet (including the header) is inserted in one Ethernet frame. However, IP packets can be much longer than the LLC data field of Ethernet frames: in this case, it is necessary to fragment the IP packets in accordance with the desired size of data field, and transfer each fragment in a separate frame. The receiving IP host then reassembles the original packet from its fragments.

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**Note** *TDMoIP packets are never fragmented. This is not necessary anyway, because a TDMoIP packet is relatively short.*

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### ARP Protocol

When sending IP packets over Ethernet, it is necessary to determine the MAC address of the destination, to insert it in the Ethernet destination MAC address of the packet. Actually, this is necessary for any physical transmission technology which is not limited to point-to-point topologies.

This is performed by means of the ARP (Address Resolution Protocol), part of the IP suite of protocols. ARP is used to generate a look-up table that translates IP addresses to MAC addresses for any transmission technology. The translation is done only for outgoing IP packets, because this is when the IP header and the Ethernet header are created.

The ARP table contains one row for each IP host: each row has two columns, one listing the IP address and the other listing the corresponding MAC (Ethernet) address. When translating an IP address to an Ethernet address, the table is searched for the row corresponding to the destination IP address, and the corresponding Ethernet address is then found in the same row.

Whenever a packet must be sent to a new IP destination, that is, a destination whose MAC address is not known, the IP host sends an ARP request packet, listing its own IP address and MAC address, the destination IP address, but no destination MAC address. When the packet reaches the destination address (using the IP routing process), the destination returns an ARP response packet, in which its own MAC address field is filled. The packet eventually returns to the sender, thereby providing the missing information.

The structure of ARP packets is shown in *Figure B-8*.

When the management traffic of the CL module is routed through an ML-IP module installed in the same chassis, the module serves as an ARP proxy for the CL module, that is, it provides the ARP service for the CL IP router.

0	4	8	12	16	20	24	28	31
Hardware Address Type (Ethernet = 1)				Protocol Address Type (IP = 2048)				
Length of Hardware (MAC) Address Field (Ethernet = 6 Bytes)		Length of Protocol Address Field (IP = 4 Bytes)		Operation: ARP Request = 1 ARP Response = 2				
Source MAC Address (Bytes 0 through 3)								
Source MAC Address (Bytes 4, 5)				Source IP Address (Bytes 0, 1)				
Source IP Address (Bytes 2, 3)				Destination MAC Address (Bytes 0, 1)				
Destination MAC Address (Bytes 2 through 5)								
Destination IP Address (Bytes 0 through 3)								

*Figure B-8. Structure of ARP Packets*

## B.5 TDMoIP Environment

### Introduction to TDMoIP

TDMoIP is a technology for emulating TDM circuits over IP networks. TDMoIP transport capabilities include E1, fractional E1, T1 and fractional T1 data streams, with and without channel-associated signaling.

The TDMoIP technology enables transmitting the continuous data stream generated by TDM equipment as a stream of discrete packets, having a structure suitable for transmission over packet-switched networks. The data stream consists of individual timeslots retrieved from the E1 or T1 frame structure; each independent set of timeslots is referred to as a *bundle*. The TDMoIP packets are encapsulated in UDP packets and transported using IP.

In many applications, the TDMoIP technology must transfer not only the data stream, but also the original timing (clock rate).

### User Datagram Protocol

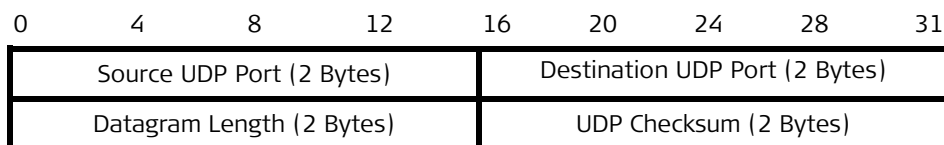
The User Datagram Protocol (UDP) is a transport protocol (that is, a layer 4 protocol in the OSI model) that provides an unreliable connectionless delivery service. UDP uses IP to transport messages among host machines.

One of the main characteristics of UDP is support for multiple destinations within a given host machine, which means that it enables the multiplexing of traffic from multiple sources, for example, different software processes running on the host machine, over the same IP link. The term used to refer to a UDP source (or destination) is *port*.

UDP messages are called *user datagrams*. A datagram consists of two parts:

- **User datagram header.** The is divided into four 16-bit fields that specify the port from which them was sent, the port to which the message is destined, the message length, and a UDP checksum.

*Figure B-9* shows the structure of a UDP datagram header.



*Figure B-9. Structure of UDP Datagram Header*

- The source and destination fields carry the 16-bit UDP protocol port numbers used to demultiplex datagrams.  
In UDP, the source port is optional: when used, it specifies the port to which replies should be sent; if not used, it should be zero.
- The length field carries the number of bytes in the complete UDP datagram (UDP header and user data).

- The UDP checksum is optional; 0 in the checksum field means that the checksum has not been computed and the field must be ignored at the receive side.
- **User datagram data field.** The datagram data field can include up to 65527 bytes.

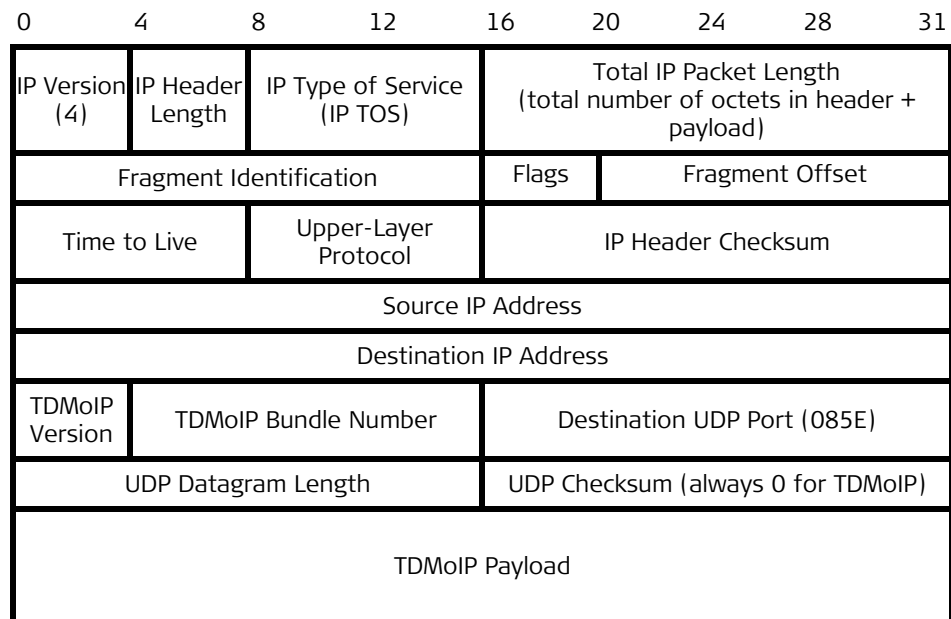
### Structure of TDMoIP Packets

*Figure B-10* shows the structure of a basic TDMoIP packet.

The packet includes the standard IP packet header, explained in [Section B.3](#), followed by the UDP datagram carrying the payload, which is encapsulated in the IP packet:

However, the UDP datagram header is slightly modified relative to the standard header:

- The UDP source port field is divided into two sections:
  - Three bits that identify the TDMoIP protocol version
  - 13 bits that identify the TDMoIP bundle number.
- The destination UDP port number is 085E.
- The checksum is 0 (not calculated).



*Figure B-10. Structure of Basic TDMoIP Packets*

### Structure of Ethernet Frame Carrying TDMoIP Payload

When the TDMoIP traffic is carried over Ethernet, the basic TDMoIP packet shown in [Figure B-10](#) is encapsulated in the frame shown in [Figure B-6](#) (without using VLANs) or [Figure B-7](#) (when using VLANs).

Essentially, this adds the corresponding frame header before the TDMoIP packet, and the CRC field after the packet.

## TDMoIP Packetizing Process

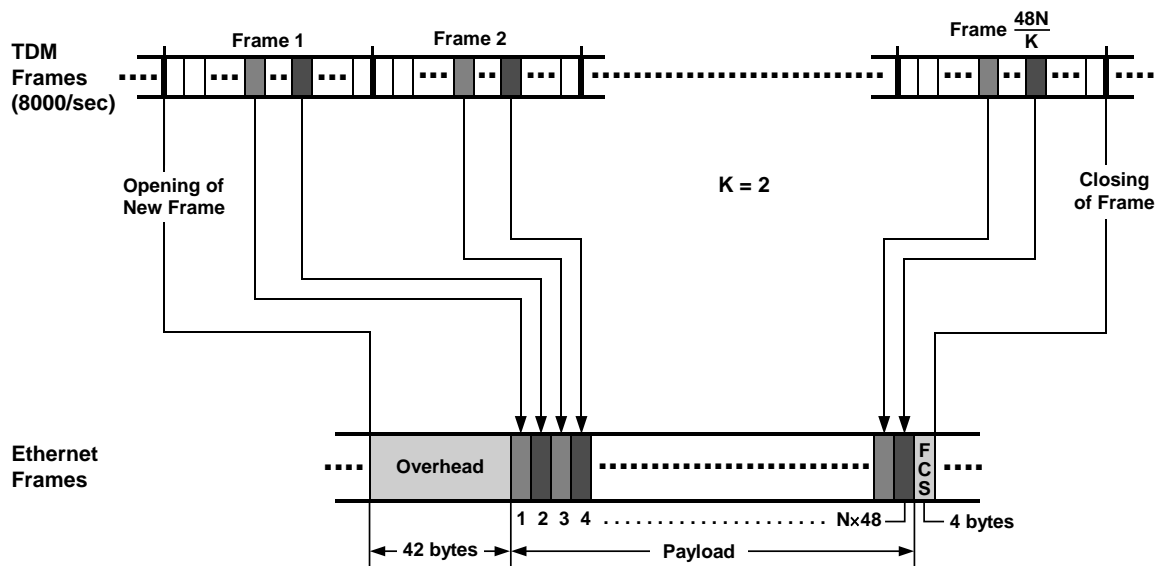
This section describes the process used to build TDMoIP packets.

A simplified diagram of this process, which identifies the main steps of the process, is shown in [Figure B-11](#). The packetizing process comprises the following main steps:

1. Splitting the continuous TDM data stream into discrete slices of appropriate size. The slice size is always an integer number of bytes. For example, in [Figure B-11](#), the number of TDM bytes per slice,  $K$ , is 2.
2. Adding the overhead necessary to transmit each slice over the packet network and enable reaching the desired destination. Basically, this process includes the following steps:
  1. Inserting the TDM bytes into the payload field of a UDP packet, and adding the overhead data needed to build a UDP packet.
  2. Inserting the UDP packet into the payload field of an IP packet, and adding the overhead data needed to build an IP packet for transmission to the desired IP destination.
  3. Inserting the IP packet into the payload field of an Ethernet frame, and adding the MAC overhead needed to build an Ethernet frame for transmission to the destination MAC address (the MAC address needed to reach the desired IP destination is determined using the ARP protocol). For example, in [Figure B-11](#) the resultant overhead comprises a total of 54 bytes.

### Note

*The actual overhead depends on several factors, one of them being the encoding method used to transmit CAS information. [Figure B-11](#) also ignores the minimum interpacket gap, which further increases the overhead.*



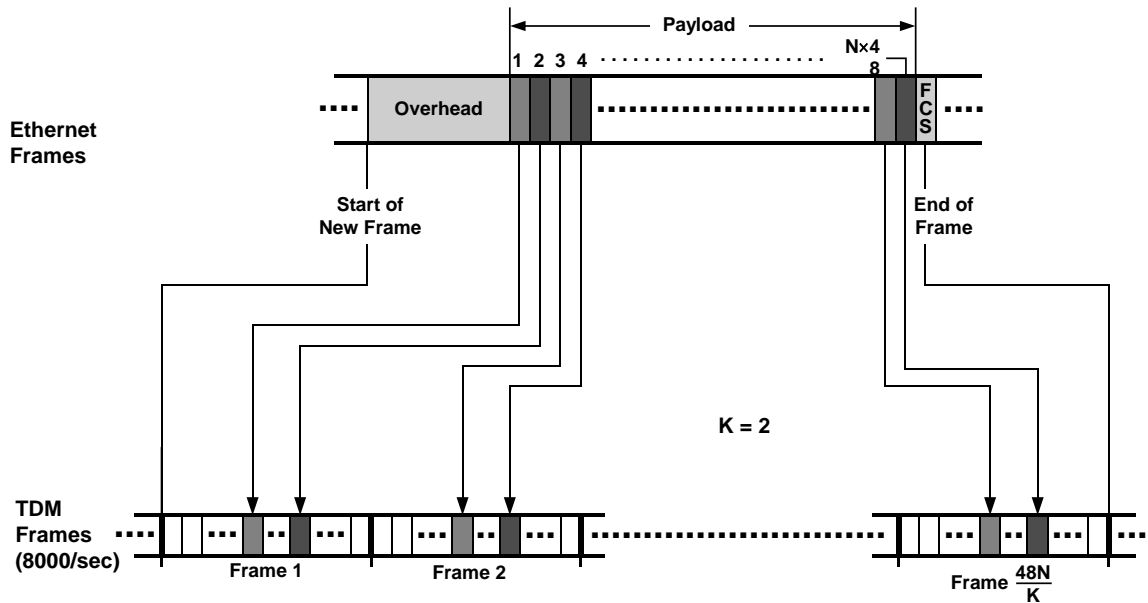
*Figure B-11. Building an Ethernet Frame with TDMoIP Payload*

The receiving end performs the steps necessary to reconstruct the original TDM data stream from the received frames, in the "best" possible way, where "best" means meeting a set of criteria that describe a compromise among several

conflicting requirements. A simplified diagram of this process, which identifies the main steps of the process, is shown in *Figure B-12*.

The number of TDM bytes inserted in each Ethernet frame sent to the network, which is actually the size of the UDP packet payload field, affects two important performance parameters:

- Bandwidth utilization
- Packetizing delay and the associated delay variance.



*Figure B-12. Retrieving the Payload from an Ethernet Frame with TDMoIP Payload*

## Bandwidth Utilization Considerations

Because of the relatively short TDMoIP payload, the bandwidth utilization efficiency depends on the overhead that must be transmitted to the LAN in order to support the transmission of a certain amount of payload. To enable the transmission of as many TDM channels as possible through a LAN operating at a given rate (10 Mbps or 100 Mbps), it is necessary to estimate the bandwidth that must be reserved for overhead.

A simplified approach that enables obtaining estimates of LAN bandwidth requirements for planning the link capacities at the system level, is presented below.

This approach provides the information needed to understand the parameters which influence the amount of overhead, and to obtain rough estimates (usually accurate within  $\pm 10\%$ ) of the required bandwidth. You can also use this approach to estimate the processing capacity needed at Layer 2 switches and routers that handle the TDMoIP traffic.

To obtain more accurate results, it is necessary to take into consideration additional factors, for example, the detailed structure of the bundle packets, which depends on parameters such as signaling support, etc.

If very accurate estimates of bandwidth are required, contact RAD Technical Support Department for additional information.



➤ **To find the frame overhead:**

Each Ethernet frame carrying TDMoIP traffic carries a fixed amount of overhead. Therefore, the maximum bandwidth that must be reserved for overhead transmission depends only on the maximum rate of Ethernet frames that can be transmitted to the LAN.

The amount of overhead is as follows:

- Without VLAN tagging, each Ethernet frame includes 46 or 66 bytes (368 or 528 bits) of overhead. The lower value ignores the preamble and the interpacket gap (the simplified diagrams shown in [Figure B-11](#) and [Figure B-12](#) use a nominal value of 54 bytes (432 bits)).
- When VLAN tagging is used, the overhead increases by 4 bytes (32 bits).

➤ **To find the maximum rate of frames that can be transmitted to the LAN:**

The payload carried by each Ethernet frame is determined by the number of TDM bytes selected by the user, which is  $N \times 48$  bytes, where  $N$  can be selected by the user in the range of 1, 2, ...8 (this results in payloads of 48 to 384 TDM bytes per frame).

Considering that any given TDM byte is received only once in every TDM frame, the maximum rate at which TDM bytes can be received for filling packets is 8000 bytes per timeslot per second. Since an Ethernet frame will be sent only after its payload field has been filled, the maximum filling rate occurs for bundles carrying 31 timeslots and a payload of 48 bytes per frame: in this case, the filling of the 48 bytes takes 1.6 internal TDM frames, and thus the rate of payload filling is approx. 5000/sec.

**Note**

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*Considering the overhead, the actual packet rate for a 31-timeslot bundle without CAS is 5290 packets per second; with CAS, the maximum bundle size is 30 timeslots and the resulting rate is 5280 packets per second.*

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The filling rate for the other available TDM payload sizes is  $N$  times smaller: for example, for the largest  $n$ , 8, the filling rate is approx. 625/sec.

➤ **To find the actual rate of frames that can be transmitted to the LAN:**

The approach presented above for calculating the maximum filling rate per port can also be used for calculating the actual filling rate for other configurations.

For example, at any given  $N$  value, the filling rate also decreases when the number of timeslots per bundle is less than the maximum. However, in many practical cases the timeslots available on an internal TDM port will be divided among several bundles, where each bundle has its own filling rate. This tends to increase again the average filling rate per internal port.

➤ **To find the transport capacity requirements:**

The maximum bandwidth that must be allocated to the transmission of TDMoIP traffic depends on the payload rate, the number of TDM bytes per frame, CAS support, and the use of VLAN tagging.

The maximum values for the minimum and maximum numbers of TDM bytes per frame are given in [Table B-1](#).

*Table B-1* provides two types of information:

- The maximum LAN transport capacity required to support a single internal TDM port (maximum bundle size of 30 payload and one CAS timeslots).  
When considering the LAN capacity needed to support both internal ports of an ML-IP module, the values are doubled.
- The maximum IP transport and processing capacity needed to support a single TDM internal port, and the values for both internal ports. These values are useful for planning the maximum load on IP routers handling TDMoIP traffic.

*Table B-1. Maximum Transport Capacity Requirements*

TDM Bytes per Frame	Maximum Required IP Capacity		Maximum Required LAN Transport Capacity			
			Without VLAN Tagging		With VLAN Tagging	
	TDM Port	Module	TDM Port	Module	TDM Port	Module
48	3308 kbps	6616 kbps	4912 kbps	9824 kbps	5136 kbps	10272 kbps
384	2242 kbps	4484 kbps	2448 kbps	4996 kbps	2470 kbps	4980 kbps

The values appearing in *Table B-1* should be used for conservative design, which means that full flexibility in changing bundle configuration is available without having to reconsider the LAN transport capacity.

For ML-IP modules, additional factors must be considered when evaluating the LAN transport capacity requirements are:

- Bandwidth needed for the CL module management traffic routed through the ML-IP module
- Bandwidth needed for transferring the user's port traffic (the traffic received through the ML-IP USER port), when this port is indeed used.

You may also have to take into consideration the bandwidth needed by other equipment connected to the same LAN, when the LAN to which the ML-IP ports are connected is shared with additional users.

## Packetizing Delay Considerations

The discussion presented above with respect to bandwidth utilization efficiency seems to point to the advantages of using a large payload size per frame. However, there are additional aspects that must be considered when selecting the size of the TDMoIP payload:

- **Filling time:** the filling time, which is the time needed to load the payload into an Ethernet frame, increases in direct proportion to the number of bytes in the TDMoIP payload. This is particularly significant for bundles with few timeslots; for example, a voice channel could be carried by a single-timeslot bundle. Considering the nominal filling rate (approximately one byte every 0.125 msec), the time needed to fill a single-timeslot bundle is as follows:
  - At 48 TDM bytes per frame: 5.5 msec with CAS support and 5.9 msec without CAS support
  - At 384 TDM bytes per frame: 44 msec with CAS support and 47 msec without CAS support.

Therefore, before considering any other delays encountered along the end-to-end transmission path, the round-trip (or echo) delay for the voice channel example presented above is 92 msec at 384 TDM bytes per frame (including the additional intrinsic delay of processor – see below).

Such long delays may also cause time-out in certain data transmission protocols.

- **Intrinsic jitter:** the transmission of packets to the network is performed at nominally equal intervals (for the ML-IP module, the interval is 1 msec). This means that every 1 msec the TDMoIP packet processor sends to the network (through the appropriate Ethernet interface) all the frames ready for transmission. As a result, the actual payload transmission intervals vary in an apparently random way whose peak value depends on the bundle size, an effect called *delay variance* (or jitter).

For example, a bundle with 6 timeslots will fill a 48-byte payload field of an Ethernet frame every 1 msec. If the sending instants are not perfectly synchronized with the filling instants, the sending time will sometimes occur just in time and sometimes will be delayed by 1 msec relative to the ideal, creating a peak delay variance of 1 msec at the transmitting side.

The intrinsic jitter in other cases is lower, therefore the delay variance generated by the ML-IP module cannot exceed 2 msec.

## Use of Jitter Buffers

The method used to mitigate the effects of delay variation is the use of a jitter buffer.

### Background

Ideally, since frames are transmitted at regular intervals, they should reach the destination after some fixed delay. If the transmission delay through the network were indeed constant, the frames would be received at regular intervals and in their original transmission order.

In practice, the transmission delay varies because of several factors:

- Intrinsic jitter at the transmit side, described above
- Variations in the transmission time through the network, caused by the frame handling method: frames pass through many switches and routers, and in each of them the frame (or the packet encapsulated in the frame) is first stored in a queue with frames or packets from other sources, and is then forwarded to the next link when its time arrives.
- Intrinsic jitter at the receive side, due to the variation in the time needed to extract the payload from the received packets.

### Jitter Buffer Functions

Any network designed for reliable data transmission must have a negligibly low rate of data loss. Therefore, it is reasonable to assume that essentially all the transmitted frames reach their destination. Under these circumstances, the rate at which frames are received from the network is equal to the rate at which

frames are transmitted by their source (provided that the measurement is made over a sufficiently long time).

As a result, it is possible to compensate for transmission delay variations by using a large enough temporary storage. This storage, called *jitter buffer*, serves as a first-in, first-out buffer.

The buffer has two clock signals:

- Write clock, used to load packets into the buffer. Since each packet is loaded immediately after being successfully received from the network, packets are written into the buffer at irregular intervals.
- Read clock, used to transfer packets to the packet processor at a fixed rate.

The jitter buffer operates as follows:

- At the beginning of a session, the buffer is loaded with dummy frames until it is half full. No bits are read from the buffer at this time. Therefore, a delay is introduced in the data path.
- After the buffer reaches the half-full mark, the read-out process is started. The data bits are read out at an essentially constant rate. To prevent the buffer from either overflowing or becoming empty (underflow), the read-out rate must be equal to the average rate at which frames are received from the network. Therefore, the buffer occupancy remains near the half-full mark.

The buffer stores the frames in accordance with their arrival order.

## Selecting an Optimal Jitter Buffer Size

For reliable operation, the jitter buffer must be large enough to ensure that it is not emptied when the transmission delay increases temporarily (an effect called *underflow*, or *underrun*), nor fills up to the point that it can no longer accept new frames when the transmission delay decreases temporarily (an effect called *overflow*).

The minimum size of a jitter buffer depends on the intrinsic jitter: for example, for the ML-IP module, the minimum value is 3 msec. The maximum size is 300 msec.

The theoretically correct value for the size of the jitter buffer of any given bundle is slightly more than the maximum variation in the transmission delay through the network, as observed on the particular link between the bundle source and the destination. For practical reasons, it is sufficient to select a value that is not exceeded for any desired percentage of time: for example, a value of 99.93% means that the jitter buffer will overflow or underflow for an accumulated total of only one minute per day.

Jitter buffers are located at both ends of a link, therefore the delay added by the buffers is twice the selected value. The resultant increase in the round-trip delay of a connection may cause problems ranging from inconvenience because of long echo delays on audio circuits (similar to those encountered on satellite links) to time-out of data transmission protocols.

Therefore, the size of each jitter buffer must be minimized, to reduce the round-trip delay of each connection in as far as possible, while still maintaining the link availability at a level consistent with the application requirements.

## Adaptive Timing

Because of the transmission characteristics of packet switching networks, which use statistical multiplexing, the average rate must be measured over a sufficiently long interval. The optimal measurement interval is equal to the difference between the maximum and minimum transmission delays expected in the network.

As explained above, the buffer is used to store packets for an interval equal to the maximum expected delay variation. Therefore, this buffer can be used by the adaptive timing mechanism, to recover a clock having a frequency equal to the average transmit rate.

The method used to recover the payload clock of a bundle is based on monitoring the fill level of the jitter buffer: the clock recovery mechanism monitors the buffer fill level, and generates a read-out clock signal with adjustable frequency. The frequency of this clock signal is adjusted so as to read frames out of the buffer at a rate that keeps the jitter buffer as near as possible to the half-full mark. This condition can be maintained only when the rate at which frames are loaded into the buffer is equal to the rate at which frames are removed.

Assuming that the IP network does not lose data, the average rate at which payload arrives will be equal to the rate at which payload is transmitted by the source. Therefore, the adaptive clock recovery mechanism actually recovers the original payload transmit clock.

This mechanism described above also generates a clock signal having the frequency necessary to read-out frames at the rate that keeps the jitter buffer as near as possible to the half-full mark.

The bundle used as the basis for recovering the adaptive clock can be selected by the user.





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