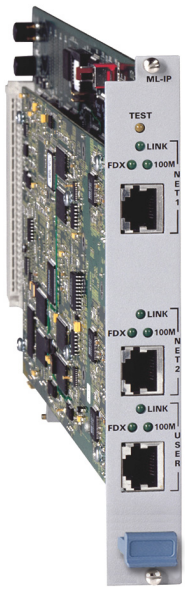
Data Sheet

Megaplex-2100/2014 Module

ML-IP

Pseudowire Main Link Module



- TDM multiplexing integrated with Ethernet switching for voice, fax and sync/async data transfer over Ethernet or IP networks
- Resilient Fast Ethernet Ring (RFER) technology for self-healing protection on 100-Mbps Fast Ethernet or IP networks
- Compatible with RAD's IPmux TDMoIP Gateways
- Two 10/100BaseT or 100BaseF uplink ports for connecting to IP networks and supporting daisy chain or ring topologies
- Echo canceller option for canceling the near-end echo

Cost-effective, versatile solution for legacy TDM services over Ethernet/IP networks

TDMoIP® Driven

The ML-IP main link module provides a cost-effective and versatile, modular pseudowire (TDMoIP) solution for legacy TDM services over packet networks. It converts the TDM bit stream delivered by the internal Megaplex-2100/2104 backplane from the I/O modules, into IP packets that can be transmitted over packet switched networks.

ML-IP provides standard Ethernet connectivity for Megaplex. The module works with 10/100BaseT or 100BaseF Ethernet equipment, including RAD's IPmux family of TDMoIP Gateways, as part of an integrated corporate or campus IP network.

A Megaplex chassis equipped with ML-IP can be deployed at a main site to provide voice and data services over IP to multiple sites. It can also operate at the local site level with an IPmux unit at a main site, for extending digital PBX services over IP to the other sites (see *Figure 1*).

RAD data communications
The Access Company

ML-IP

Pseudowire Main Link Module

The module is equipped with three Ethernet ports. **Net 1** and **Net 2** are Ethernet uplink ports with 10/100BaseT or 100BaseF interface. One of the uplinks can serve as the main link to the IP network, while the second uplink can be connected to other ML-IP equipped Megaplex units, IPmux units or any other IP equipment. The second uplink enables daisy chaining other Megaplex units for a single connection to the IP network (see *Figure 4*). Alternatively, the two uplinks can be used for redundancy or constructing ring topologies.

User is a 10/100BaseT Ethernet port for connecting a local LAN or PC directly to ML-IP. The user port can be used for interlinking other ML-IP modules or IPmux units to extend the bandwidth capacity of a single node. In RFER topology, in addition to the TDM payload protection, up to 32 IP addresses connected to the user port can be added to the 50 ms protected stream. The user traffic can be switched directly into the IP network by ML-IP's internal switch, via one of the uplinks.

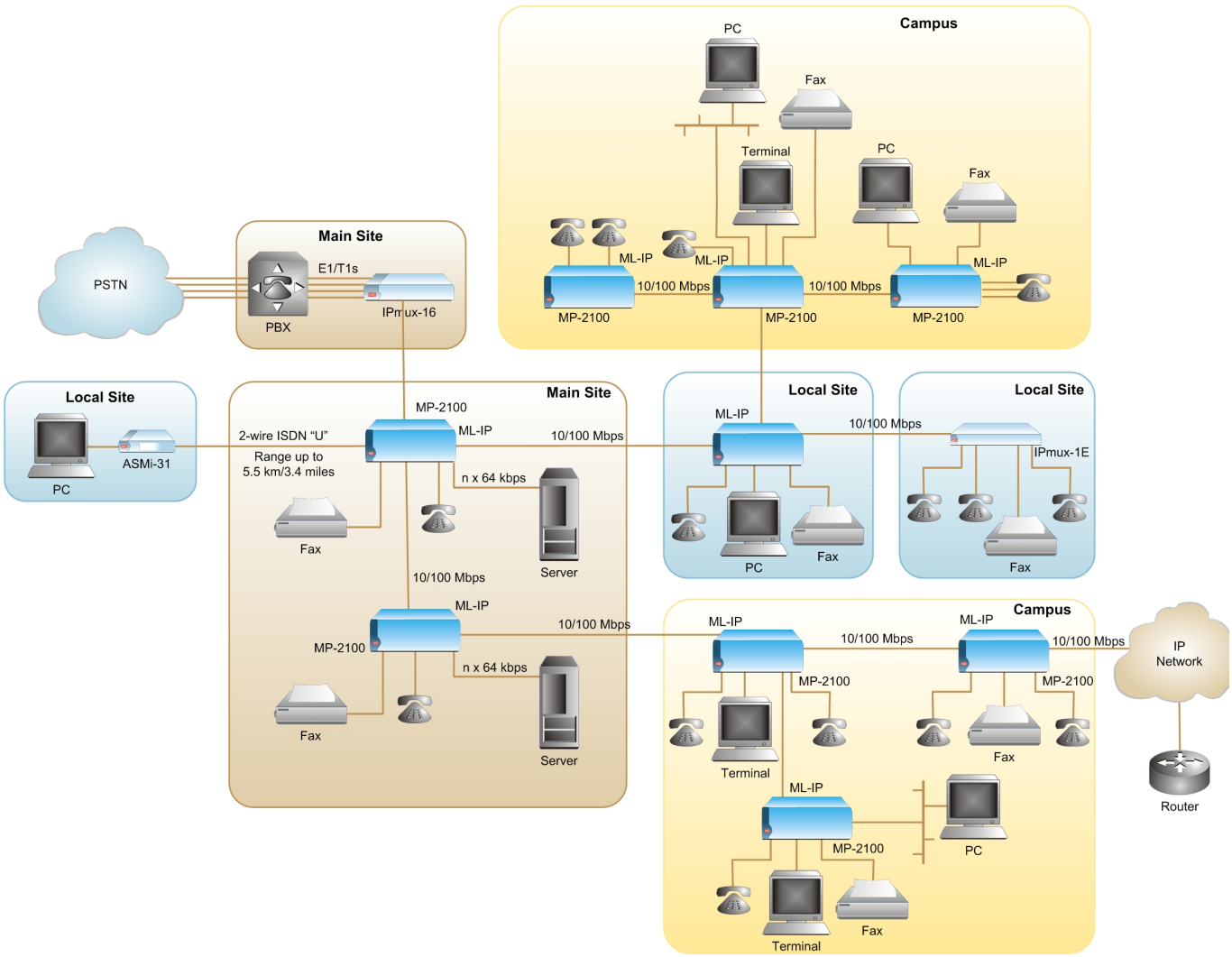


Figure 1. Megaplex with ML-IP in Daisy-Chain Topology in a Campus

All copper UTP Ethernet interfaces operate in both full- or half-duplex modes, at either 10 or 100 Mbps speed. Each interface terminates with an RJ-45 connector.

The two uplinks can be ordered with full duplex 100BaseF interfaces. The following fiber optic interface options are currently available:

- 850 nm for multimode fiber with ST or FC connectors, typical range up to 2 km (1.2 miles)
- 1310 nm for single mode fiber using a laser transmitter with ST or FC/PC connectors, typical range up to 20 km (12 miles).

The total pseudowire (TDMoIP) payload of a single module is 4 Mbps (other Ethernet traffic connected to the ML-IP module is switched from one port to another in the Ethernet layer, and does not affect the payload capacity of ML-IP). To increase the TDMoIP payload capacity of a single chassis to a maximum of 8 Mbps, an additional ML-IP module can be installed. The uplinks of the two ML-IP modules can be interconnected (the traffic is switched in the Ethernet layer) so that the combined payload is transmitted via a single Ethernet link to the IP network (see Site A in *Figure 4*).

TIMING

ML-IP operates in three timing modes:

- **Internal mode**: Megaplex's internal oscillator is the source for the timing used by the Ethernet links, as well the other I/O modules. ML-IP is the sole clock source for all the units in the network.
- **External mode**: One of the I/O modules is the source for the system timing.
- **Adaptive mode**: The ML-IP timing clocks are regenerated using the Adaptive method, according to the monitored received packet rate from the IP network. The timing is then also passed on to the I/O modules.

ML-IP uses an enhanced packet delay variation (jitter) buffer to store incoming IP packets. The buffer compensates for up to 300 msec of delay variation in the IP network.

QOS SUPPORT

ML-IP complies with all relevant Ethernet LAN standards. At the Ethernet level, it employs VLAN tagging and priority labeling according to IEEE 802.1D-2004 and 802.1Q to provide reliable, high quality of service (QoS).

The user can configure the ToS (Type of Service) of the outgoing IP packets. This allows an en-route Layer-3 router or switch that supports ToS (or Diffserv), to give higher priority to ML-IP traffic for delay-sensitive applications.

Assigned, IANA-registered UDP socket number for TDMoIP simplifies flow classification through switches and routers.

TIMESLOT BUNDLING & CROSS-CONNECT

ML-IP supports the same cross-connect features as the Megaplex-ML 2E1/T1 TDM main link module family. The internal cross-connect matrix of the ML-IP module routes voice and data channels from any I/O module installed in the chassis to any installed main link. In addition, traffic can be routed from one link to another, including between IP and regular TDM links. With the non-blocking full cross-connect, timeslots are flexibly assigned for improved link bandwidth utilization.

ML-IP places individual or multiple (up to 31) TDM timeslots into bundles with a single IP destination address. Point to multipoint applications are implemented by defining multiple bundles with different IP addresses (each bundle can be considered as a Fractional E1/T1 link in TDM network applications). Up to 24 bundles (without CAS, or 12 bundles with CAS) are supported by the module. To support more timeslot bundles, a Megaplex chassis can be equipped with additional ML-IP modules.

ML-IP

Pseudowire Main Link Module

BUNDLE REDUNDANCY

For redundancy, bundles can be duplicated and transmitted simultaneously. This provides functionality similar to "parallel transmit redundancy" used with E1/T1 TDM links: if the active bundle stream fails, Megaplex will switch to the other bundle stream.

To provide different levels of network and hardware protection, redundant bundles can be transmitted in the following ways:

- Via the same Ethernet uplink for IP connection redundancy (*Figure 2A*). Both bundles have the same IP address, but are tagged differently. Switching takes place within 50 msec.
- Via the same ML-IP module, but using different uplinks, to also provide physical link redundancy (*Figure 2B*). Both bundles have the same IP address, but are tagged differently. This option requires a Layer-2 (VLAN supporting) switch, which can block untagged IP packets to prevent packet storming. Switching takes place within 50 msec.
- Via different Ethernet uplinks on separate ML-IP modules (*Figure 2C*) to provide module (hardware) redundancy, in addition to physical link and IP connection redundancy. Both bundles have different IP addresses and are tagged differently. Switching takes place within 2 seconds.

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 functionality similar to the parallel transmit redundancy used for TDM fractional E1 and T1 links.
- **1:1** Redundancy. When this redundancy type is enabled, one of the bundles transmits and receives data packets, while the other bundle transmits OAM packets to verify connectivity.

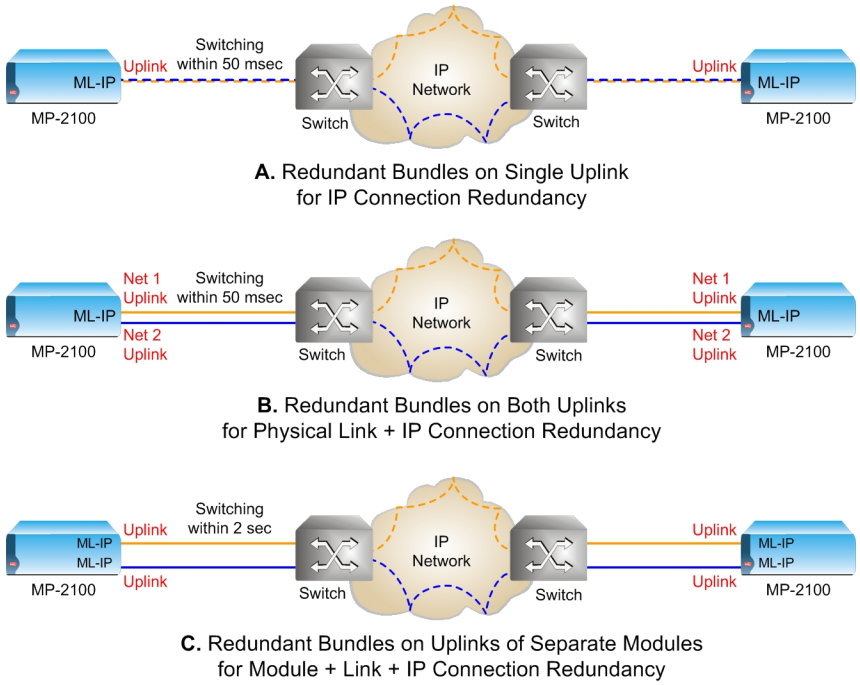


Figure 2. Redundant Bundling for IP Link Backup

RESILIENT FAST ETHERNET RING

ML-IP's two uplink ports employ RAD's Resilient Fast Ethernet Ring (RFER) technology to construct self healing 100-Mbps Fast Ethernet fiber or copper ring topologies (ring resiliency functions similarly to that of STM-1 networks). In case of link failure on any segment of the ring, RFER reroutes the TDMoIP traffic within 50 ms, fast enough to maintain the required voice quality. (For other Ethernet traffic, recovery takes longer, approximately 20 seconds.) An extended protection mechanism allows adding up to 32 IP addresses connected to the user port, to the 50-ms protected stream.

ML-IP's resilient ring performance was independently tested and verified by a well-known European network test center. It was found to provide superb service resilience and voice quality, with proper prioritization of TDM traffic.

RFER enables enterprises, campuses, power companies, transportation companies and utilities to create highly reliable networks, using dark fiber or dry copper in a ring topology (see *Figure 3*).

Survivability is further enhanced by RFER's scalable support for multiple rings, which eliminates the risk of a single point of failure. This is ideal for dispersed applications, such as commuter railroads.

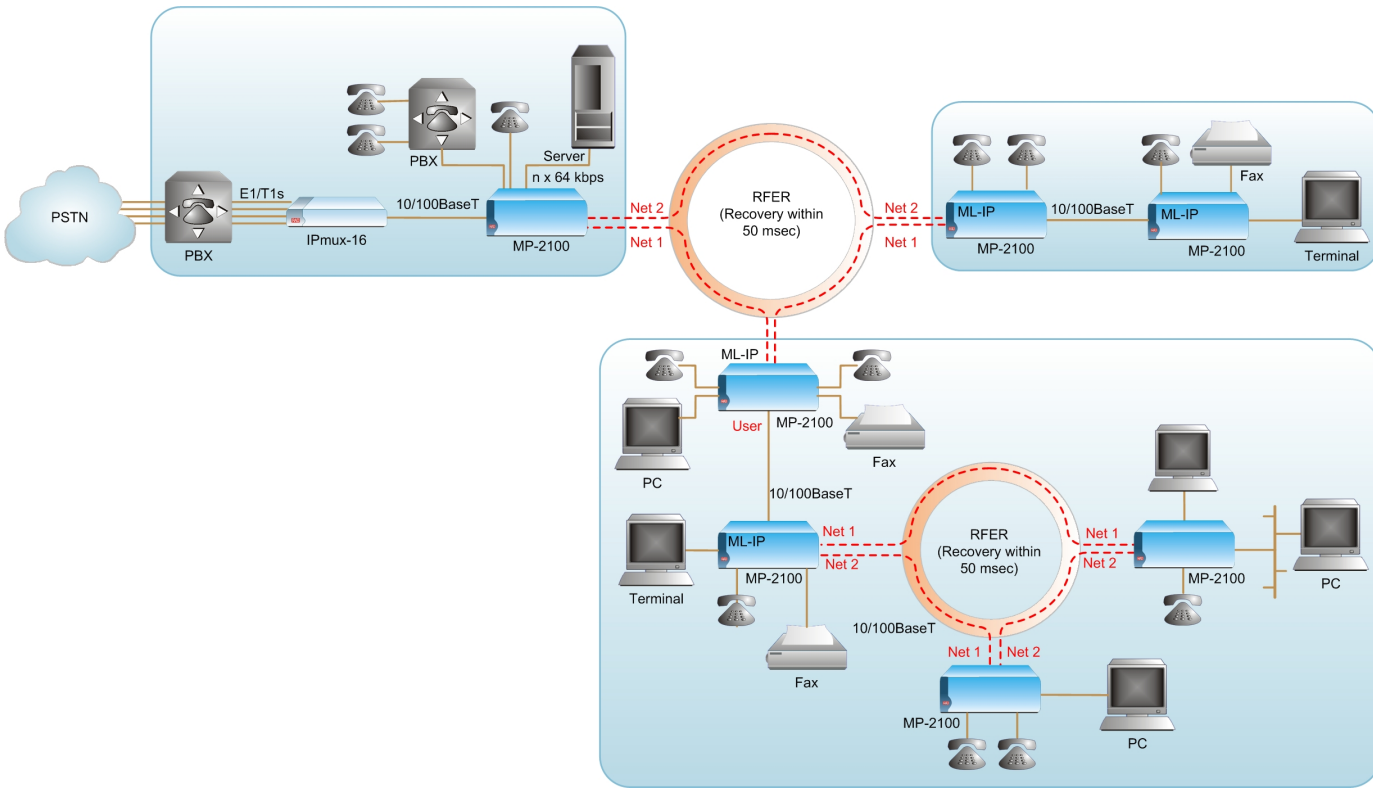


Figure 3. Resilient Fast Ethernet Ring (RFER) Enables Self-healing Networks

ML-IP

Pseudowire Main Link Module

REDUNDANCY BETWEEN ML-IP AND TDM MAIN LINK MODULES

ML-IP modules can be used as backup for TDM E1/T1 links (and vice versa). Redundancy between ML-IP modules and TDM main link modules is accomplished by configuring different databases for each Megaplex: one for transferring the traffic via TDM main link modules through E1/T1 networks, and the other for transmitting the same traffic via ML-IP modules through IP networks. Appropriate flipping conditions are then specified to switch between the two databases.

ECHO CANCELLER

A built-in echo canceller option can be ordered for canceling the echo signals that may be generated on the local (near-end) voice channel analog interface. When enabled, the echo canceller operates on the timeslots carrying voice, providing acceptable voice quality even on networks with long delay. Echo delays of up to 4 msec are tolerated.

The echo canceller is enabled/disabled by the user, for all voice timeslots assigned to one of the two ML-IP internal ports. Up to 30 voice timeslots are supported. The echo canceller automatically detects fax and modem transmissions and does not affect them.

DIAGNOSTICS

The following diagnostic tools are available to facilitate monitoring and testing:

- LAN performance monitoring and statistics
- Bundle performance monitoring and statistics
- ICMP ping
- Tone injection per timeslot, for checking any voice channel in either the local or remote direction
- BERT and Loop+BERT for any timeslot at the TDM level
- Internal loop on any bundle at the TDM level, towards the I/O modules.

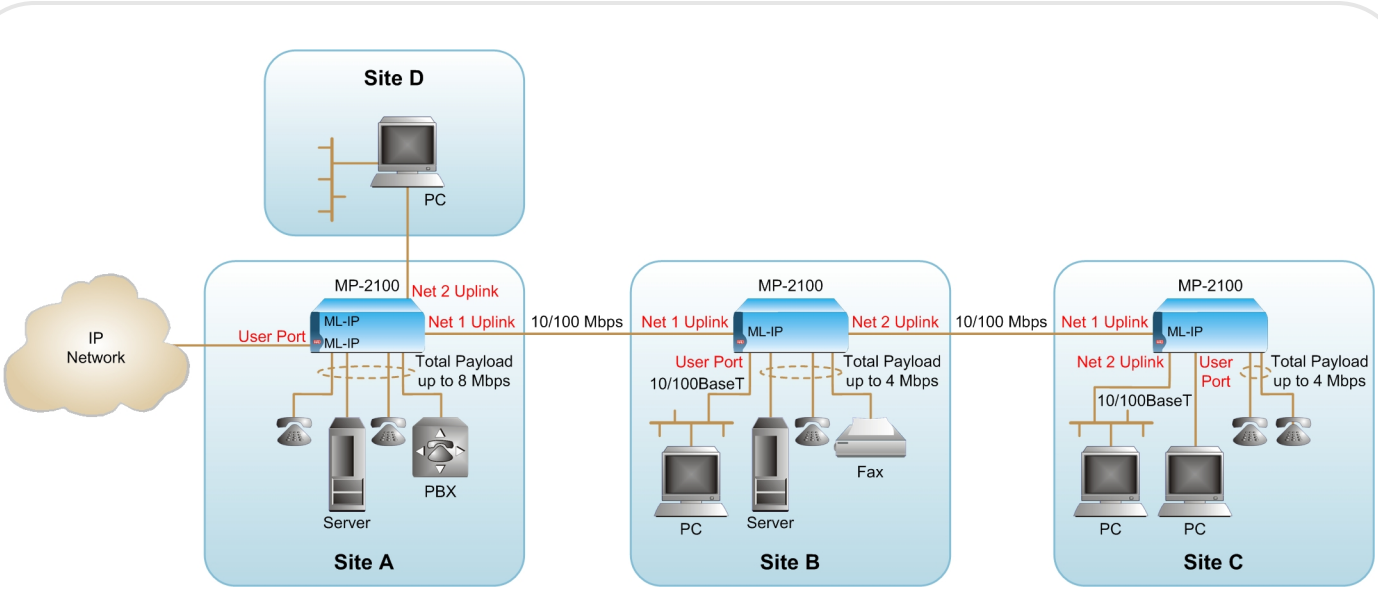


Figure 4. Daisy Chain Connection of Megaplex-2100 Units, to Maximize Utilization of a Single 10/100 Mbps Connection to the IP Network

Specifications

ETHERNET PORTS

Number of Ports
2 uplink ports (Net 1 and Net 2)
1 user port (User)

Uplink Payload
Combined payload of Net 1 and Net 2 ports of a single module: up to 4 Mbps

Two modules in a single chassis: up to 8 Mbps

Data Rate
8.448 Mbps

Compliance
IEEE 802.3, 802.1D, 802.1Q

Clock Modes
Internal, External, Adaptive

Statistics
According to RFC 2665:

Received Frames: Correct Frames, Correct Octets, FCS Errors

Transmitted Frames: Correct Frames, Correct Octets

IP Network Delay Variation Tolerance
300 msec

IP Network Requirements
ToS support for IP level priority

802.1p and 802.1Q support for MAC level priority

UTP INTERFACE (UPLINK AND USER PORTS)

Speed
10 or 100 Mbps

Operation Mode
Full or half duplex

Media
Copper

Connectors
8 pin RJ-45 (one per port)

Range
Up to 100m/330 ft using UTP cat. 5 cable

FIBER OPTIC INTERFACE (UPLINK PORTS ONLY)

Speed
100 Mbps

Operation Mode
Full duplex

Optical Specifications and Range
See *Table 1*

ECHO CANCELLER (OPTIONAL)

Voice Channels
Up to 30 (all timeslots must be from one internal port)

Echo Path Length
4 msec for each channel

Echo Return Loss Enhancement (ERLE)
>30 dB

GENERAL

Diagnostics
LAN diagnostics:

- LAN statistics
- Bundle statistics
- ICMP ping

WAN diagnostics:

- Loopback on bundles
- BERT, BERT+loopback
- Local/remote tone injection

LED Indicators
Per module:

- TEST (yellow) – On when test is run on the module (performed on any bundle or internal port)

Per port:

- LINK (green) – On when Ethernet line is OK
- FDX (green) – On when link is configured for full duplex operation
- 100M (green) – On when link is operating at 100 Mbps

Power Consumption
13.1W (2.62A @ +5V)

Environment
Operating temperature: 0°C to 45°C (32°F to 113°F)
Storage temperature: -20°C to +70°C (-4°F to +160°F)
Humidity: up to 95%, non-condensing

Table 1. Fiber Optic Interface Characteristics

Wavelength	Fiber Type	Connector Type	Transmitter Type	Power Coupled into Fiber	Receiver Sensitivity	Maximum Range	
[nm]	[µm]			[dBm]	[dBm]	[km]	[miles]
850	62.5/125 multimode	ST, FC	VCSEL	-9 to -3	-32	2	1.2
1310	9/125 single mode	ST, FC	Laser	-15 to -8	-34	20	12

Ordering

STANDARD CONFIGURATIONS

MP-2100M-ML-IP/UTP

MP-2100M-ML-IP/UTP/1E

SPECIAL CONFIGURATIONS

MP-2100M-ML-IP/*/@

Legend

* Uplink interface (User port is always UTP):

- **UTP** copper interface with RJ-45 connectors
- **ST/85** 850 nm multimode fiber with VCSEL transmitter, ST connectors
- **FC/85** 850 nm multimode fiber with VCSEL transmitter, FC connectors
- **ST/13L** 1310 nm single mode fiber with laser transmitter, ST connectors
- **FC/13L** 1310 nm single mode fiber with laser transmitter, FC/PC connectors

@ Echo canceller for up to 30 voice channels (Default= no echo canceller)

- **1E** Echo canceller

Table 2. Megaplex Main Link Modules

	ML-E1/T1	MLF-E1/T1	ML-8E1/8T1	MSL-8	ML-IP	ML-20N
						
Interface Type	E1/T1	E1/T1	E1/T1	SHDSL	ETH (TDMoIP)	n x 64 kbps
Number of Channels	1/2	1/2	8	8	2	1/2
Redundancy	Link	Link	None	None	Bundle	Link
Ring	E1/T1	E1/T1	None	None	RFER	None

International Headquarters
24 Raoul Wallenberg Street
Tel Aviv 69719, Israel
Tel. 972-3-6458181
Fax 972-3-6498250, 6474436
E-mail market@rad.com

North America Headquarters
900 Corporate Drive
Mahwah, NJ 07430, USA
Tel. 201-5291100
Toll free 1-800-4447234
Fax 201-5295777
E-mail market@rad.com

www.rad.com

RAD data communications
The Access Company