INTRODUCTION
Due to the cost of running disparate or parallel networks, enterprises and carriers are looking for ways to transport multiple services over a lower cost packet-based network such as Ethernet or MPLS. The Xedge T1/E1 Multi-Protocol LIM allows circuit emulation over packet or cell networks. The front panel 68-pin high-density connector terminates in up to 16 individually configurable T1 or E1 ports. The LIM card provides all physical interfaces, cell delineation and convergence sub-layers.

The Xedge T1/E1-16MP LIM operates in three circuit emulation modes: SAToP, CESoPSN or AAL-1. In addition to Circuit Emulation Services, a future release of the 16-port LIM will also support the Multi-Link point-to-point protocol (ML-PPP) used for aggregation of T1s for bitrates above 1.5 Mbps or 2 Mbps per connection.

Flexible, Scalable Operation
The LIMs install behind an Xedge PCX slot controller at the midplane connector of an Xedge switch. Low-, mid- and high-density Xedge switch chassis allow efficient sparing and deployment options. The 1RU Xedge 6002 switch supports 32 ports (2x16 T1 or E1 ports), while the high-density Xedge 6640/6645 switch supports up to 256 ports. A standalone version of the LIM is also available which does not require a slot controller.

Timing Options
The Xedge T1/E1-16MP LIM can provide node timing/synchronization in compliance with IEEE 1588. The LIM is also an ideal solution for critical time-independent (TID) applications where individually configured port timing must be maintained across a packet network in accordance with ITU-T G.8261/RFC 4197. Each link can be optioned to one of four transmit timing modes:

- With System timing the LIM employs the Xedge switch timing bus structure, selecting which timing bus to use as the 8KHz reference to generate timing for the LIM.
- With an External clock reference, timing is derived from other links on the LIM.
- With the Local Oscillator on the LIM (an independent clock reference) timing is generated for the LIM. This timing arrangement supports failover.
- With the Adaptive clock reference on the LIM, when there are cell/packet arrival rate changes, this clock also changes. It will then clock the transmit timing for the link on the LIM to adapt to the new derived clock. Each of the 16 ports can use different derived timing.

LIM FEATURES
- Single-slot LIM supports sixteen T1/E1 ports for circuit emulation services.
- Support for sixteen T1/E1 ports for ML-PPP is planned in a future release of the LIM.
- Channelized circuit emulation support (CESoPSN-RFC 5086) and AAL1
- Clear Channel Circuit Emulation (SAToP RFC 4553 or AAL-1)
- ANSI T1.102, T1.107, T1.403, T1.408, ITU-T G.703, G.704
- Configured E1 ports conform to ITU-T G.703, G.704.
- Support for Multi-Link Point-to-Point Protocol (ML-PPP) RFC 1990
- Pseudowire Emulation (PWE) RFC 3985
- Interworking function with Ethernet support
- Transmit timing options for each T1/E1 port: System, Adaptive, External or Local Oscillator (internal). Local oscillator supports failover scenarios.
- Conforms to IEEE 1588 Precision Timing Protocol Version 2 as an IEEE 1588 Client over Ethernet.
- Designed for use with the PCX controller in any Xedge switch chassis
- One front panel 68-pin connector fans out to individual ports via cable/patch panel assy.
- Managed via RS232 console port, remote inband Telnet, SNMP, Ethernet, ProSphere NMS.
- Able to generate and monitor BER traffic
- Configured T1 ports comply with ANSI T1.102, T1.107, T1.403, T1.408, ITU-T G.703, G.704
- Configured E1 ports comply with ITU-T G.703, G.704
- Supports T1/E1 statistics, alarms, and line/local loopbacks, available at the user interfaces
- Front panel LEDs indicate In Service, Alarm and Loopback status.

Figure 1: Front Panel Features of Xedge T1/E1 Multi-Protocol LIM
**Circuit Emulation**

**SAToP Applications**

The Xedge 16-port T1/E1 LIM card supports Structure Agnostic TDM over Packet (SAToP) according to RFC 4553. The RFC describes a method for encapsulating TDM bit streams into packet. The SAToP CES mode of operation is for clear channel only.

**CESoPSN Applications**

The Xedge 16-port T1/E1 LIM supports Circuit Switch Circuit Emulation Service over a Packet Switched (CESoPSN) network in accordance with RFC 5086. This mode of operation provides for NxDS0 signals as pseudowires over packet switched networks.

**AAL-1 Applications**

The Xedge 16 port T1/E1 LIM supports AAL-1 ATM circuit emulation in accordance with ATM Forum and ITU standards. In this application, the LIM operates in both structured and clear channel modes.

**Multi-Link Point-to-Point**

In a future release, the Xedge 16-port T1/E1 LIM will support the point-to-point protocol over T1s or E1s that are grouped together to form a bandwidth higher than 1.54 Mbps (T1) or 2 Mbps (E1). Grouping T1 or E1 circuits is a flexible means of creating higher bandwidth on a link costing less than a full DS3 or E3 circuit.

For example, four E1s can be bonded to create 4 x 2M or 8 megabits on a link. The 16-port LIM can provide two groups of up to eight T1s or E1s in a bonded group. Sub groups of less than eight T1s or E1s are also supported.

*Figure 2* shows the Xedge 16-port LIM providing T1 or E1 ports for circuit emulation services over a packet network using Ethernet and ATM interfaces.

*Figure 3* shows the Xedge 16-port LIM grouping T1/E1 circuits in an ML-PPP application where Ethernet connectivity is not available.

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**Figure 2: Circuit Emulation Service**

**Figure 3: Multi-Link Point-to-Point Protocol Application**
Xedge T1/E1 MP16 LIM

Physical Specifications

**Xedge PCX Slot Controller only (Dual-slot Module)**
(Horizontally installed)
- Dual-slot Height: 40.13 mm (1.58 in.)
- Width: 395.73 mm (15.58 in.)
- Depth: 240.53 mm (9.47 in.)
- Weight: TBD

**Xedge T1/E1 MultiProtocol Line Interface Module**
- Width: 19.81 mm (0.78 in.)
- Height: 261.62 mm (10.3 in.)
- Depth: 198.12 mm (7.80 in.)
- Weight: TBD

**Xedge PCX and LIM in Xedge 6002 Chassis**
- Width: 482.61 mm (19.0 in.)
- Height: 40.38 mm (1.59 in.)
- Depth: 482.6 mm (19.0 in.)
- Weight: TBD

Environmental Specifications

**Non-Operating**
- Temperature: -40 to 70 degrees C (-40 to 158 degrees F)
- Relative Humidity: Up to 95%
- Altitude: up to 12,191 m (40,000 ft)

**Operating**
- Temperature: 0 to 50 degrees C (32 to 122 degrees F)
- Relative Humidity: Up to 95% non-condensing
- Altitude: -60 to 4,000 m (-197 to 13,123 ft)

Operational Specifications

- Port Capacity: 16 ports
- Transmit Timing Modes: System, External, Adaptive, Local Oscillator
- Compatible Controllers: PCX
- Network Management: SNMP
- Line Encoding: B8ZS, AMI, HDB3
- Performance Monitoring: Errored Seconds, Severely Errored Seconds, Unavailable Seconds
- Transmit Timing: From received clock or internal oscillator

Standard Interfaces

- DS1 Services:
  - T1/E1 ANSI T1.102, T1.107, T1.403, T1.408, ITU-T G.703, G.704
- Management:
  - SNMP, standard and GDC MIB management, and GDC's ProSphere Network Management System
- IPV6 Addressing:
  - Conforms to RFC 1884 IPV6 addressing schemes

Diagnostics & Alarms

- Diagnostics: Transmit, Receive, and Payload Loopbacks
- Status LEDs:
  - IS (In Service); LS (Loss of Signal); AL (Loopback or Loss of Frame)
- Alarms:
  - IS (In Service); LS (Loss of Signal); AL (Loopback or Loss of Frame)