

**VX-MD4024**

**IP Digital Subscriber Line Access Multiplexer**

## **System Description**

**Part Number A0-31-0128-2.1**

**Issue 2.1**



## Mandatory Regulations

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The following sections describe the mandatory regulations that govern the installation and operation of the VX-MD4024 VDSL2 IP-DSLAM.

### List of Terms

Table 1 lists the terms used in this chapter.

**Table 1 List of Terms**

Term	Expansion
CE	Conformité Européenne
EN	European Standards
FCC	Federal Communications Commission
ITU-T	Telecommunication Standardization Sector of the International Telecommunications Union
RoHS	Restriction of Hazardous Substances

### General Requirements

The sections that follow outline the mandatory regulations that govern the installation and operation of the VX-MD4024 VDSL2 IP-DSLAM. You must adhere to these instructions so that your system meets regulatory requirements.

#### Prevention of Access

The VX-MD4024 must be accessible only to authorized personnel. Install this apparatus in a restricted access location or similar environment to prevent unauthorized access.

#### Laser Interface

The VX-MD4024 uses Class I lasers as optical transmitter sources which are inherently safe unless mishandled. The radiation from laser diodes is much more intense than other light sources radiation. Only trained operating personnel thoroughly familiar with laser radiation hazards should install or remove the fiber optic cables and cards in this system.

#### EMC Compliance

EMC compliance may require the use of ferrites, shielded cables or other special accessories. Where required, these special accessories must be installed as per the instructions.

## **Regulations compliance**

### **Safety Approval**

The system complies with the following safety norms:

- Product Safety Requirements identified in EN60950:2000
- Over Voltage Protection Requirements of ITU-T K.20

### **EMI/EMC**

The system meets the requirements of Telecommunications Network Equipment: EN300-386.

### **Electromagnetic Compliance**

The system complies with the standard **FCC Part 15 Class A and EN55022**.

### **RoHS**

The system complies with the RoHS.

### **CE**

The system conforms to the CE requirements.

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# **Preface**

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## **Scope**

This document provides an overview on the VX-MD4024. It contains:

- Descriptive material about the DSLAM and its units (chapter 1)
- Descriptive material about the software of the DSLAM (chapter 2)
- Expansions of abbreviations used in the manual (Abbreviations)

## **Audience**

The guide is intended for system engineers or operating personnel who want to have a basic understanding of the VX-MD4024.

## **Related Documentation**

For information about installing, operating and maintaining, and troubleshooting the DSLAM, refer to the *VX-MD4024 HW Installation and User Guide*.

For information about how to manage the DSLAM through Command Line Interface (CLI), refer to the *VX-MD4024 CLI Command Reference*.

For information about how to manage the DSLAM through Web GUI, refer to the *VX-MD4024 Web Configuration Tool Guide*.

## **Documentation Conventions**

The following conventions are used in this manual to emphasize information that will be of interest to the reader.

**Caution** — The described activity or situation might or will cause service interruption.

**Note** — The information supplements the text or highlights important points.

# **1 — System Description**

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**1.1 General Overview of the VX-MD4024**

**1.2 Technical Summary of the VX-MD4024**

**1.3 Detailed Description of the VX-MD4024**

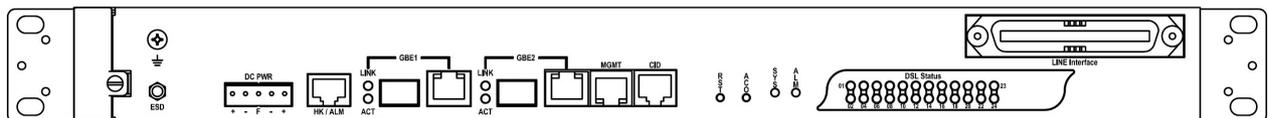
## 1.1 General Overview of the VX-MD4024

The VX-MD4024 is a rack-mountable VDSL2 IP DSLAM. It supports two Gigabit Ethernet (GbE) trunk interfaces and 24 VDSL2 ports (ADSLx backward compatible). Its ideal for deploying in space-constrained indoor areas, MDU, or external cabinets.

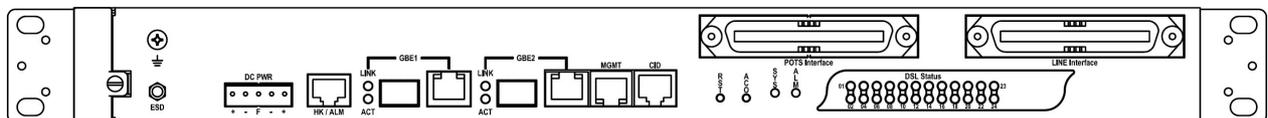
As the demand for broadband connections steadily increases, cable modems and ADSL are not fast enough to support the integration of home services. Many people see VDSL/VDSL2 as the next step in providing a complete home-communication/entertainment solution. The VX-MD4024 takes advantage of VDSL2 technology with core IP switching functionality to participate in the competition of broadband last mile. This allows operators to easily offer services such as IPTV, VoIP, HDTV, VOD, videoconferencing, Internet access and advanced voice services at the same copper line.

The VDSL2 is limited by loop length (performance degrades dramatically when loop length is longer than 300m.) and provides ADSL1/2+ operation mode in the same copper line with VDSL2 which allows industries to compensate for coverage weakness of a VDSL2 DSLAM. The VX-MD4024 is suitable for a small size application and can be easily deployed in remote locations such as a remote terminal, business parks, street cabinets, etc., extending the distance of its service.

The following figures show the front panel view of the VX-MD4024.



**Figure 1-1 VX-MD4024-1x0-DC with DC power and no splitter**



**Figure 1-2 VX-MD4024-1x1-DC with DC power and splitter**

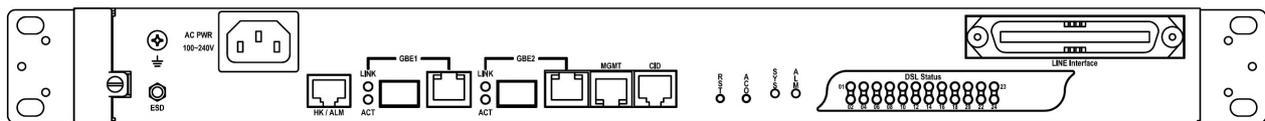


Figure 1-3 VX-MD4024-1x0-AC with AC power and no splitter

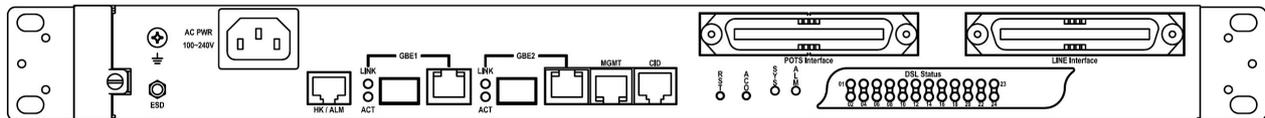
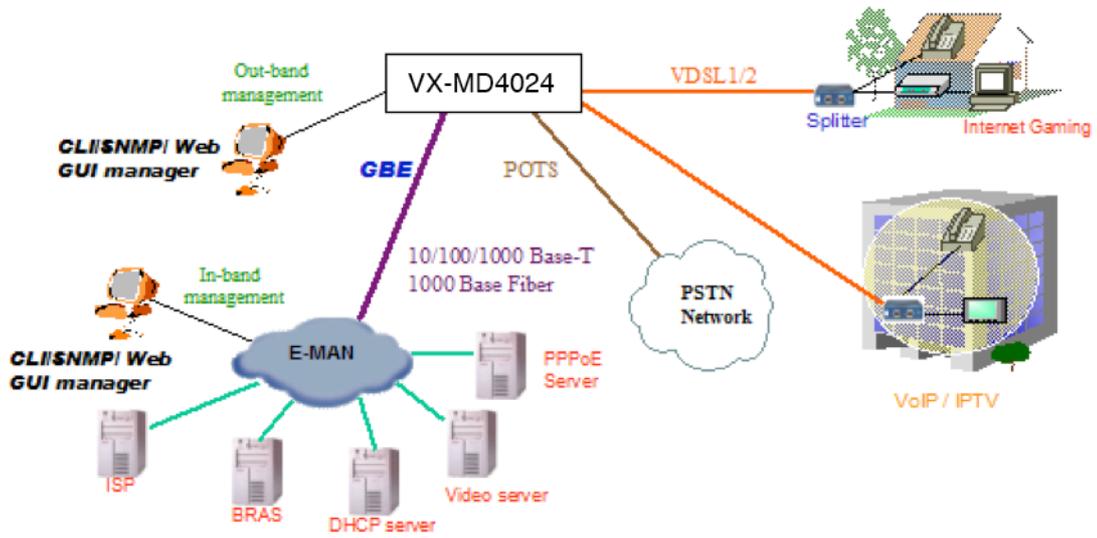


Figure 1-4 VX-MD4024-1x1-AC with AC power and splitter

### 1.1.1 Features

- Highly compact solution that provides 24 VDSL2 only by 1U space and stackable for higher port density
- Scalable solution that allows new revenue to be generated with a minimum amount of installation time and expense
- Equipped with fan and air filters
- Low power requirements
- Full diagnostics and alarm reporting capability
- Standard-based with remote configuration and software upgrade to help service providers minimize daily operational costs
- Wide operating temperature range from -40C ~ 65C
- Provide two combo GBE trunk interfaces with both RJ-45 and SFP ports, and the priority for these two types of connectors (RJ-45 first or SFP first) is configurable
- Support Link Aggregation in IEEE 802.3ad that allows 2 GBE links to be aggregated together as a logical link. Supports both LACP protocol (dynamic) for load sharing and failover in case Ethernet link is lost
- Supports SNTP to automatically calibrate the time and date of the system
- Support on board thermal sensor to detect temperature conditions with software configurable thresholds that generate SNMP traps and syslog alarm entries
- Provide SSH (Secure Shell) for more secure remote operation
- Meet CE requirement

### 1.1.2 System Application



**Figure 1-5 VX-MD4024 system application**

The VX-MD4024 supports up to 24 VDSL2 lines per 1U box. It supports 802.3ad link aggregation so that it extends the uplink bandwidth to 2 Gbps. It is also stack-able to provide higher port density.

Users can manage the system with CLI/SNMP/Web GUI via in-band/out-band management channel.

By enabling both GbE ports of VX-MD4024 for uplink traffic, a closed ring topology can be implemented, using spanning tree protocol (STP/ RSTP).

## 1.2 Technical Summary of the VX-MD4024

### 1.2.1 Physical Specifications

Item	Value
Width	431.8 mm (17 in.) not including the mounting brackets
Height	44.45 mm (1U)
Depth	265 mm (10.4 in.)
Weight	4.1 Kg (DC power, with on-board splitter) 4.4 Kg (AC power, with on-board splitter) about 0.5 Kg less without splitter
Rack mounting	Standard 19" or 23" or ETSI rack

### 1.2.2 Environmental Specifications

Item	Value
Operating Temperature	DC: -40°C ~ 65°C AC: 0°C ~ 50°C
Relative Operation Humidity	5% to 95% (non-condensing) at 35°C

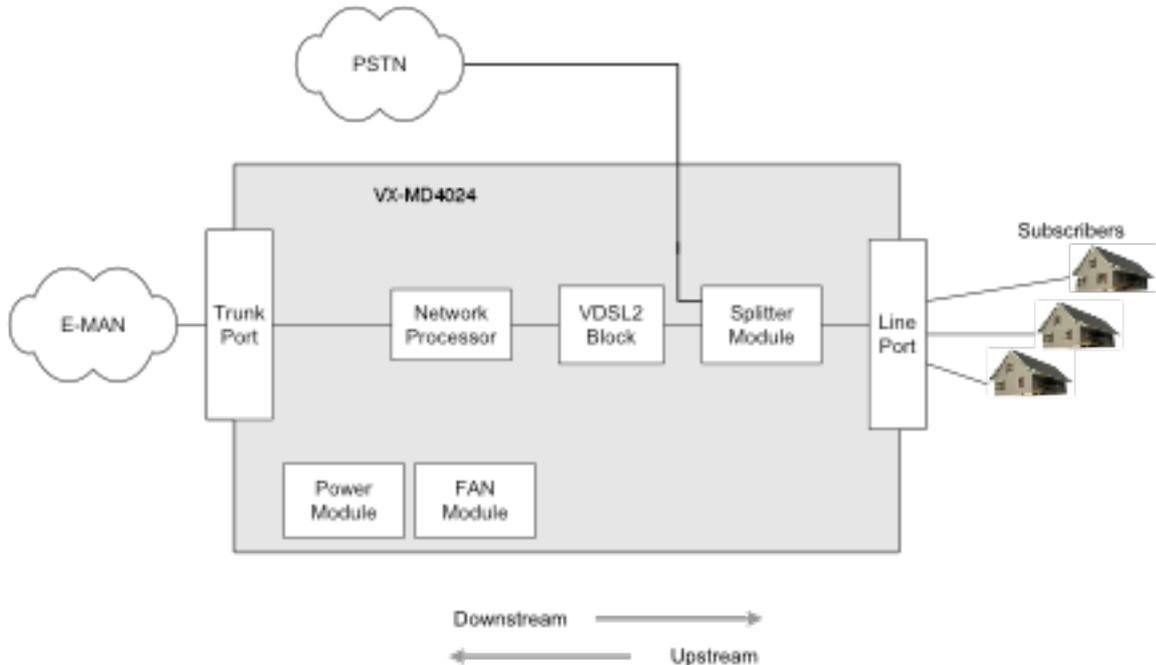
### 1.2.3 Power Specifications

Item	Value
Power Supply Interface	Two options: DC: Dual A+B feeds, -36 ~ -60V, nominal - 48V AC: 100 ~ 240V ( $\pm$ 10% tolerance).
Power Consumption:	Max < 90 W, Typical < 75 W per 1U system

### 1.3 Detailed Description of the VX-MD4024

The VX-MD4024 uses Gigabit Ethernet interface for the uplink to the Ethernet Metropolitan Area Network (E-MAN). It transmits VDSL traffic between the subscriber equipment (router, bridge/modem or network interface card) and the E-MAN.

#### 1.3.1 Major Functional Block Diagram



**Figure 1-6 Major Functional Block Diagram (with Splitter)**

The network processor provides the Layer-2 Ethernet function. Most of the board control are provided by processor including chip initialization, traffic processing and system management (OAM&P).

As to the two GbE uplink (trunk) interfaces, the system can provide:

- Link Aggregation (802.3ad)
- One of the GbE can be used as an uplink and the other can be used as a stacking interface
- Provide Rapid Spanning Tree (802.1w) as a loop protection architecture

### 1.3.2 Interface and Functionality Specifications

Item	Description
Trunk Interface	<p>Supports both RJ45 and mini-GBIC (SFP) connectors for each uplink port (total 2 ports per box).</p> <p>Supports auto-selection between SFP and RJ-45 of Gigabit Ethernet interfaces with programmable priority.</p> <p>For <b>RJ-45</b> interface:</p> <p>Supports IEEE 802.3 10/100/1000 Base-T auto-sensing GbE. And the selection of speed for each port is independent.</p> <p>Supports auto-adaptive between full-duplex and half-duplex operation modes for 10 and 100 Mbps operation speed on a per trunk port basis. The system only supports full-duplex mode for 1000 Mbps.</p> <p>For <b>SFP</b> interface:</p> <p>Supports 1000 Base-TX/SX/LX/EX/ZX/LHX interfaces (defined in IEEE 802.3z) depending on plug-in SFP transceiver</p> <p>Supports Ethernet frame that complies with IEEE 802.3z</p>
Line Interface	<p><b>General:</b></p> <p>Supports a total of 24 xDSL subscribers lines and supports provisioning of the operation modes (VDSL2, ADSL/ADSL2+) with a default of VDSL2 on a per port basis.</p> <p>Handshake procedure of each DMT xDSL circuit complies with ITU-T G.994.1.</p> <p>Physical layer management of each DMT xDSL circuit complies with ITU-T G.997.1.</p> <p>xDSL subscriber interfaces support the following functions:</p> <ul style="list-style-type: none"> <li>• Upstream and downstream non-overlapped mode</li> <li>• Auto retrain</li> <li>• Scrambling functionality</li> <li>• FEC functionality</li> <li>• Trellis coding</li> <li>• Bit-swap</li> <li>• Interleaving selection</li> <li>• Target, maximum and minimum SRN margins programmable per port basis, independently for UP/DOWN directions</li> <li>• Tx power adjustment while the SNR margin detected from the xDSL line exceeds the configured maximum SNR margin</li> </ul> <p>Support rate adaptation modes defined in ITU-T G.992.5 and</p>
Line Interface (continued)	<p>G.997.1 including Fixed (manually configured) and Adaptive At Init modes.</p> <p>xDSL subscriber interface is able to support Fast Channel or Interleaved Channel independently for each xDSL port.</p>

Item	Description
	<p>Supports Upstream Power Back-off (UPBO) while received power exceeds configured max-aggregation-PSD in the upstream direction.</p> <p>Supports detection of Dying Gasp message from xDSL CPE and indicate a CPE power loss alarm in the management interface. This is cleared upon the commencement of a retrain operation (i.e. when the CPE becomes active once more).</p> <p>Supports PSD shaping feature in VDSL2, ADSL and ADSL2+</p> <p>Supports Downstream Power Back-Off (DPBO) for xDSL ports while operating in ADSL/2+ or VDSL2 mode</p> <p><b>VDSL2:</b></p> <p>VDSL2 functions comply with ITU-T G.993.2.</p> <p>Support Packet Transport Mode (PTM) per G.993.2 when operating in VDSL mode.</p> <p>Support provisioning the VDSL optional band types A, B and M (25K to 276K Hz) usage</p> <p>Supports VDSL OAM communication channels including IB (Indicator Bits) channel, EOC (Embedded Operations Channel), and VOC (VDSL Overhead control Channel).</p> <p>Supports selectable band plan A (profile 998, Annex A of G.993.2 and plan B (profile 997, Annex B of G.993.2) for each VDSL line on a per port basis.</p> <p>Line rate of a VDSL2 line port can reach symmetrical 100/100 Mbps or asymmetrical 100/50 Mbps at an ideal loop condition.</p> <p>Supports selectable spectrum profile of 8a/b/c/d, 12a/b, 17a, and 30a for frequency bands (Annex A, B and C) defined in G.993.2 when operating in VDSL2 mode.</p>
POTS Splitter Module (option)	<p>Compliant with ETSI TS 101 952-1-1 option A for European, ETSI TS 101 952-1-3 for Annex B European ISDN, or ANSI 600.</p> <p>The splitter/low pass filter is passive element. Even the system is loss of power (power supply fails), the POTS service is still OK.</p>
Management Interface	<p>In-band management: provide all system OAM&amp;P functions: software updates, configurations import/export, and management system interaction through trunk port.</p> <p>Out-band management: provide two kinds of management interfaces. One is the RS-232 local craft interface for basic provisioning. Interface default configuration: 9600 baud rate, 8-bit data, none parity, and 1 stop bit. The other is a 10/100 Base-T auto-sensing Ethernet Interface.</p>
OAM&P	<p>Configuration Management</p> <p>Performance Management</p> <p>Fault Management</p> <p>Status Monitoring.</p>

Item	Description
Ethernet/IP Functionality	<ul style="list-style-type: none"> <li>• Supports L2 bridge functionalities defined in IEEE 802.1d including: <ul style="list-style-type: none"> <li>– Automatic source MAC learning</li> <li>– Static source MAC address table provisioning</li> <li>– Maximum 8K MAC addresses allowed to be learned into MAC table per system; 1 ~ 4095 MAC addresses per trunk bridge port with a limitation of maximum 4096 MACs for total number assigned to two trunk interfaces; 0 ~ 512 MAC addresses per line bridge port</li> <li>– Provision-able aging time for MAC address table with a default of 300 seconds on a per bridge port basis.</li> </ul> </li> <li>• The uplink and line bridge interfaces support Spanning Tree Protocol (STP) per IEEE 802.1D and Rapid Spanning Tree Protocol (RSTP) per IEEE 802.1w.</li> <li>• VLAN <ul style="list-style-type: none"> <li>– Supports IEEE 802.1q Port-based VLAN and Protocol-based VLAN</li> <li>– Supports 512 active VLANs simultaneously and the VLAN ID ranges from 1 to 4094</li> <li>– Supports 2 layers VLAN stacking (“Q-in-Q”)</li> <li>– Supports VLAN translation</li> <li>– Supports port isolation functionality. When port isolation is enabled, no Layer-2 bridging between different ports (or subscriber lines) is supported in a VLAN</li> <li>– Supports static VLAN group and membership provisioning per bridge port basis</li> <li>– Supports configuring a port to be VLAN transparent (i.e., enabled for TLS)</li> </ul> </li> <li>• Multicast <ul style="list-style-type: none"> <li>– Supports Multicast forwarding with IGMP v1 [RFC 1112], v2 [RFC 2236], v3 [RFC 3376], and Multicast MAC address mapping</li> <li>– Supports up to 512 concurrent IGMP groups (multicast channels) per system and a multicast channel has a maximum of 512 copies</li> <li>– Supports profile-based Multicast Access Control (up to 24 configurable profiles) and assign any profile to a subscriber interface (the maximum number of registered multicast channels within a profile is 512)</li> <li>– Able to limit the maximum number (0 ~ 20) of concurrent multicast groups to be joined per bridge port</li> <li>– Supports IGMP snooping/proxy in v1, v2, and v3</li> <li>– Supports selection between IGMP proxy and IGMP snooping</li> <li>– Supports Fast and Normal Leave modes</li> </ul> </li> <li>• DHCP</li> </ul>

Item	Description
	<ul style="list-style-type: none"><li data-bbox="699 277 1366 443">– Supports DHCP Server (IP allocation to DSL users), DHCP transparent forward, and DHCP relay agent option-82 functionality (the value within Agent Circuit ID and Agent Remote ID sub-options are configurable).</li><li data-bbox="699 450 1366 757">– Supports selection of DHCP forwarding modes with enabled relay option-82<ul style="list-style-type: none"><li data-bbox="746 517 1366 613">(a) Normal Forwarding Mode: the system follows general MAC bridging mechanism for DHCP frame forwarding.</li><li data-bbox="746 622 1366 757">(b) Secured Forwarding Mode: the system forwards DHCP frames according to attached Option-82 tags in downstream direction, rather than the destination MAC address of each DHCP frame.</li></ul></li><li data-bbox="655 766 1366 862">• Able to pass through CDP (Cisco Discovery Protocol) message for both directions: between trunk ports and between DSL ports and trunk ports</li><li data-bbox="655 871 1366 1037">• Supports Link Layer Discovery Protocol (LLDP) defined in IEEE 802.1ab that allows network devices to advertise and also recognize identities and capabilities within devices which are directly connected. This feature can be configured on a per port basis.</li><li data-bbox="655 1046 1366 1798">• Security<ul style="list-style-type: none"><li data-bbox="699 1081 1366 1115">– Supports ARP anti-Spoofing and MAC anti-Spoofing</li><li data-bbox="699 1124 1366 1182">– Supports Layer-2 frame filtering based on source/destination MAC addresses</li><li data-bbox="699 1191 1366 1288">– Supports Layer-3 filtering based on IP header including source/destination IP address, protocol ID, and TCP/UDP destination port number</li><li data-bbox="699 1296 1366 1462">– Supports filtering out broadcast frames (destination MAC Address 0xFFFFFFFF) in the downstream direction. When this option is activated, only protocol-specific broadcasts (DHCP, ARP) are allowed to be forwarded to downstream users.</li><li data-bbox="699 1471 1366 1597">– Supports secured forwarding that forces upstream traffic to the specific gateway, by means of replying upstream ARP request with MAC address of default gateway</li><li data-bbox="699 1606 1366 1664">– Supports IEEE 802.1X Authentication using RADIUS protocol on each DSL port</li><li data-bbox="699 1673 1366 1798">– Supports the ability of RADIUS Client for management access authentication whose identifier (username and password) can be authenticated by remote RADIUS Server</li></ul></li><li data-bbox="655 1807 1366 2016">• QoS<ul style="list-style-type: none"><li data-bbox="699 1843 1366 2016">– Support Ethernet rate limit function including:<ul style="list-style-type: none"><li data-bbox="746 1883 1366 1917">a. Per bridge port rate limiting<ul style="list-style-type: none"><li data-bbox="794 1919 1366 1953">✓ Profile based configuration</li><li data-bbox="794 1955 1366 1989">✓ Ingress: all kinds of traffic</li><li data-bbox="794 1991 1366 2016">✓ Egress: unicast traffic</li></ul></li></ul></li></ul></li></ul>

Item	Description
	<ul style="list-style-type: none"> <li>✓ Apply to line bridge port</li> <li>b. Per bridge port per VLAN rate limiting               <ul style="list-style-type: none"> <li>✓ Profile based configuration</li> <li>✓ Ingress: all kinds of traffic</li> <li>✓ Egress: unicast traffic</li> <li>✓ Apply to line bridge port</li> </ul> </li> <li>c. Per bridge port broadcast traffic rate limiting               <ul style="list-style-type: none"> <li>✓ Profile based configuration</li> <li>✓ Apply to line/trunk bridge port</li> </ul> </li> <li>d. Per VLAN rate limiting               <ul style="list-style-type: none"> <li>✓ Non-profile based</li> <li>✓ Broadcast: support rate limiting for PVIDs of trunk interfaces with an internal maximum rate 500K bps per PVID VLAN</li> <li>✓ Flooding: support rate limiting for all defined VLANs, trunk/line</li> </ul> </li> <li>– Supports Three Color Marking (TCM) rate limit policer in accordance with the Metro Ethernet Forum (MEF) Bandwidth Profile and RFCs 2697 &amp; 2698.</li> <li>– Supports VLAN priority queue per IEEE 802.1p (4 priority queues for 8 802.1p CoS value. The mapping between 4 priority queues and 8 priority values are configurable.)</li> <li>– Supports selectable adopted priority queue mechanisms according to Strict Priority Queue (SPQ) and Weighted Fair Queue (WFQ)</li> <li>– Supports traffic classification by re-assigning CoS (p-bit) value according to CoS (802.1p priority bit), VLAN ID, ToS, DSCP, Source/Destination IP address, or Source/Destination MAC address</li> <li>– Configurable mapping between ATM PVC and 802.1p CoS for received untagged frame from subscriber port</li> </ul>
ATM and Interworking	<p>Supports 8 PVCs per subscriber line; VPI range is from 0 to 255 and VCI range from 32 to 65535 conforming to ATM Forum UNI 3.1/4.0, PVCs only.</p> <p>Supports multi-protocol encapsulation over ATM per RFC 2684 / RFC 1483 for bridged mode, LLC encapsulation method only.</p> <p>Supports AAL5 per ITU-T I.363.5.</p> <p>Commit the supported ATM service categories in the increasing order of UBR, CBR on a per port basis.</p> <p>Provide PCR (peak cell rate) configurable parameter for CBR service.</p> <p>Supports profile-based ATM traffic management (up to 16 traffic descriptors with one default and 15 user-configurable descriptors).</p> <p>Supports PPPoE transparent forwarding and PPPoE intermediate agent.</p>



### 1.3.3 Controls and Indicators

**Table 1-1 VX-MD4024 Controls and Indicators**

<b>VX-MD4024 Front Panel</b>	
<b>LED</b>	<b>Description</b>
SFP1 - LINK SFP2 - LINK	To indicate the mini-GBIC trunk port link status
SFP1 - ACT SFP2 - ACT	To indicate the mini-GBIC trunk port data traffic status
GBE1 - Speed GBE2 - Speed (LED on RJ-45)	To indicate the electrical trunk port transmission speed (orange color LED on the Ethernet port)
GBE1 - Link/Act GBE2 -Link/Act (LED on RJ-45)	To indicate the electrical trunk port link status (green color LED on the Ethernet port)
MGMT- Speed (LED on RJ-45)	To indicate the transmission speed of the Ethernet management port (orange color LED on the Ethernet port)
MGMT- Link/Act (LED on RJ-45)	To indicate the link status of the Ethernet management port (green color LED on the Ethernet port)
SYS	To indicate the system operation status
ALM	To indicate the system alarm status
DSL Status	To indicate the link status of the subscriber lines.
<b>Interface</b>	<b>Description</b>
GBE1/GBE2	Gigabit Ethernet trunk port 1/2
MGMT	Ethernet Port connected to LAN for providing system out-band EMS/Telnet control interface, such as system monitor, control or software upgrade.
CID	RS-232 port connected to the terminal for monitoring and controlling the trunk card.
HK / ALM	RJ-50 connector for four housekeeping inputs and one alarm contact output.
POTS	RJ-21 connector (50-pin dual row header) for connecting POTS lines.
LINE	RJ-21 connector (50-pin dual row header) for connecting DSL lines.
<b>Button</b>	<b>Description</b>
ACO	Alarm Cut Off
RST	A hidden reset button for hardware resetting.

## **2 — *Software Introduction***

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**2.1 General Overview**

**2.2 Configuration Management**

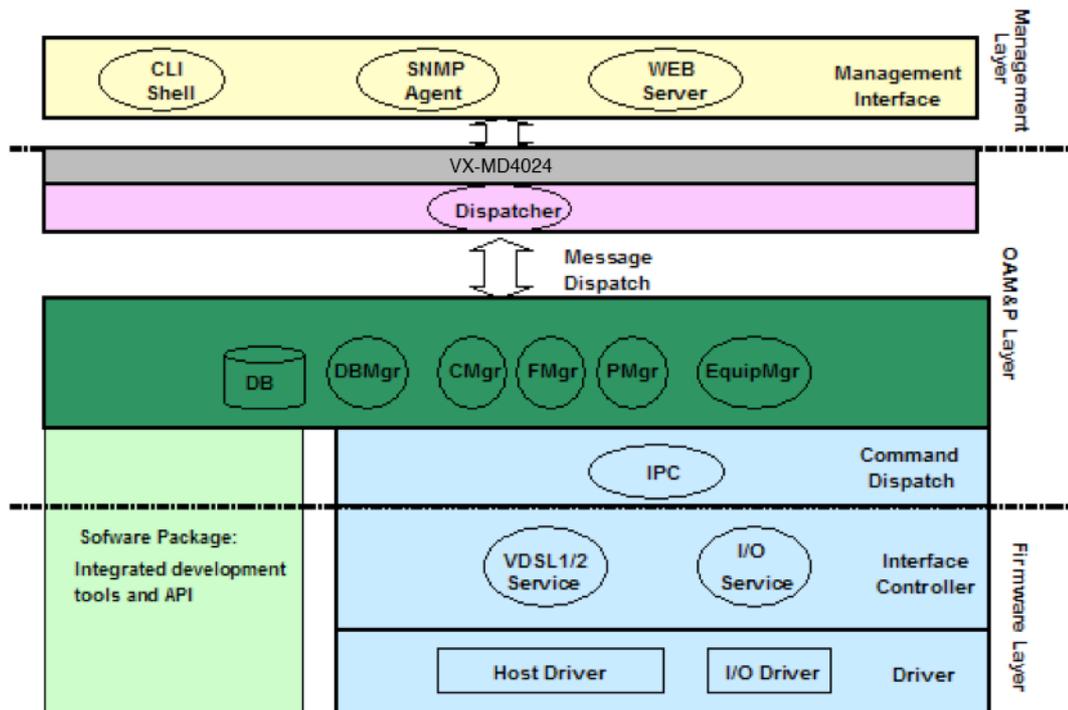
**2.3 Performance Management**

**2.4 Fault Management**

**2.5 Cluster Feature**

## 2.1 General Overview

The software architecture of the VX-MD4024 is shown in the figure below. It can be divided into three layers: Management layer, OAM&P layer, and Firmware layer.



**Figure 2-1 Management Software Model**

As in the figure, CLI shell, SNMP agent, and WEB server are in the top-most layer (management layer) of the system software and offering OAM&P function of the DSLAM based on the conceptual management features as follows:

- Configuration Management
- Performance Management
- Fault Management

The VX-MD4024 uses Flash memory as the database (DB) to store system configuration parameters, alarms and events. The firmware layer includes line card control drivers, Memory and I/O control, etc.

### 2.1.1 Features of Management Interface

- Supports CLI, SNMP (v1, v2c), and web-based GUI management interface through both in-band and out-band channels
- Supports up to 10 users accessing simultaneously for each management interface
- Supports out-band management via:
  - UART at full duplex line rate of 9600 bps (Craft port), 8-bit data, none parity, 1 stop bit
  - 10/100 Base-T auto-sensing Ethernet interface
- Supports Telnet interface for remote operators to login system operating console
- Supports in-band management of the unit via separate VLAN terminating on Network Processor; support prioritization of in-band management traffic
- Supports SNMP Management for SNMPv2, MIB I, MIB II and Enterprise MIBs including traps, sets, gets, and get next
- Supports UNIX syslog functionality per RFC 3164 (syslog messages are sent via UDP and the source port number is 1027)
- The IP address and subnet mask of the system for out-band management are provision-able with a default of 192.168.1.1 and 255.255.255.0.

## 2.2 Configuration Management

The configuration management contains the following aspects:

1. System Setup, including setup for management IP address/IP routes, circuit setup (including to enable/disable/reset VDSL/ADSL circuit, query the administrative/operational status of a circuit, and bind profiles on a per port basis), GBE trunk interface setup, SNTP, IP routes, and user administration (including login authorization and provides three security levels).
2. Bridge Setup (see “Bridge Setup” below for more description)
3. VDSL/ADSL configuration (see “VDSL Configuration” below for more description)
4. Traffic Profile configuration, including traffic descriptor and priority queue mapping table
5. SNMP setup
6. System inventory and configuration information query

The configuration management provides detecting and reporting to the operators through SNMP Trap for all memory updates reflecting changes in the system configuration. It also provides logging the changes in the operational state and making this information available (on-demand) to the operators over the operation interface.

The system contains a database (DB) to store all the provisioning data so that the configuration can be restored in re-booting. Authorized operators can query the DB to obtain configuration data.

### Bridge Setup

The bridge setup of the VX-MD4024 includes the following aspects:

- Interface setup, including Trunk/Line bridge port setup, Rate limit policer profile configuration and binding.
- VLAN configuration, including Trunk priority mapping, Static VLAN, Priority remark, VLAN Rate limit, VLAN translation, and Protocol Based VLAN.
- 802.1X Security configuration
- Spanning Tree Protocol configuration
- Filtering, including Filtering rule, ACL.
- Forwarding database
- DHCP/PPPoE configuration
- IGMP configuration
- Allowed IP filtering
- Anti-Spoofing configuration

## VDSL Configuration

Configuration for a VDSL2 user port is provisioned by the parameter set, which is a group of attributes that determine the user port behaviors; also known as the profile. The VX-MD4024 provides a profile-based provisioning per the definition of ITUT G.993.2 for VDSL line configuration data and a mechanism to associate the VDSL port to these profiles. One or more VDSL lines may be configured to share the parameters of a single profile.

The VDSL profiles of VX-MD4024 include:

- Configuration Profile

The parameters include Band Plan selection, Rate Adaptive Mode selection, Line Type, Max/Min data rate for fast/slow channel, Overhead data rate, PSD Mask, Maximum Tx Power, Max/Min/Target SNR Margin, Interleaving Max delay, Minimum impulse noise protection, Service Level Agreement data rate threshold, downstream PSD shaping type, parameters for Upstream Power Back-Off (UPBO), parameters for Downstream Power Back-Off (DPBO), Band Mask, Operation Mode, and etc.

- Alarm Profile

This profile contains the TCA threshold values for near-end/far-end ESs, SESs, and UASs.

The system provides up to 25 profiles. One of the profiles is a fix default that cannot be modified; users are allowed to create, delete, and edit the other 24 profiles. Each profile contains a parameter set for downstream and upstream direction respectively. Users can also observe the actual values of these parameters through CLI, Web-GUI, JG-2200, or EMS.

The VDSL configuration also includes the function for user to query the line status, the channel interface status, and the failure state for VTU-C and VTU-R. The status information includes the attenuation rate, actual net data rate, the line attenuation, SNR margin, transmission power, actual interleaving delay, and etc.

## 2.3 Performance management

Performance management supports performance monitoring by collecting and thresholding performance parameter counters against 15-minute intervals for each interface and module respectively. Users can query the data of these parameters through CLI, Web-GUI, JG-2200 or EMS.

Performance statistics include the following:

1. Statistics for current interval:  
A real-time aspect contains the reflection of the current value situation before the new interval. The current value includes values of current 15-min interval and current 1-day interval.
2. Statistics history at 15-minute basis:  
The system stores previous 96 statistics of PM parameters at 15-min interval for retrieving.
3. Statistics history at 1-day basis:  
The system stores previous 7 statistics of PM parameters at 1-day interval for retrieving.

Most of the performance parameter thresholds are user-programmable. The VX-MD4024 uses a threshold crossing alert (TCA) to notify the management system when one of the counts during a measurement interval exceeds its threshold.

The TCA contains the following information:

- Specific interface involved
- Error condition identifying the measurement type
- Value of the parameter
- Occurrence date and time of the event

The performance management also provides the traffic counter including transmitted packets, error packets and discarded packets for each interface (network and subscriber interface) in both transmit and receive direction. Users can observe these data through CLI, Web-GUI, JG-2200 or EMS.

The VX-MD4024 provides the following thresholds for the PM statistics, and all these thresholds are configurable:

<b>NE threshold</b>	<b>FE threshold</b>
15min ES threshold	15min ES threshold
15min SES threshold	15min SES threshold
15min UAS threshold	15min UAS threshold
24hour ES threshold	24hour ES threshold
24hour SES threshold	24hour SES threshold

24hour UAS threshold	24hour UAS threshold
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### **Ethernet PM**

The VX-MD4024 provides Ethernet performance statistics of transmitted packets, error packets, discarded packets, etc. on each bridge Interface.

### **xDSL PM**

The VX-MD4024 provides the following xDSL PM parameters:

<b>Parameter</b>	<b>Description</b>
LOF	Loss of Frame Count
LOS	Loss of Signal Failure Count
LOSS	Loss Of Signal seconds
LOPRS	Loss Of Power seconds (only for VTUR)
ESS	Errored Seconds
SESS	Severely Errored Seconds
UAS	Unavailable Seconds
Inits	Modem Failed Initialization events (only for VTUC)
Fixed Octets(Fast)	Count of corrected octets for fast channel.
Bad blks(Fast)	Count of uncorrectable blocks for fast channel.
Fixed Octes(Slow)	Count of corrected octets for slow channel.
Bad blks(Slow)	Count of uncorrectable blocks for slow channel.

### 2.3.1 RMON Feature

The VX-MD4024 supports performance statistics defined in RMON MIB groups 1 (Ethernet statistics), 2 (history control), 3 (alarm), and 9 (event) per RFC 2819 for all network uplink 10/100/1000 ports. The supported parameters are as follows:

**Table 2-1 RMON ETH Statistics variables**

Variable	Description
DropEvents	Monitoring Rx dropped packets
Octets	Monitoring Rx bytes packets
Pkts	Monitoring Rx packets
BroadcastPkts	Monitoring Rx broadcast packets
MulticastPkts	Monitoring Rx multicast packets
CRCAlignErrors	Monitoring Rx error alignment packets
UndersizePkts	Monitoring Rx undersize packets
OversizePkts	Monitoring Rx oversize packets
Fragments	Monitoring Rx fragments packets
Jabbers	Monitoring Rx jabber packets
Collisions	Monitoring Tx single collision packets
Pkts64Octets	Monitoring Tx 64 octets
Pkts65to127Octets	Monitoring Tx 65 to 127 octets
Pkts128to255Octets	Monitoring Tx 128 to 255 octets
Pkts256to511Octets	Monitoring Tx 256 to 511 octets
Pkts512to1023Octets	Monitoring Tx 512 to 1023 octets
Pkts1024to1518Octets	Monitoring Tx 1024 to 1518 octets

**Table 2-2 RMON ETH History Control variables**

Variable	Description
HistoryDropEvents	Monitoring Rx dropped packets
HistoryOctets	Monitoring Rx bytes packets
HistoryPkts	Monitoring Rx packets
HistoryBroadcastPkts	Monitoring Rx broadcast packets
HistoryMulticastPkts	Monitoring Rx multicast packets
HistoryCRCAlignErrors	Monitoring Rx error alignment packets
HistoryUndersizePkts	Monitoring Rx undersize packets
HistoryOversizePkts	Monitoring Rx oversize packets
HistoryFragments	Monitoring Rx fragments packets
HistoryJabbers	Monitoring Rx jabber packets

HistoryCollisions	Monitoring Tx single collision packets
HistoryTxBytes	Monitoring Tx bytes
HistoryTxPackets	Monitoring Tx packets
HistoryTxMulticast	Monitoring Tx multicast
HistoryTxBroadcast	Monitoring Tx broadcast
HistoryUtilization	Monitoring Tx Utilization

## 2.4 Fault Management

Fault management is conceptually partitioned into two levels: the system top level, and interface-specific level. Both levels are alarm-level configurable and can be Major and Minor. All the alarms are mask-able.

Fault management provides the alarm output through hardware output interface (on the system front panel) and visible indicator (LED). The alarm/status indications are automatically generated as a result of certain events/conditions. The VX-MD4024 supports query of all current alarm status. It is also able to keep 256 records of historical alarms and events respectively.

### System Alarms

The VX-MD4024 provides the following System alarms:

Alarm Name	Description
SYS_HOUSEKEEP1	House Keeping 1
SYS_HOUSEKEEP2	House Keeping 2
SYS_HOUSEKEEP3	House Keeping 3
SYS_HOUSEKEEP4	House Keeping 4
SYS_FAN	Fan Error
SYS_SELFTESTFAILED	Self Test Failed
SYS_ABOVETEMP	Temperature Above Threshold
SYS_BELOWTEMP	Temperature Below Threshold
SYS_PIV	Product Identification Violation
GBE_LOS	Gigabit Ethernet Loss of Signal
Cluster_MasterDuplication	Cluster has duplicate Master (two Masters exist)
Cluster_MasterOutOfCapacity	Cluster is out of capacity
Cluster_HostUnmanaged	Cluster node enter unmanaged state

## xDSL Alarms

The VX-MD4024 provides the following alarms for VDLS/ADSL interface:

Alarm Name	Description
XDSL_LOF	XDSL Loss Of Framing
XDSL_LOS	XDSL Loss Of Signal
XDSL_LOSQ	XDSL Loss Of Signal Quality
XDSL_LOL	XDSL Loss Of Link
XDSL_INIT_FAILURE	XDSL Init Failure
XDSL_BELOW_SLA_DS	XDSL actual data rate is less than the configured Service Level Agreement threshold for downstream direction
XDSL_BELOW_SLA_US	XDSL actual data rate is less than the configured Service Level Agreement threshold for upstream direction
XDSL_ESE	XDSL Excessive Severely Errored Seconds
XDSL_NCD_SLOW	XDSL No Cell Delineation on the slow channel
XDSL_LCD_SLOW	XDSL Loss of Cell Delineation on the slow channel
XDSL_NCD_FAST	XDSL No Cell Delineation on the fast channel
XDSL_LCD_FAST	XDSL Loss of Cell Delineation on the fast channel
XDSL_LOF_FE	XDSL Far End Loss Of Framing
XDSL_LOS_FE	XDSL Far End Loss Of Signal
XDSL_LPR_FE	XDSL Far End Loss Of Power Failure
XDSL_LOM_FE	XDSL Far End Loss Of Margin
XDSL_NO_PEER_VTU_PRESENT_FE	XDSL Far End No Peer Vtu Present
XDSL_ESE_FE	XDSL Far End Excessive Severely Errored Seconds
XDSL_NCD_SLOW_FE	XDSL Far End No Cell Delineation on the slow channel
XDSL_LCD_SLOW_FE	XDSL Far End Loss of Cell Delineation on the slow channel
XDSL_NCD_FAST_FE	XDSL Far End No Cell Delineation on the fast channel
XDSL_LCD_FAST_FE	XDSL Far End Loss of Cell Delineation on the fast channel

## 2.5 Cluster Feature

The VX-MD4024 supports Cluster feature that can make a group of NEs (network elements) work together as a single NE from the management point of view. Operators can manage the NEs in a cluster, called cluster nodes, via the same single IP address in terms of CLI, Web-based GUI or SNMP based management interfaces. Currently, a VX-MD4024 cluster can include up to sixteen cluster members (NEs). There is one Master and the other members are all Slaves in a cluster. The Master works as a gateway of the Slaves, and it also can forward CLI/Web/SNMP commands to the destination Slave. The Slaves can execute the commands and respond to the Master.

There are two possible network topologies for conducting a Clustering Management group: *Daisy chain* and *Star*.

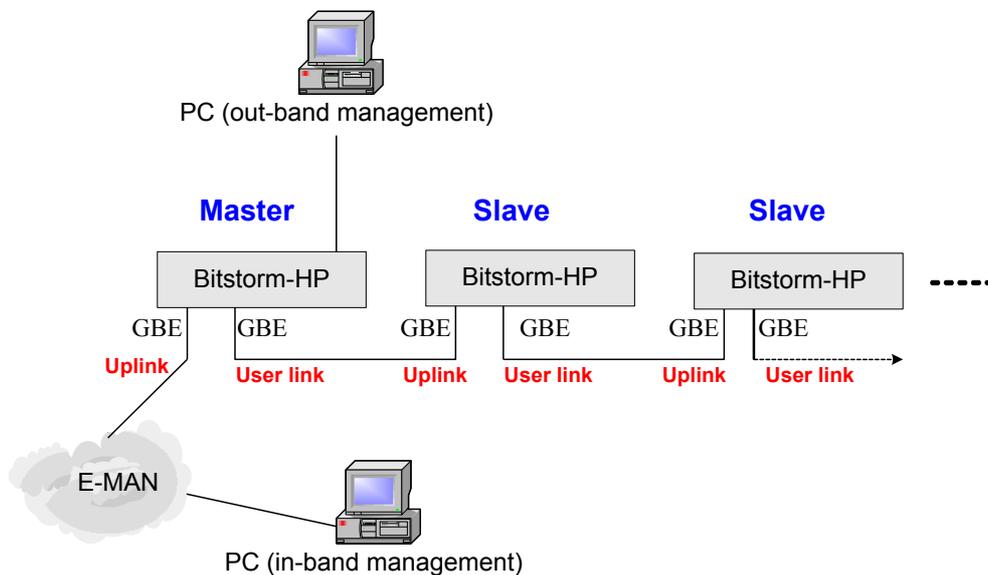


Figure 2-2 Cluster network topology – Daisy Chain

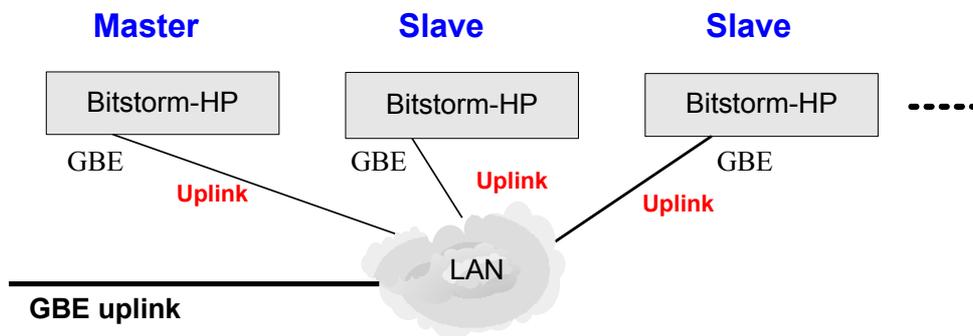


Figure 2-3 Cluster network topology – Star

Before you group a Master and a Slave IPDSLAM, some parameters need to be well configured:

1. Cluster domain name: The group name for a cluster. Must be the same on Master and Slaves within a cluster group.
2. Cluster IP address: IP address to be used for remote management when Master and Slave are grouped together. Only one IP address is required for Master/slaves management within a cluster group.
3. NE cluster name: A unique name to identify the NE (Master or Slave) in a cluster group.
4. Set private IP address on in-band port for both Master and Slave IPDSLAM. The private IP is used for communication between Master and Slave. The management center actually uses Cluster IP address for remote management.
5. Master and Slave need to be configured with same management VLAN.
6. The default gateway should be configured to the router that is aware how to route management traffic to Management Center of the management network. The setting of Cluster default gateway should be the same between Master and Slave.

## ***Abbreviations***

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<b>ADSL</b>	asymmetrical digital subscriber line
<b>ADSLx</b>	ADSL/ADSL2/ADSL2+
<b>ANSI</b>	American National Standards Institute
<b>ATM</b>	asynchronous transfer mode
<b>CLI</b>	command line interface
<b>DSLAM</b>	digital subscriber line access multiplexer
<b>EMS</b>	element management system
<b>DSL</b>	digital subscriber line
<b>EMC</b>	electromagnetic compatibility
<b>EMI</b>	electromagnetic immunity
<b>ETSI</b>	European Telecommunications Standards Institute
<b>Mbps</b>	megabit per second
<b>LED</b>	light emitting diode
<b>POTS</b>	plain old telephone service
<b>PSTN</b>	public switched telephone network
<b>PVC</b>	permanent virtual circuit
<b>SNMP</b>	simple network management protocol
<b>UNI</b>	user-network interface
<b>VDSL</b>	very high speed digital subscriber line



