Technical Report
TR-030

ADSL EMS to NMS Functional Requirements

February 2000

Abstract:
The purpose of this Technical Report is to provide high level functional requirements describing a north-bound interface from an ADSL Element Management System (EMS) to a Network Layer Inter-domain Network Management System (NMS).

ADSL EMS to NMS Protocol-Independent Interface Functional Requirements

1. Introduction

1.1 Purpose

The purpose of this working text is to provide high level functional requirements describing a north-bound interface from an ADSL Element Management System (EMS) to a Network Layer Inter-domain Network Management System (NMS) for ATM-based ADSL access networks. This working text defines an interface that is based on the ATM Forum's M4 Network View-logical MIB and T1M1 M.3100 network management standards. ADSL-specific requirements such as NE-level ADSL configuration and operational data as defined by the ADSL Forum should be exposed over the ADSL EMS to NMS interface described herein. These functional requirements will provide input to subsequent EMS/NMS interface information modeling work as well as provide a basis for future protocol-dependent interface requirements.

1.2 Document Road Map

This contribution addresses the following areas for the EMS/NMS interface in the ADSL environment:

- Section 2 addresses the network management architecture.
- Section 3 addresses the functional perspective of the EMS and NMS.
- Section 4 addresses the interface functional requirements including
  - general requirements and assumptions,
  - configuration management,
  - fault management,
  - performance management, and
  - security management.
- Section 5 addresses the references for this document

No accounting management functional requirements are envisioned at this time.

2. Network Management Architecture

This section describes a typical Broadband Network Management Architecture for managing an ATM-based ADSL access network which provides the basis for this working text. In a Broadband OS architecture, an NMS provides end-to-end network management functions for a multiple-supplier, multiple-technology network. This architecture leverages the capabilities of network-supplier EMS products and also supports gateway interfaces to upstream Operation Support Systems (OSS).

Figure 1 depicts the typical environment in which the ADSL EMS and Broadband NMS could co-exist. Note that the Broadband NMS interfaces to subnetwork management

systems to actually manage the network. The network managed by the NMS could include ATM, SONET, ADSL and other broadband type network elements and EMS(s).

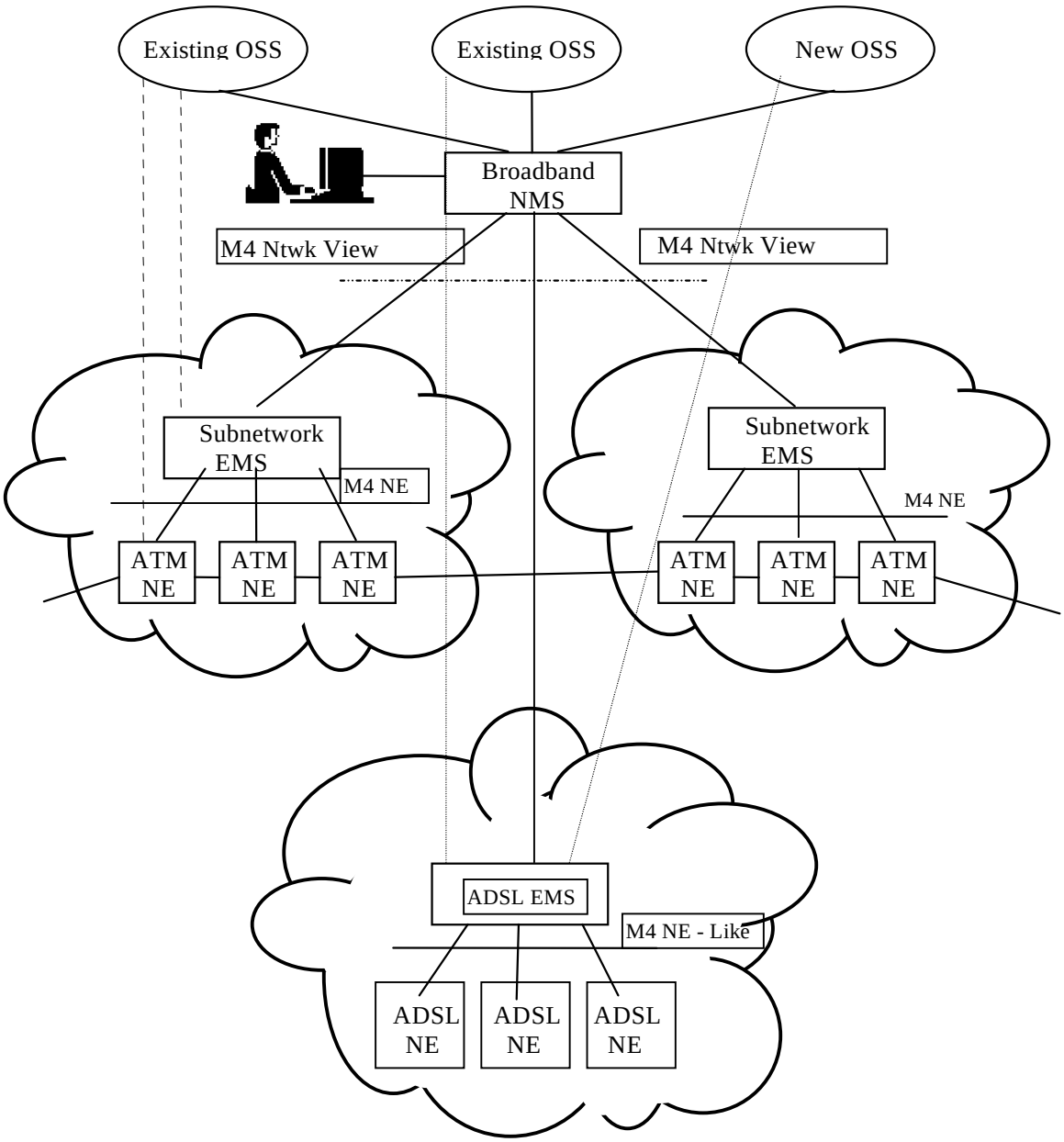

Figure 1. Example of Broadband NMS Environment

3. Functional Perspective

For informational purposes only, this section addresses the functional perspective assumed functions of the ADSL EMS and Broadband NMS, and EMS to NMS interface implementation guidelines. NE(s) typically interface to an ADSL EMS as shown in Figure 2. This EMS can be considered a supplier-specific EMS. The supplier typically provides documentation on the capabilities of that EMS. The EMS may have either an

open interface or a proprietary interface to allow it to manage a subnetwork of NE(s). If a standards-based versus proprietary interface is used standard MIB(s) are preferred.[1]

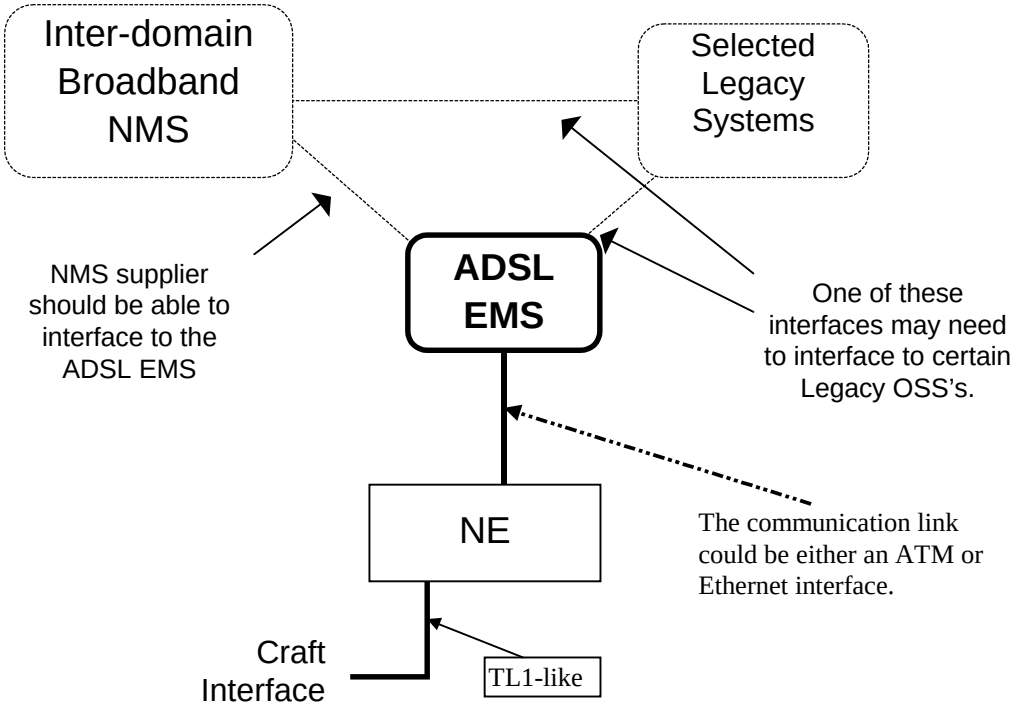

Figure 2 Example of an ADSL Network Management Architecture

3.1 Assumed Functions of the EMS

The ADSL EMS provides element-level management of the ATM-based ADSL access subnetwork made up of DSLAM(s), ATU-C(s) and ATU-R(s). Element management capabilities to be performed include but are not limited to the following:

- Configuration Management for creation/deletion of the ADSL line parameters between the ATU-C and ATU-R
- Connection Management for setting up/tearing down VCC(s) between the user and the network
- Fault Management for assessing the impact of ADSL line failures
- Security Management for partitioning the element layer view and control
- Establishing and monitoring the communication between the EMS and NE(s)

[1] An "open" interface is one which has been published in sufficient detail for other manufacturers to build equipment that can inter-operate. A "standard open" interface is not only published, but has been agreed to in a standards body, such as the IETF.

3.2 Assumed Functions of the NMS

The Broadband NMS will provide end-to-end network-level management of Broadband networks composed of ATM, ADSL and other potential broadband subnetworks. Network Management capabilities to be performed include but are not limited to the following:

- Configuration Management for creation/deletion of network links that connect subnetworks
- Connection Management for setting up/tearing down end-to-end VCC(s) using inter-subnetwork routing
- Fault Management for assessing the impact of network link failures on existing VCC(s)
- Security Management for partitioning the network view and control
- Communication with EMS systems for managing individual subnetworks.

The Broadband NMS should provide gateway interfaces to existing OSS and new OSS to support service activation, service assurance, network planning, network engineering and possibly, billing.

The Broadband NMS should provide a cut-through capability from the NMS GUI to a specific EMS as if the NMS user is using the EMS GUI.

The NMS shall be responsible for data synchronization between the NMS and the EMS(s) by on-demand auditing of the EMS database(s). The NMS shall also be able to audit a specific part of the EMS database(s). The steward for interface objects is the EMS, but the NMS is responsible for synchronization.

3.3 Implementation Guidelines

3.3.1 NMS to EMS Interface

The NMS commands are targeted for the EMS(s). How the command is processed by the EMS is an internal EMS design choice. For example, an EMS may respond to the NMS command by looking at its database, or it may send a request to its subtending NE(s) to obtain the requested information and then respond back to the NMS. Furthermore, to respond to a NMS request, an EMS may need to issue multiple commands in its domain to perform the requested NMS operations. It is up to the EMS to perform such tasks.

3.3.2 EMS Translation to Vendor-Specific Parameters

The intent is to provide a unified EMS/NMS interface across all the EMS(s). The EMS(s) should be responsible for translating all standard information (e.g. Managed Object representation) to vendor-specific representation.

4. Interface Functional Requirements

This section addresses the EMS to NMS functional requirements categorized by the systems management functional areas defined by the ITU [3]: Configuration Management, Fault Management, Performance Management and Security Management. Accounting Management is not a requirement for this interface.

4.1 General Requirements

4.1.1 EMS Responses to NMS Messages and Their Correlation

The EMS response to NMS messages will contain a correlation indicator to the NMS input command. In the response to an NMS message, the EMS could echo back the same correlation indicator contained in the NMS message. The NMS is responsible for the uniqueness of the correlation indicator across all its subtending EMS(s).

4.1.2 Sequence Number for Autonomous EMS messages to NMS

For each EMS autonomous message to the NMS, the EMS shall assign a sequence number for that message. Such a sequence number should be included in all EMS autonomous messages. Note that these autonomous messages may be EMS-generated or NE-generated alarms, events or report database changes. These sequence numbers are used by the NMS to identify the missing autonomous EMS messages.

4.1.3 Logging of Autonomous EMS messages

The EMS should provide a logging function for all autonomous messages generated by the EMS or the NE. Specific logging requirements should be defined by the protocol-dependent interface requirements.

4.1.4 Logical NE Definition

A Logical NE (LNE) is a collection of NE(s) which can be viewed from an NMS perspective as a single provisionable and/or maintainable entity. To implement an NMS logical NE command, an EMS may need to issue multiple commands to perform the requested logical NE operations in its domain. For example, if an ATM EMS is used, from the NMS perspective, the ATM cloud would be a logical NE. For provisioning, the NMS needs only to define the entrance and exit points to the ATM cloud. The ATM EMS will then take care of all appropriate cross-connects and routing in its domain. The EMS provides a grouping of NE(s) which behave as a logical NE to the NMS. Logical NE(s) belong to one EMS domain and can not cross EMS domains. A Containment hierarchy can be used to model logical NE clustering in the NMS MIB.

Logical NE subnetwork is required for ATM connection management to set up, release, and modify point-to-point and multi-point ATM subnetwork connections. Network View objects will be used even though the EMS will send objects per NE. It is recommended that atomic subnetworks be supported.

4.1.5 Naming Requirements or Services

Naming requirements and/or services should be defined by protocol-dependent interface requirements.

4.1.6 Association of Circuit ID/Name to NE Autonomous Messages

The circuit ID is an important concept in a Service Provider's environments. Traditionally, this circuit ID is applied to network physical entities. It is proposed that this concept be extended to the logical ATM entities such as VCC(s) and VPC(s).

The general philosophy is to download the circuit ID (or user-definable label) to the EMS(s) at the time of capacity and service activation. The EMS then stores the circuit ID and appends it to the associated NE autonomous messages, whenever they are forwarded from the EMS to the NMS. This would require an EMS to store the NMS-provided circuit ID/label related to:

- ATM VCC(s) (an end-to-end connection consisting of multiple VPL(s))
- Cross EMS Virtual Paths (VP(s))
- Cross EMS physical transmission facilities (e.g., SONET or DS3)
- ADSL lines

Hence, the circuit ID/label applies to both, physical facilities as well as ATM logical entities. In the ATM arena, sometimes the term "PVC ID" instead of the "circuit ID" is used.

Although the circuit ID or PVC ID is an NMS concept, this requirement proposes the EMS(s) to provide "hooks" to simplify the NMS cross-EMS event correlation.

If an autonomous message is associated with the high level line failure (e.g., OC3c facility in a NE), then only the circuit ID associated with that OC3c facility shall be appended to the message which is sent from the EMS to NMS. It is not required to transmit all the impacted lower level circuit IDs, such as those associated with the ADSL line termination. That is, only the root cause circuit ID is reported by the EMS. The NMS will provide the appropriate mapping to lower level circuit IDs.

4.1.7 Support of NMS/EMS Link Heartbeat

The EMS should send periodic heartbeat notifications to the NMS to indicate that it is alive at user-definable intervals. The option to disable this notification should also be provided.

4.1.8 EMS Acknowledgment

If the actual response to specific NMS messages cannot be received within a pre-specified time period, the EMS shall send an appropriate acknowledgment to the NMS. An acknowledgment is a response to an NMS request. This acknowledgement may be implemented for specific commands for which a response could take a long time. If the response to an NMS input command takes longer than a pre-specified time interval, the

EMS shall periodically issue an acknowledgment message indicating the pending state of the NMS-requested operations. These acknowledgments imply the command is being executed. The EMS should continue to send acknowledgment messages at every interval of the designated delay period until the "completed" or "denied" response is sent back to the NMS. The periodicity of acknowledgments should be a settable parameter. This feature prevents the NMS operator from issuing a command multiple times due to not receiving a response in a reasonable timeframe.

Example: If the NMS requests an EMS to perform NE software restoration and completing such task could take approximately 20 minutes, then that EMS should send an appropriate acknowledgment to the NMS indicating that the requested operations is being performed.

4.2 Configuration Management

4.2.1 Retrieval of the NE List

The NMS shall be able to request an EMS to provide the list of NE(s) under its domain together with their ID(s).

4.2.2 Manipulation and Application of EMS Profiles

The NMS operator should be able to retrieve, create and distribute EMS profiles through the NMS/EMS interface. The NMS shall also have the capability to request an EMS to apply a specific profile or a QOS class (i.e., super profile).

It is assumed that at the time of installation, when the NE is activated, it will automatically come with factory default parameters (e.g., for NE equipment and SONET OC3c, DS3 and ADSL terminations). However, if a different profile (other than the factory default profile) is needed, the NMS operator must have the capability to request the EMS to apply the NMS-requested profile. The NMS operator shall be able to perform this function across the EMS via an NMS/EMS command. Hence, the NMS must have the capability to specify and request the EMS to apply a specific EMS-stored profile.

Retrieval of profiles and their content is a requirement. Creating and deleting profiles is also useful, however, modifying profiles would not be required. The ADSL profile and traffic descriptor profiles as well as any other ADSL-related profiles should be exposed through the interface. Profiles need not necessarily exist in the NMS.

4.2.3 ATM Level Cross-connection (Logical Provisioning)

The EMS shall be able to receive an ATM level cross-connection request from the NMS. To activate a service, one or multiple cross-connect commands from the NMS to EMS may need to be issued. The crossconnection may be at the VC level or VP level, as required. The following information shall be included in a crossconnect message:

- Ingress assigned port on an NE (or logical NE) and specific VPI/VCI or VP
- Egress assigned port on NE (or logical NE) and VPI/VCI or VP

– Identification of ATM traffic descriptor profiles, as appropriate
– VCC ID associated with ATM VCC(s) and VPC ID, as appropriate
– Type of cross-connection (point-to-point, multi-point, broadcast, etc.)

The NMS shall also be able to request to disconnect (i.e., tear down) the existing VPL and VCL cross-connections.

4.2.4 Allow/Inhibit Switching of ATM Cell Flow

The EMS to NMS interface shall support the NMS request to inhibit/allow the switching of ATM cell flow for a particular VP/VC cross-connection. When the cell flow is inhibited, the EMS shall continue to maintain the existing cross-connect relationship.

4.2.5 Request EMS to Retrieve NE Inventory Data

The NMS shall be able to request an EMS to retrieve NE physical and logical inventory data. The EMS shall respond to the NMS query by either retrieving the data from its database or directly from the NE(s).

The physical inventory data includes a list of all cards (including hardware & software versions), associated ports and their current state, if available, such as:

i) in-service,
ii) available (installed but not in service), and
iii) pending or reserved designations. (The pending or reserved state indicates that the port has been assigned by the EMS, but it has not yet been put into service.)

The logical inventory data includes a list of all VC and VP cross-connect tables in a NE with associated current states (e.g., inhibit/allow switching, QOS, VCC ID, etc.)

The NMS shall be able to request the EMS to provide the current software version of a specific NE, including all cards. The NMS shall also be able to request the software version of all the NE(s) under an EMS domain. It is up to the EMS to respond to this request based on the information in its database or to query such data from the NE(s).

Standard Port ID for all equipment should be based on the following example:

```
PortId  ::= SEQUENCE {
    managedElement [0]  GraphicString,
    bay [1] GraphicString OPTIONAL,
    shelf [2] GraphicString OPTIONAL,
    drawer [3] GraphicString OPTIONAL,
    slot [4] GraphicString OPTIONAL,
    port [5] GraphicString }
```

Basically it is a sequence of six "strings" where all are optional except the Managed Element and Port.

4.2.6 Request EMS to Provide an Available Port Assignment

The NMS shall have the option to request the EMS for an available port assignment. The EMS shall respond back by assigning a specific port from its inventory and changing the state of that port from "available" to "reserved" so that it can not be re-assigned before service activation. If the "pending" state of a port is not changed to "working" state after a user-defined time, the EMS shall send a warning message to the NMS. If no action is taken by the NMS, the EMS shall change the port status back to "available". This is to avoid indefinite tying up of the network resources if the service activation has not taken place.

4.2.7 "On-Demand" Discovery of Network Topology

The NMS shall be able to request, on demand, the EMS to provide the view of the subnetwork of the EMS. This should include associated facility (i.e. DS1, DS3, OC3, etc.) link information and link terminations for the network elements (i.e. NE(s)). The NMS shall be able to construct an updated physical network map/topology view from such information.

If the EMS automatically and autonomously performs network discovery and has updated information in its database, then it should provide such information to the NMS, upon request.

4.2.8 Auto-discovery

This interface will allow for the transmission of the auto-discovered information from the EMS to the NMS. This transparent flow-through of EMS information to the NMS is considered critical to the successful operation of a Broadband Inter-domain NMS.

4.2.8.1 Auto-discovery of "Physical Network" to NMS

Whenever the EMS creates, deletes or discovers a new NE, card, port, or facility termination (e.g., SONET or DS3), the EMS shall send an autonomous message to the NMS informing it of the new discovery with appropriate identification. This requirement does not specify "how" an EMS creates, deletes or discovers the underlying resources. Such discovery function could have been performed:

- Manually by the EMS user
- NE autonomous messages
- EMS automatic inquiry

4.2.8.2 Auto-discovery of "Logical Network" to NMS

Whenever the EMS creates, deletes or discovers a new VC or VP cross-connect, the EMS shall send an autonomous messages to the NMS informing it of the new discovery with appropriate identification.

4.2.9 Retrieve EMS Software Version

The NMS shall be able to request the EMS to report it's software version.

4.2.10 Edit User Definable Labels

The ability to edit all user definable labels, such as circuit ID(s), for connections, ports, and NE(s) is required.

4.2.11 Capability to Provision ADSL Lines

The NMS shall have the capability to provision ADSL line(s) through this interface after NE is installed and discovered by the NMS with or without the use of profiles.

4.2.12 Capability to Pre-Provision ADSL Lines

The NMS shall have the capability to pre-provision ADSL line(s) through this interface prior to NE being installed or discovered by the NMS with or without the use of profiles.

4.2.13 Request ADSL Port Status

The NMS shall have the ability to request the status or state of an ADSL port(s). The state or status of the port should indicate whether the port is assigned, pending or reserved, defective or disabled.

4.2.14 Provision signaling channel

The NMS will have the ability to provision SVC service on a UNI port for each SVC Customer through the EMS to NMS interface if supported in the NE. This process configures the signaling channel attributes, and configures the address prefix to identify the SVC customer.

4.2.15 Enable/Disable SVC on NE

The NMS will have the ability to enable/disable the SVC capability on a specific NE through the EMS to NMS interface if supported by the NE. It is assumed that all SVC-related profiles have already been created in the target NE via the EMS GUI.

4.3 Fault Management

4.3.1 Forwarding of the NE Alarms/Events from EMS to NMS

The EMS shall provide appended information associated with NE messages before they are forwarded to the NMS. The EMS must forward all alarms/events (i.e., the ones passing through the filter residing in the EMS, see subsequent sections) originating from the NE(s) (e.g., NE and ADSL, ATM, SONET and DS3 terminations). This section addresses reporting of NE-generated alarms and events from EMS to NMS. (Refer to Section 4.1.2.)

The EMS shall append the following information to the NE messages received at the EMS, before they are forwarded to the NMS:

i) A unique EMS sequence number for the autonomous messages.
ii) Appending of User Definable Labels (i.e. circuit IDs or PVC Ids) to the NE messages are required before transmitting them to NMS. These labels are

provided, by the NMS to the EMS(s) during the capacity and service activation processes.

Appending of a label to a NE-generated message should be provided in the following cases:

a. For those messages which are directly related to ATM VCC(s) and ATM VPC(s). Such labels are provided by the NMS to the EMS(s) during the capacity & service activation processes. The labels should be appended to the message.
b. For those autonomous messages which are directly related to physical ADSL, SONET or DS3 facility terminating on the NE. Such a label may be manually input into the EMS(s) during the capacity activation/resource provisioning process. The label should be appended to the message.

If an autonomous message is not directly related to a label (e.g., equipment alarm), then appending of all the impacted labels are not required.

4.3.2 Autonomous Reporting of EMS-Generated Events/Alerts

In addition to NE-generated alarms/events, the EMS will generate an autonomous message to the NMS to report the following conditions:

- EMS/NE link failure
- Internal EMS processing errors

4.3.3 Upload Autonomous Messages Upon Link Re-activation

If the NMS/EMS link goes down, the EMS shall log the autonomous messages (i.e., NE and EMS-generated alarms/events) that would have been sent to the NMS if the link was operational. Upon link re-activation, the NMS will automatically request the EMS to upload all stored autonomous messages for the duration of the time that NMS/EMS link was down. Refer to Requirement 4.1.2 and 4.1.3 for specific logging requirements.

4.3.4 Manipulation of the EMS Alarm/Event Filter from NMS

The EMS shall provide a "filter" for alarms/events which are sent from EMS to NMS. The NMS shall be able to manipulate the EMS filter for autonomous messages so that the NMS can receive only an appropriate subset of EMS-originated or NE-originated messages. The parameters specified in this message shall specify the criteria for filtering messages at the EMS level. The messages must be able to allow/inhibit EMS events from being transmitted to NMS based on parameters such as:

- Facility termination (e.g., OC3c), ATM VCC(s), equipment, subscriber, etc.
- EMS-initiated, NE-initiated, etc.
- NE ID
- Severity of alarms such as Critical, Major, Minor, etc.
- Message type (Alarms, TCA(s), PM, etc.)
- User Definable Label (for both physical and logical entities)

If specific type of EMS autonomous messages are inhibited, this should not impact other commands issued by NMS and responses provided by that EMS.

The following two features may be implemented as a separate feature or as a specific implementations of the above filtering capability.

4.3.5 Allow/Inhibit EMS Uplink Autonomous Messages to NMS

The NMS shall be able to allow/inhibit "all" the EMS autonomous messages sent to NMS. This includes NE-generated events and EMS-generated messages. This feature may be used to prevent flooding of the Data Communication Network (DCN). (Special case of Requirement 4.3.4)

4.3.6 Allow/Inhibit Specific NE Autonomous Messages

The NMS shall be able to allow/inhibit EMS transmittal of autonomous messages related to a particular NE. When the NMS inhibits autonomous messages from a NE, no messages from that NE are sent over the EMS/NMS link. The EMS should continue to receive autonomous messages from that NE. This requirement provides the capability to exclude a NE from being monitored by the NMS while it is behaving abnormally and too many alarms/alerts are generated by that NE. (Special case of Requirement 4.3.4.)

4.3.7 Retrieval of Current NE Status Information

This requirement allows the NMS to retrieve current NE-specific information (i.e. current problem list, operational data) from the EMS for diagnostic purposes. This data is used to evaluate the current network situation either before or after maintenance operations. The NMS shall be able to restrict the status information to specific parts of the NE (i.e. ports, boards or miscellaneous equipment (e.g. fans, power supply)). The EMS shall not apply any filtering to this data. If an EMS cannot provide this data from its database, it must query the NE to acquire the information.

4.3.8 OAM Cell Loopback (F4/F5)

The NMS/EMS interface shall support an NMS request to perform OAM Cell Loopback (i.e., F4/F5) if supported by the NE.

4.3.9 Additional Miscellaneous Loopbacks

The EMS/NMS interface shall support an NMS request to perform additional miscellaneous loopbacks as supported by the NE or ADSL EMS.

4.3.10 Edit Alarm Severity Assignments

The ability to edit alarm severity assignments on a per port basis with or without profile capability is required. The objective is to enable/disable alarm severities per port.

4.3.11 Correlation of Alarms

Correlation of alarms and root cause analysis should be exposed through this interface based on the capabilities of the EMS in this area.

4.4 Performance Management

4.4.1 ADSL Line Operational Data

The NMS shall be able to initiate a request to the ADSL EMS to obtain ADSL line operational data. If a time stamp is available it should also be provided.

4.4.2 Retrieval of Performance Monitoring Register Data

The EMS shall allow the NMS to retrieve the content of any or all of the PM registers in a NE. This includes parameters related to ATM QoS.

4.4.3 Manipulation of PM Thresholds/PM Data

The EMS shall allow the NMS to set and modify the PM thresholds or collection of PM data on a per termination point basis in the NE.

4.5 Security Management

4.5.1 Set Privileges, Authentication Data and Passwords for Access to NE(s)

The EMS shall allow the NMS to retrieve NE security data including current passwords to access that NE. The NMS will then have the ability to remotely set up user accounts with privileges and modify/change password information in the NE(s). The EMS shall also allow the NMS to change all the passwords associated with the NE(s) with one command. The EMS shall allow the NMS to add/delete a specific password on all NE(s) with one command.

4.5.2 Set Privileges, Authentication Data and Passwords for Access to EMS

The EMS shall allow the NMS to retrieve EMS security data including current passwords to access that EMS. The NMS will then have the ability to remotely set up user accounts with privileges and modify/change password information in the EMS(s). The EMS shall also allow the NMS to change all its passwords with one command. The EMS shall allow the NMS to add/delete a specific password on all EMS(s) with one command.

4.5.3 Autonomous Reporting of NE Security Messages

The NMS will receive (via EMS) any NE autonomous messages which are related to occurrence of NE security violation events. Filtering of these messages should be provided as on a operator-controlled basis.

4.5.4 NMS/EMS Interface Link Security

The NMS/EMS interface shall support appropriate link layer security mechanisms. As an example for TCP/IP, the current leading technology in this area is Secure Socket Layer (SSL) protocol from Netscape 3.0. The IETF has published the next generation of SSL in RFC 2246, which is Transport Layer Security (TLS). It is recommended that TLS be used when this protocol matures.

4.5.5 NMS/EMS Interface Access Control

Access Control allows association of appropriate access permissions with resources. Resources can be either physical (modems, Links, Line Cards) or logical (VCC) entities. Only specific operations indicated by the Access Control information are permitted on a resource. NMS & EMS applications must support an Access control mechanism to associate specific permissions with resources and to protect resources from unauthorized operations. Implementation of this requirement will require joint agreements and development between the ADLS EMS and Broadband NMS suppliers.

5. Glossary and References

5.1 Glossary of Terms, Acronyms and Terminology

ATM (Asynchronous Transfer Mode) - a connection-oriented high-speed communications protocol in which data is divided into 48 byte “cells” that can be individually switched and routed. Each cell is pre-appended with a 5 byte “header” containing an identifier of the connection of which the data is a part, along with quality of service parameters associated with the connection.

Customer - an entity to which the service provider provides network services.

EMS (Element Management System) - typically provided by a network element supplier and capable of managing multiple network elements of that supplier. An EMS may communicate with one or more NE(s) on an individual or collective basis (e.g., individually to a switch or collectively to a SONET ring). An EMS may have some network management layer capabilities, particularly, when an EMS manages multiple types of NE(s) and/or NE(s) from multiple suppliers.

MIB (Management Information Base) - a set of data elements and capabilities made available by a system to enable it to be managed. The CMIP protocol relies upon a formal definition of a system’s MIB written in a language called “GDMO.”

NE - a Network Element (i.e. NE)

Network - one or more subnetworks connected by network links, providing end-to-end service to one or more customers. Each subnetwork is administered by an EMS and the network is administered by a service provider.

NMS (Network Management System) - responsible for end-to-end management of a network composed of network elements from multiple suppliers. Instead of directly managing network elements, it relies upon the capabilities of the EMS(s). An NMS may interface with one or more Service Management Systems and may include some service management functionality. An NMS may also include some element management layer capabilities that allow it to manage individual NE(s) or it may contain only network management layer functionality to manage one or more EMS(s).

Port - an access point on an NE to which a link or a customer access link is attached.

PVC (Permanent Virtual Connection) - an ATM connection established to provide a "permanent" communications channel similar to the way private lines are used in narrowband communications.

QoS (Quality of Service) - parameters describing the attributes of a connection such as bandwidth, burstiness of the information on the connection, and priority.

Subnetwork - a collection of one or more NE(s), interconnected by subnetwork links, with connectivity between any pair of NE(s) (i.e., the topology is a connected graph).
VCC (Virtual Channel Connection) - an ATM connection identified on each end of the network by the combination of a virtual channel identifier (VCI) and a virtual path identifier (VPI) unique to that interface, and having an associated quality of service (QoS).

VCI (Virtual Channel Identifier) - an integer in each ATM cell header identifying the virtual channel of which the information in the cell is a part.

VPC (Virtual Path Connection) - an ATM connection identified on each end of the network by a virtual path identifier (VPI) unique to that interface, and capable of "containing" a number of virtual channel connections to be transmitted through the network as a single stream of information.

VPI (Virtual Path Identifier) - an integer in each ATM cell header identifying the virtual path of which the information in the cell is a part.

5.2 References

[1] GR-2869-CORE, *Generic Requirements for Operations Based on the Telecommunications Management Network (TMN) Architecture*, Issue 2, Bellcore, October, 1996.

[2] ATM Forum AF-NM-0058.000 *M4 Interface Requirements and Logical MIB: ATM Network View*, Version 1.0, 1995.

[3] ATM Forum 94-3888R4 *M4 Interface Requirements and Logical MIB: ATM Network Element View*, Version 1.0, October 14, 1994.

[5] ITU-T Recommendation M.3010, *Principles for a Telecommunications Management Network*, October, 1992.

[6] ITU-T Recommendation M.3100, *Generic Network Information Model*, October, 1992.

[7] SR-TSV-002690, *Requirements for an EML Platform Environment*, Bellcore, Issue 1, March, 1994.

[8] *Network Management Layer to Element Manager Interface Description*, Bellcore, February 7, 1996.

[9] ITU-T *Recommendation X.721, Information Technology – Open Systems Interconnection – Structure of Management Information: Definition of Management Information*, January, 1992.

[10] ITU-T *Recommendation X.720, Information Technology – Open Systems Interconnection – Structure of Management Information: Management Information Model*, January, 1992.