

# INTRODUCTION TO THE TM FORUM'S MULTI-TECHNOLOGY NETWORK MANAGEMENT (MTNM) MODEL

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## 1 Overview

The TM Forum's Multi-Technology Network Management (MTNM) team is modeling an NMS-EMS interface for the management of SONET/SDH, ATM and DWDM equipment and networks. The MTNM model builds on the SONET/SDH Information Model (SSIM). The SSIM focused on connection management, network topology discovery and fault management for SONET/SDH and is now complete (see TM Forum 509 v1.1).<sup>[1]</sup> The MTNM extension adds support for the management of DWDM and ATM equipment and networks, and enhances management support for SONET/SDH, e.g., performance management is now supported. The MTNM work is expected to be complete around May 2001.

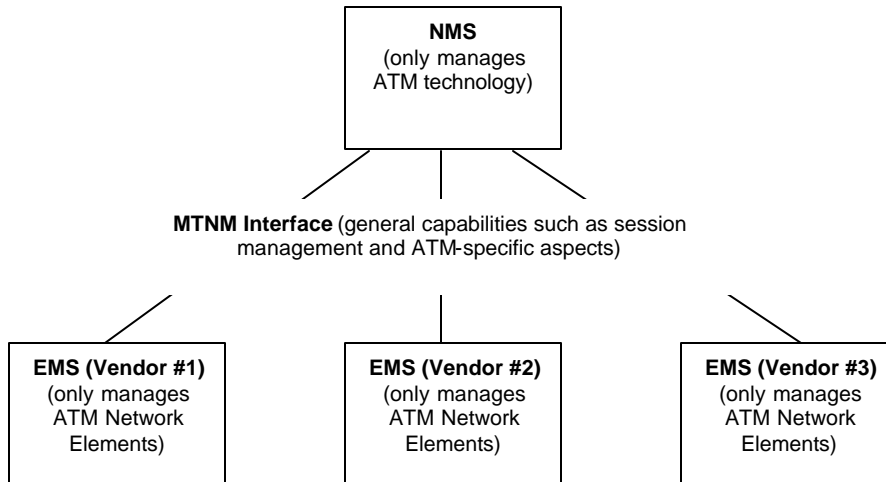
The output of the MTNM effort will be documented in:

- TMF 513, MTNM Business Agreement,<sup>[2]</sup>
- TMF 608, MTNM Information Agreement,<sup>[3]</sup>
- TMF 814, MTNM Solution Set,<sup>[4]</sup> and
- TMF 814A, MTNM Implementation Statement.<sup>[5]</sup>

The Business Agreement (BA) identifies the requirements and use cases (functionality) to be supported by the interface. The Information Agreement (IA) is a protocol-neutral (UML) description of the interface. The CORBA-based Solution Set maps the UML model to OMG IDL. The three documents cover ATM, SONET/SDH and DWDM management functions accessible over the NMS-EMS interface. The Implementation Statement (IS) is similar to the Managed Object Conformance Statements (MOCS) Proforma designed in support of interfaces based on the Guidelines for the Definition of Managed Objects (GDMO). TMF 814A provides implementation templates for the various aspects of the MTNM IDL.

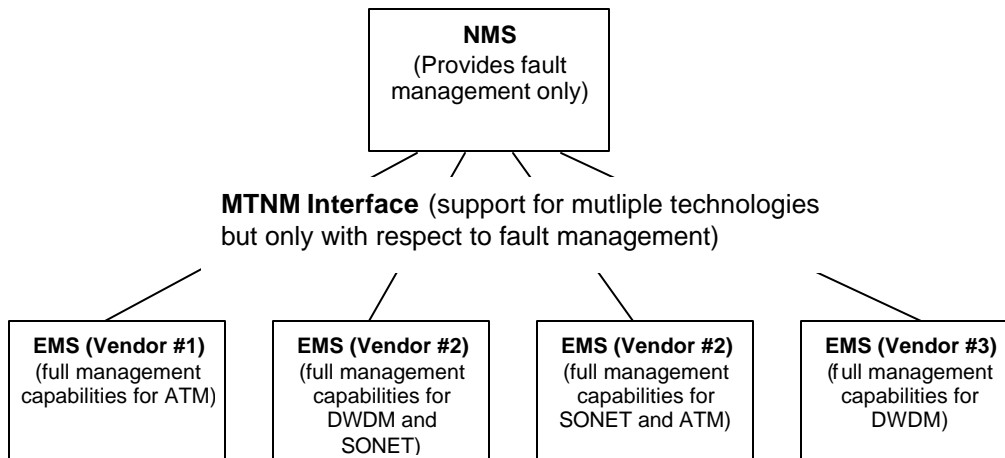
## 2 Application of the MTNM Interface

The MTNM interface can be used in a variety of ways. Although the MTNM interface supports multiple technologies, it can be used to support a single technology such as ATM. Figure 1 shows three EMSs that only manage ATM Network Elements (NEs). Each EMS manages the equipment of a different NE vendor. A third vendor's NMS manages the three EMSs. The situation shown in Figure 1 is a multi-vendor, single-technology application of the MTNM interface.



**Figure 1.** Multi-Vendor, Single-Technology Example

In Figure 2, the MTNM interface manages one functional area (in this case fault management) for multiple technologies.



**Figure 2.** Multi-Vendor, Multi-Technology, Single-Management-Area Example

Other uses of the MTNM interface are possible:

- The NMS and the EMS could manage a single technology (say ATM) for a particular subset of a management area, e.g., performance monitoring.
- Both the NMS and EMSs could support multiple technologies and multiple management areas, and be provided by multiple vendors.

### 3 Relationship to Other TM Forum Defined Interfaces

The relationship between the MTNM interface and other TM Forum management interfaces is shown in Figure 3. The Connection and Service Management Information Model (CaSMIM) is an interface for connection management that can be used between a Service Management System (SMS) and a Cross Domain Manager (XDM), or between an XDM and a technology-specific Domain Manager (DM). The CaSMIM interface is documented in references [6], [7] and [8]. In the figure below, the MTNM interface is depicted with circled, two-sided arrows. In addition, the IP Network Management (IPNM) team is working on an NMS-EMS interface for IP management.

The MTNM interface is used at the EML which is closer to the underlying transport technology than where the CaSMIM interface is applied, i.e., the NML and SML. Consequently, the MTNM model is more technology specific than the CaSMIM model. The CaSMIM model is more closely related to customer services, e.g., end-to-end connections, and tends to represent managed resource more abstractly than the MTNM model.

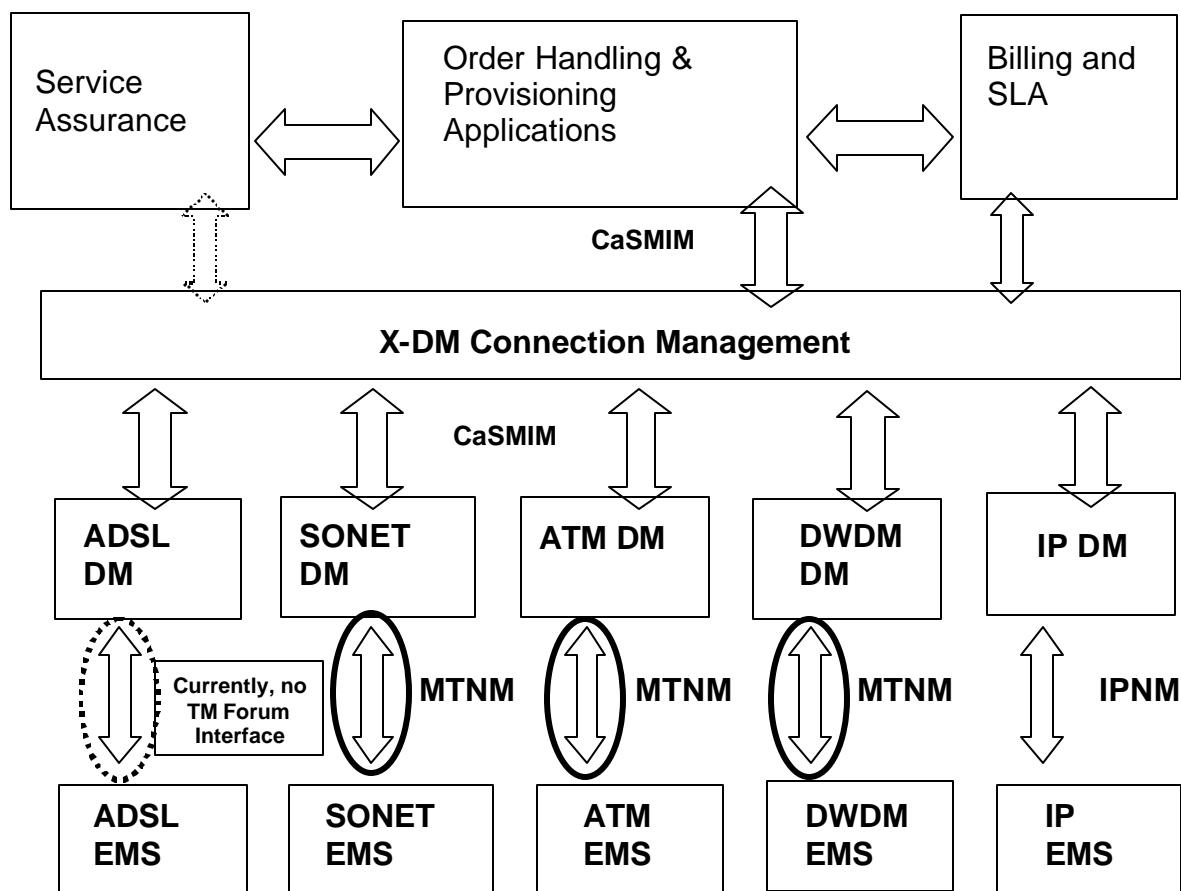


Figure 3. Relationships Among the Various TM Forum Management Interfaces

## 4 The Management Scope of the MTNM Interface

The MTNM interface covers management functions for ATM, DWDM, SDH and SONET. For each technology, a specific set of management functions is supported. Table 1 summarizes the MTNM management functions supported by each of the IDL modules. The main management areas covered by the MTNM interface are connection management, NE and EMS configuration, network inventory discovery, equipment inventory management, performance administration and monitoring, alarm surveillance and event reporting (e.g., object creations/deletions, state change and attribute value change notifications).

**Table 1.** Summary of Functionality Supported by Each IDL Module

| Module Name           | Description   | Supported Technologies                            |
|-----------------------|---|---|
| emsMgr                | This module provides an interface (i.e., EMSMgr_I) that contains operations that deal with the EMS itself, e.g., getAllEMSSystemActiveAlarms.   | Not specific to a particular transport technology |
| emsSession            | This module supports interfaces that allow the NMS to determine what managers are supported by the EMS.   | Not specific to a particular transport technology |
| emsSessionFactory     | This module contains an interface that serves as an entry point to the EMS. A user name and password is needed to gain access.  | Not specific to a particular transport technology |
| equipment             | This module supports the representation and discovery of network inventory such as racks, shelves, slots and circuits packs.  | Not specific to a particular transport technology |
| guiCutThrough         | This module allows the NMS to cut through to the EMS GUI in a standard manner.  | Not specific to a particular transport technology |
| maintenanceOperations | This module allows the NMS to request that the EMS have particular maintenance activities performed in the subtending subnetwork, e.g., Facility Loopback, Terminal Loopback, Facility Forced AIS, and Terminal Forced AIS. | SONET/SDH   |
| managedElement        | This module contains a data structure that is used to represent Managed Elements. It also provides an iterator interface that allows for the bulk retrieval of information about Managed Elements associated with an EMS.   | ATM, SONET/SDH, DWDM                              |
| managedElementManager | One instance of this interface is used to manage all Managed Elements associated with an EMS. The focus is configuration management and alarm retrieval.  | ATM, SONET/SDH, DWDM                              |
| multiLayerSubnetwork  | One instance of this interface is used to manage all the subnetworks with an EMS's management domain. The focus is on connection management.  | ATM, SONET/SDH, DWDM                              |
| performance           | This module supports the retrieval of current and historical performance data related to SONET/SDH and DWDM. The method of PM data transfer is file transfer.   | SONET/SDH, DWDM                                   |

| Module Name            | Description   | Supported Technologies                            |
|------------------------|---|---|
| protection             | This module allows the NMS to discover SONET/SDH shared protection ring relationships (i.e., allows for the discovery of protection groups).  | SONET/SDH   |
| session                | This module provides an interface that is used to manage a session between an EMS and an NMS.   | Not specific to a particular transport technology |
| subnetworkConnection   | This module contains data structures that are used to represent Cross Connections and Subnetwork Connections. It also provides iterator interfaces that are used for the bulk retrieval of information about the Cross Connections and Subnetwork Connections associated with an EMS. | ATM, SONET/SDH, DWDM                              |
| terminationPoint       | This module contains a data structure that is used to represent Termination Points. It also provides an iterator interface that allows for the bulk retrieval of information about a collection of Termination Points.  | ATM, SONET/SDH, DWDM                              |
| topologicalLink        | This module contains a data structure that is used to represent Topological Links. It also provides an iterator interface that allows for the bulk retrieval of information about a collection of Topological Links.  | ATM, SONET/SDH, DWDM                              |
| trafficDescriptor      | This module allows the NMS to create and delete ATM traffic descriptors. The NMS may associate a traffic descriptor with one or more existing Termination Points. Traffic descriptors are used to specify the desired QoS for ATM connections.  | ATM   |
| transmissionParameters | This module contains the data type definitions for transmission parameters related to ATM, SONET/SDH and DWDM, e.g., Frame Format for SONET, ATM Signaling Type, and Frequency Spread for DWDM.   | ATM, SONET/SDH, DWDM                              |

## 5 The MTNM Model

As noted previously, the MTNM model comes in three parts, i.e., requirements, a protocol-neutral (UML) information model, and an IDL model derived from the UML model. The information model is fine-grained with each network resource being modeled as an object. For example, objects are defined for managed elements, equipment, equipment holders, termination points, subnetworks and subnetwork connections. On the other hand, the IDL is coarse-grained. In the MTNM model, a single IDL interface can potentially encapsulate many information objects. In the IDL, objects defined in the information model are represented as data structures (referred to as second-level objects). So, an instance of a single IDL interface will manage access to many second-level objects. For example, a managed element is represented by a data structure in the IDL, and information concerning managed elements is accessed via the ManagedElementMgr interface.

The MTNM IDL model is process-centric as opposed to data-centric. The interface is primarily based on processes (or functions) rather than on data types. For example, the MTNM model has interfaces such as EquipmentInventoryMgr, PerformanceManagementMgr, MaintenanceMgr, ProtectionMgr and TrafficDescriptorMgr. In general, the objects in the MTNM information model are encapsulated (accessed through) the various manager interfaces. This approach is different from most other network management interfaces that use CORBA. The T1M1 CORBA framework, the ATM Forum CORBA IDL

Network View, the DSL Forum Network View and the TM Forum's CaSMIM interface all use data-centric approaches. In these models, managed resources are represented as interfaces in the IDL as opposed to being encapsulated by process-specific interfaces. Both process-centric and data-centric models can be used effectively to model management interfaces. However, mapping from one style to another is difficult. Consequently, the goal of having one general approach for all network management standards may be difficult to achieve.

## 6 Use of OMG Services

The MTNM model uses the OMG's Notification Service for event reporting. Specifically, structured events are being used to model notifications. The OMG's Telecom Log Service is not currently used because the MTNM team has yet to analyze this service. The naming service is used to store the name and object reference of the EmsSessionFactory interface for each EMS (as noted earlier, the EMSMgr interface is used as an access point to a particular EMS). Once the NMS obtains the object reference for the EmsSessionFactory corresponding to an EMS, all other naming information is gotten from the EMS itself and not from the Naming Service. The MTNM model makes modest use of the OMG services for the following reasons:

- some services do not apply to the MTNM interface, e.g., the externalization service,
- there is not much to be gained by using some services over the MTNM interface (the naming service falls into this category),
- vendor implementations of some service may not be ready for incorporation into network management products (the Telecom Log Service may fall into this category, however, the team has not yet analyzed vendor implementations), or
- some services could be used in conjunction with the MTNM interface but have not been studied sufficiently by the MTNM team (the security services fit into this category).

## 7 Possible Future Work

The MTNM team has covered connection management and basic fault management for SONET/SDH, DWDM and ATM. Performance management has been covered for SONET/SDH and DWDM but not for ATM. In general, only "basic" ATM has been addressed. ATM related items such as Inverse Multiplexing over ATM (IMA), Multi-Protocol Label Switching (MPLS), voice over ATM and ATM protection have not been covered.

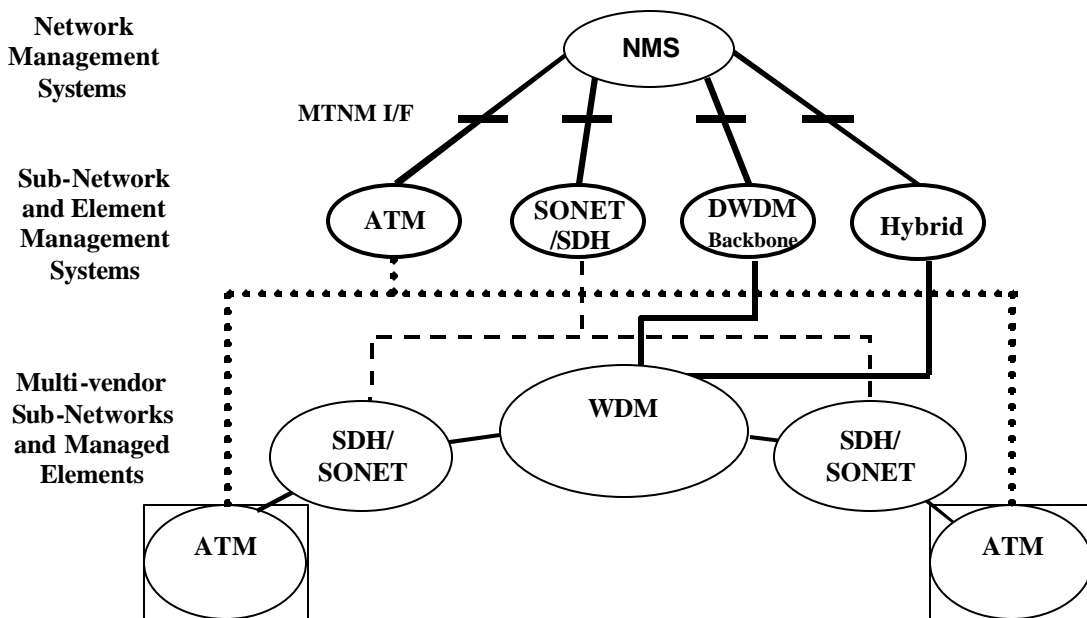
Phase III of the MTNM work is expected to begin in mid-2001 and may include support for Frame Relay, DSL, ATM protection, configuration of dynamic routing protocols such as Private Network-Network Interface (PNNI) and MPLS, ATM performance statistics, further use of OMG services such as the Telecom Log Service, subnetwork connection reservations, and enhancements to the fault and performance management capabilities.

## 8 Industry Acceptance

The MTNM activity has wide support within the TM Forum, with two dozen companies regularly attending the MTNM meetings (these companies include many of the world's major SONET/SDH and DWDM equipment vendors, and management system providers). Many companies are currently developing products based on the MTNM Phase II recommendations.

At the TeleManagement World conference in Nice, France (May 2001) nine companies participated in the MTNM Catalyst showcase, demonstrating for the first time an NMS-EMS interface for the management of SONET/SDH, ATM and DWDM networks. The demonstration highlighted flow-through connection

provisioning, topology discovery and fault management functionalities. This integrated catalyst solution delivers a common management platform for the telecommunications industry to adopt a Multi-Technology Network Management (MTNM) capability for existing and new network infrastructures. Figure 4 depicts a generic (non-vendor specific) diagram of the MTNM demonstration presented at the TeleManagement World conference in Nice.



**Figure 4.** MTNM Catalyst Demonstration (May 2001)

## 9 Types of Products Based on the MTNM Interface

The MTNM Implementation Statement (TMF 814A) contains product profiles. A product profile is a packaging of MTNM functionality for a particular technology and set of management functions, e.g., an ATM Configuration Manager. The product profiles are meant to assist vendors and service providers in selecting an appropriate subset of the MTNM capabilities for their needs. TMF 814A includes product profiles for the following: SONET/SDH Fault-Configuration Manager, ATM Fault-Configuration Manager, DWDM Fault-Configuration Manager, SONET/SDH Performance Manager, SONET/SDH Configuration Manager, ATM Configuration Manager, and DWDM Configuration Manager.

In practice, vendor products are being released to enable seamless, flow-through management of mixed ATM, SONET/SDH and DWDM networks. Initial products include single technology EMSs for ATM, SONET, SDH, and DWDM, with the greatest product focus being on SONET/SDH. There are some EMS products that manage both SONET (or SDH) and DWDM. The EMSs typically support configuration management (including connection management) and fault management. Some vendors have indicated that performance management and equipment management may be supported by separate EMSs, e.g., statistics collectors (in the case of performance management) and inventory managers (in the case of equipment management). Initial NMS support has tended to focus on configuration/connection and fault management across multiple technologies.

## 10 Conclusion

Many, if not most, Network management standards have gotten only mediocre vendor support and, in many cases, only after significant cajoling from service providers (consider the situation with vendor implementation of GDMO-based network management standards). The TM Forum MTNM effort represents a rare occurrence in the area of network management on two counts: the work is lead by vendors and the interface is actually finding a high degree of implementation in vendor products. It should be noted, however, that service providers have taken the lead during the requirements phase of the MTNM and the prior SSIM work.

## REFERENCES

- [1] TM Forum 509 v1.1, *NML-EML Interface Business Agreement for Management of SONET/SDH Transport Networks*, October 2000.
- [2] TMF 513, *Multi Technology Network Management (MTNM) Business Agreement*, to be issued in 2001
- [3] TMF 608, *Multi Technology Network Management (MTNM) Information Agreement*, to be issued in 2001
- [4] TMF 814, *Multi Technology Network Management (MTNM) Solution Set (CORBA IDL)*, to be issued in 2001.
- [5] TMF 814A, *MTNM Implementation Statement Template and Guidelines*, to be issued in 2001.
- [6] TMF 508, *CaSMIM Business Agreement*, Version 2.0, May 2001.
- [7] TMF 605, *CaSMIM Information Agreement*, Version 1.0, May 2001.
- [8] TMF 807, *CaSMIM CORBA IDL Solution Set*, Version 1.0, May 2001.