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SERIES M: TELECOMMUNICATION MANAGEMENT,
INCLUDING TMN AND NETWORK MAINTENANCE

Telecommunications management network

Multi-technology network management: CORBA IDL solution set (TMF814) with implementation statement templates and guidelines (TMF814A)

ITU-T Recommendation M.3170.3

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ITU-T Recommendation M.3170.3

Multi-technology network management: CORBA IDL solution set (TMF814) with implementation statement templates and guidelines (TMF814A)

Summary

The multi-technology network management (MTNM) solution suite realizes a TMN interface between the NML and EML according to ITU-T Recommendation M.3010 for the FCAPS management of multi-technology fixed transport, access and aggregation networks.

This Recommendation first explains the structure of the MTNM CORBA IDL solution set (TMF814) and associated implementation statement templates and guidelines (TMF814A), then refers to ITU-T Recommendation X.780.2, ITU-T Recommendation Q.816.2 and MTNM supporting documents for relating the TMF814 and TMF814A components to key Recommendations on TMN and functional network architectures, and finally points out MTNM interoperability in a multi-vendor network.

This Recommendation wraps TMF814 and TMF814A, and the associated MTNM supporting documents, by referencing them normatively and relating them to key ITU-T Recommendations utilized by the MTNM approach to CORBA and functional modelling. These relationships imply that MTNM operations systems are TMN-compliant and TMN-conformant according to ITU-T Recommendation M.3010. This Recommendation can also be used as a first lead-in to the MTNM CORBA IDL solution set with implementation statement templates, interoperability guidelines and MTNM feature matrices.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

CONTENTS

Introduction

This Recommendation provides an overview of the TM Forum's MTNM CORBA IDL solution set TMF814 v3.0 and TMF814 v2.1 and CORBA implementation statement templates and guidelines TMF814A v3.0 and TMF814A v2.1, and provides evidence that MTNM is TMN-compliant, TMN interface protocol-conformant and Level B TMN interface information-conformant according to [ITU-T M.3010] by using the compliance and conformance points of the service-oriented CORBA TMN framework [ITU-T X.780.x] and [ITU-T Q.816.x].

ITU-T Recommendation M.3170.3

Multi-technology network management: CORBA IDL solution set (TMF814) with implementation statement templates and guidelines (TMF814A)

1 Scope

The multi-technology network management (MTNM) solution suite is an implementation standard of a TMN interface between the NML and EML according to [ITU-T M.3010] for the FCAPS management of multi-technology fixed transport, access and aggregation networks. The MTNM implementation view specifies a CORBA-based TMN Q interface between an NMS (CORBA client or TMN manager) and an EMS (CORBA server or TMN agent which is in contact to the NEL).

The MTNM solution suite consists of the following deliverables:

- The MTNM business view is specified in the business agreement (BA) TMF513.

- The MTNM system view is specified in UML in the information agreement (IA) TMF608.

- The MTNM CORBA-based implementation and deployment views are specified in the CORBA IDL solution set (SS) TMF814 (with HTML documentation) and associated implementation statement (IS) templates and guidelines TMF814A.

- The MTNM supporting documentation (SD) guides and lightens the work with the MTNM views and also includes normative parts of the interface such as name/value pairs.

This Recommendation:

- provides an outline of the TMF814 components (uniformly structured CORBA IDL files with inline comments, generated HTML documentation and MTNM supporting documents) (see also clauses 6.1.2 and 6.4 [ITU-T M.3170.0]) and how they are related;

- refers to [ITU-T X.780.2] for the structure of the CORBA IDL files and modules, the used parts of the IDL repertoire and foundation IDL, and the applied IDL style;

- refers to [ITU-T Q.816.2] for the used CORBA-based TMN services;

- proves compliance and basic profile conformance of TMF814 with [ITU-T X.780.2] and [ITU-T Q.816.2] (i.e., the service-oriented CORBA framework);

- provides an outline of the structure of TMF814A and how it relates to MTNM supporting documents (such as MTNM feature matrices) and complies with the CORBA-based interface implementation conformance statement (ICS) proformas of [ITU-T X.781];

- wraps TMF814 and TMF814A with their supporting documents by referencing them normatively according to ITU-T Rec. A.5 and pointing to key closely related in-force ITU-T Recommendations on TMN (NGNM) and functional (NG) network architectures;

- as a consequence, provides evidence that MTNM is TMN compliant, TMN interface protocol-conformant and Level B TMN interface information-conformant according to [ITU-T M.3010];

- indicates that TMF814 and TMF814A collectively specify an interoperable CORBA-based NML-EML interface and so get wrapped jointly according to Figure 8-1;

- indicates that TMF814 provides a vendor-independent two-part data model (behaviour and state of managed objects) that offers standardized means for vendor-specific extensions;

- determines for further study the recommended contents of CORBA-based vendor-provided ICS documents (if needed) such as a vendor-specific implementation statement (IS) as per TMF814A and an interface implementation specification (IIS) as per [b-TMF833 v1.0];

- indicates that the applicability of the service-oriented CORBA paradigm goes beyond CORBA and the management of NEs and networks, for example towards XML-based management of both telecom networks-based services and content and applications-based services.

This Recommendation first explains the structure of TMF814 and TMF814A, then refers to [ITU-T X.780.2] and [ITU-T Q.816.2] and identified MTNM supporting documents for relating the TMF814 and TMF814A components to key Recommendations on TMN (NGNM) [ITU-T M.3010], [ITU-T M.3060], etc. and functional (NG) network architectures (allowing for details) [ITU-T G.805], [ITU-T G.852.2], [ITU-T Y.2012], etc., and finally points out the MTNM support of interoperability (when vendors use TMF814A and the built-in extension mechanisms of TMF814) that would enable the deployment of a multi-technology cooperative network management solution (CoNMS) in a multi-vendor network.

This Recommendation wraps TMF814 and TMF814A, and the associated MTNM supporting documents, by referencing them normatively and relating them to key Recommendations. These relationships imply that MTNM operations systems are TMN-compliant and TMN-conformant according to [ITU-T M.3010]. This Recommendation can also be used as a first lead-in to the TM Forum MTNM CORBA IDL SS with IS templates, interoperability guidelines and MTNM feature matrices.

2   References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T G.805]   ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.

[ITU-T G.809]   ITU-T Recommendation G.809 (2003), *Functional architecture of connectionless layer networks*.

[ITU-T G.852.2]   ITU-T Recommendation G.852.2 (1999), *Enterprise viewpoint description of transport network resource model*.

[ITU-T M.3010]   ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*.

[ITU-T M.3013]   ITU-T Recommendation M.3013 (2000), *Considerations for a telecommunications management network*.

[ITU-T M.3060]   ITU-T Recommendation M.3060/Y.2401 (2006), *Principles for the management of Next Generation Networks*.

[ITU-T M.3170.0]   ITU-T Recommendation M.3170.0 (2007), *Multi-technology network management: Introduction and supporting documentation*.

[ITU-T M.3170.1]   ITU-T Recommendation M.3170.1 (2007), *Multi-technology network management: Business agreement (TMF513)*.

[ITU-T M.3170.2]   ITU-T Recommendation M.3170.2 (2007), *Multi-technology network management: Information agreement (TMF608)*.

[ITU-T Q.811]	ITU-T Recommendation Q.811 (2004), *Lower layer protocol profiles for the Q and X interfaces*.
[ITU-T Q.812]	ITU-T Recommendation Q.812 (2004), *Upper layer protocol profiles for the Q and X interfaces*.
[ITU-T Q.816.x]	ITU-T Recommendations Q.816.x, *CORBA-based TMN services*.
	NOTE – This series of Recommendations has the following structure:
	Q.816 (2001), *CORBA-based TMN services*.
	Q.816.1 (2001), *CORBA-based TMN services: Extensions to support coarse-grained interfaces*.
	Q.816.2 (2007), *CORBA-based TMN services: Extensions to support service-oriented interfaces*.
[ITU-T X.780.x]	ITU-T Recommendations X.780.x, *TMN guidelines for defining CORBA managed objects*.
	NOTE – This series of Recommendations has the following structure:
	X.780 (2001), *TMN guidelines for defining CORBA managed objects*.
	X.780.1 (2001), *TMN guidelines for defining coarse-grained CORBA managed object interfaces*.
	X.780.2 (2007), *TMN guidelines for defining service-oriented CORBA managed objects and façade objects*.
[ITU-T X.781]	ITU-T Recommendation X.781 (2001), *Requirements and guidelines for Implementation Conformance Statements proformas associated with CORBA-based systems*.
[ITU-T X.920]	ITU-T Recommendation X.920 (1997)	ISO/IEC 14750:1999, *Information technology – Open Distributed Processing – Interface Definition Language*.
[ITU-T Y.110]	ITU-T Recommendation Y.110 (1998), *Global Information Infrastructure principles and framework architecture*.
[ITU-T Y.2011]	ITU-T Recommendation Y.2011 (2004), *General principles and general reference model for Next Generation Networks*.
[ITU-T Y.2012]	ITU-T Recommendation Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.
[TMF513 v3.0]	TM Forum TMF513 Version 3.0 (2004), *Multi-Technology Network Management (MTNM) NML-EML Interface: Business Agreement*, except for the table of references contained in Appendix B.
	NOTE – Refer to the companion Recommendation ITU-T M.3170.1 for an explanation of this exception.
[TMF608 v3.0]	TM Forum TMF608 Version 3.0 (2004), *Multi-Technology Network Management (MTNM) NML-EML Interface: Information Agreement*, Rational Rose™ (UML) version and generated HTML version, except for the table of references contained in Appendix B.
	NOTE – Refer to the companion Recommendation ITU-T M.3170.2 for an explanation of this exception.
[TMF814 v2.1]	TM Forum TMF814 Version 2.1 (2002), *Multi-Technology Network Management (MTNM) NML-EML Interface: CORBA IDL Solution Set*.
[TMF814 v3.0]	TM Forum TMF814 Version 3.0 (2004), *Multi-Technology Network Management (MTNM) NML-EML Interface: CORBA IDL Solution Set*.

[TMF814A v2.1]   TM Forum TMF814A Version 2.1 (2002), *Multi-Technology Network Management (MTNM) NML-EML Interface: Implementation Statement Templates and Guidelines*.

[TMF814A v3.0]   TM Forum TMF814A Version 3.0 (2004), *Multi-Technology Network Management (MTNM) NML-EML Interface: Implementation Statement Templates and Guidelines*.

3   Definitions

3.1   Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1   element management layer (EML): [ITU-T M.3010].

3.1.2   interface: [ITU-T M.3010].

3.1.3   network management layer (NML): [ITU-T M.3010].

3.1.4   operations system (OS): [ITU-T M.3010].

3.1.5   Q interface: [ITU-T M.3010].

3.1.6   q reference point: [ITU-T M.3010].

3.1.7   reference point: [ITU-T M.3010].

3.1.8   service-oriented approach/architecture (SOA): [ITU-T Q.816.2].

3.1.9   service-oriented façade: [ITU-T Q.816.2].

3.1.10   service-oriented façade interface: [ITU-T Q.816.2].

3.1.11   service-oriented façade object: [ITU-T Q.816.2].

3.1.12   service-oriented managed object: [ITU-T Q.816.2].

4   Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

CIICS   CORBA-based Interface Implementation Conformance Statement

CORBA   Common Object Request Broker Architecture

EM   Element Management

EML   Element Management Layer

EMS   Element Management System

eTOM   enhanced Telecom Operations Map

FAB   Fulfilment, Assurance and Billing

FCAPS   Fault, Configuration, Accounting, Performance and Security

FIS   Functional Interoperability Statement

FM   Fault Management

HTML   HyperText Markup Language

ICS   Implementation Conformance Statement

IDL   Interface Definition Language

IIS   Interface Implementation Specification

IS	Implementation Statement
MOC	Managed Object Class
MTNM	Multi-Technology Network Management
MTTM	Multi-Technology Telecommunications Management
NIS	Non-functional Interoperability Statement
NM	Network Management
NML	Network Management Layer
NMS	Network Management System
OMG	Object Management Group
ORB	Object Request Broker
OS	Operations System
OSS	Operations Support System
PM	Performance Management
SD	Supporting Document(ation)
SS	Solution Set
TM	Telecom(munications) Management
TMF	TeleManagement Forum
TMN	Telecommunications Management Network

5 Conventions

This Recommendation does not use any particular notational or other conventions.

6 TMF814 overview – A lead-in to the MTNM CORBA solution set

This clause provides an overview of (and can serve as a lead-in to) the MTNM CORBA solution set. The service-oriented CORBA TMN framework (i.e., [ITU-T X.780.2] and [ITU-T Q.816.2] can be used as an introduction to the overall design philosophy and lightweight modelling principles of the MTNM CORBA solution set.

The two most powerful principles are the coarse grain approach and the multi-technology approach. It should be noted that, in terms of ITU-T's CORBA framework, the MTNM coarse grain attitude is in fact service-oriented (i.e., X.780.2/Q.816.2-façade-based) and not coarse-grained (i.e., X.780.1/Q.816.1-façade-based). The overall working method of the multi-technology capability of the MTNM interface is G.805-based and explained in clauses 8.4 and 10.4 of [ITU-T X.780.2]. Further MTNM-specific information on using service-oriented CORBA is available from [b-Siemens AG].

NOTE 1 – This Recommendation presents the version MTNM v3.0 which supports connection-oriented network technologies according to the generic G.805/G.852.2 model [ITU-T G.805][ITU-T G.852.2] including point-to-point Ethernet. The next version of MTNM will also encompass connectionless technology management for carrier-class bridged (and virtually bridged) Ethernet according to the generic G.809 model [ITU-T G.809].

The MTNM CORBA solution set v3.0 is packaged into:

- cover document TMF814InterfaceVersion3.0.pdf;

- OMG-conforming CORBA IDL file set with inline documentation (26 MTNM IDL files and 13 OMG IDL files – see clause 6.4 of [ITU-T M.3170.0]);

- comprehensive generated hyperlinked HTML documentation; and

- 37 hyperlinked supporting documents (see Table 6-1 of [ITU-T M.3170.0] and Figure 8-1).

Managed object classes are modelled as CORBA structs with common attributes and managed by (singleton) instances of CORBA interfaces (the MTNM implementation view). Refer to the supporting document overview_NML-EML_Interface.pdf for the details. The supporting document MappingIASS.pdf provides "solution set"-to-"UML class dictionary" traceability.

A coarse grain approach has been used for the modelling of the interface between the EMS and the NMS. This approach leads to the adoption of a façade (or managing object) design pattern and of a singleton design pattern for the façade objects (i.e., the façades are singleton objects) extended to CORBA objects. The CORBA façade design pattern offers the following advantages:

- It naturally leads to a much smaller number of objects across the interface. This is a desirable goal when performance is a winning factor.

- It provides operations and services that focus on the primary problems to be solved and guarantee efficiency and atomicity for these operations.

- The NMS is shielded from the EMS object model. The façade design pattern provides for loose coupling between the NMS objects and the EMS objects. Even if the internal implementation of the managed object model of the EMS changes, the NMS need not be aware of it. In the fine grain approach, every change to the object model of the EMS directly impacts the NMS.

The choice of the coarse grain approach needs to be viewed from the perspective of system architecture and current technology capability instead of that of pure object-oriented modelling.

The façade approach is complemented by innovative modelling concepts for the managed object classes, known as a multi-technology approach, that allow the single interface to use just one model and consistent Façade operations paradigm for managing many disparate network technologies (PDH, SDH/SONET, DWDM/OTH, ATM, frame relay, DSL, Ethernet, fixed wireless, etc.) even where intertwined within single network devices (see also clause 6.2 of [ITU-T M.3170.0]).

To understand the MTNM interface, it is necessary to read the main documented material including requirements, use cases, UML and CORBA IDL and key supporting documents (SDs) such as:

a) Programmatic versioning (versioning.pdf).

b) Object naming/containment (objectNaming.pdf).

c) OMG services guidelines (OMGservicesUsage.pdf).

d) Probable cause strings (ProbableCauses.pdf).

e) Performance parameters (PerformanceParameters.pdf).

f) Layer rates (LayerRates.pdf).

g) Layered parameters (LayeredParameters.pdf).

h) Functional modelling concepts (layers.pdf).

Most SDs are normative and present important interface details. Some SDs are informative and provide thorough introductions to core MTNM interface concepts. The SDs are hyperlinked into the main MTNM deliverables (and among themselves) and usually are read on demand. Several normative SDs can be used to verify for MTNM certain compliance and conformance points of the service-oriented CORBA framework (see clause 6.1 below).

The detailed CORBA IDL file set with inline documentation, generated HTML documentation and hyperlinked supporting documents for the MTNM NML-EML interface (see Table 6-2 of [ITU-T M.3170.0]) shall be in accordance with [TMF814 v3.0], which extends [TMF814 v2.1].

NOTE 2 – [TMF814 v3.0] incorporates [TMF814 v2.1] in a backward-compatible fashion, and so [TMF814 v2.1] is not a formal prerequisite for [TMF814 v3.0]. However, knowledge of the more readily accessible v2.1 may greatly simplify the approach to and understanding of v3.0.

The MTNM interface provides major examples for the novel concepts of service-oriented CORBA managed objects, façade objects and TMN support services, which were developed by ITU-T's former MTNM Focus Group ([b-MTNMFG]). Compliance with and conformance to this service-oriented CORBA TMN framework [ITU-T X.780.x] [ITU-T Q.816.x] are shown in the following clauses. Note that any documentation required to provide evidence for specific compliance and conformance points is found either in the TM Forum's as-is MTNM documentation or in this Recommendation.

6.1   Compliance with the service-oriented CORBA framework

TMF814 complies with the service-oriented CORBA framework since it meets the compliance points specified by clause 13.1 of [ITU-T X.780.2] and clause 10.1 of [ITU-T Q.816.2]:

1)   A description of how TMF814's constituent documents, or document sections, and further deliverables (such as CORBA IDL files) can be split between the two aspects "information modelling in IDL" and "ORB and CORBA services usage" of CORBA-based TMN interface specification is provided here:

– **Information modelling in IDL**: All TMF IDL files (see clause 6.4 of [ITU-T M.3170.0]) except the session service IDL files are related to the "information modelling in IDL" aspect in accordance with [ITU-T X.780.2].

– **ORB and CORBA services usage**: Use of the OMG naming service is specified in the SD "versioning.pdf". Use of the OMG notification service and (optionally) the OMG telecom log service is specified in the SD "OMGservicesUsage.pdf". Use of the ITU-T session service is specified in the IDL files "mtnmVersion.idl", "session.idl", "nmsSession.idl", "emsSession.idl" and "emsSessionFactory.idl".

2)   [ITU-T X.780.2]: TMF814 meets the following standards document compliance criteria related to the "information modelling in IDL" aspect:

– It can be specified that TMF814's usage of the CORBA 2 IDL repertoire complies with [ITU-T X.780.2].

– It can be specified how TMF814's relevant documents, or document sections, and further deliverables (such as CORBA IDL files) are related to the clauses of [ITU-T 780.2].

– TMF814 includes one or more IDL files with specifications of IDL modules globaldefs, common, transmissionParameters and notifications according to clauses 8 and 9 of [ITU-T X.780.2] that are guided by the normative IDL of Annex A of [ITU-T X.780.2] (see next criterion).

– It can be specified how the normative IDL of Annex A of [ITU-T X.780.2], including comments, can be obtained from TMF814's IDL files (see previous criterion) without any syntactical changes, except for pragmas, a few minor additional IDL constructs that are considered absolutely necessary and do not at all affect the constructs of Annex A of [ITU-T X.780.2], a few omitted IDL constructs that are not (yet) used, and refactoring of definitions between standard IDL modules and IDL modules claiming conformance, and with only moderate and reasonable modifications with regard to comments.

3) [ITU-T Q.816.2]: TMF814 meets the following standards document compliance criteria related to the "ORB and CORBA services usage" aspect:

– It can be specified that TMF814's usage of the ORB, the telecom-related OMG common object services and the ITU-T TMN support services complies with [ITU-T Q.816.2].

– It can be specified how TMF814's relevant documents, or document sections, and further deliverables (such as CORBA IDL files) are related to the clauses of [ITU-T Q.816.2].

– TMF814 includes IDL files that collectively define a session service according to clause 9.1 of [ITU-T Q.816.2] and it can be specified how the normative IDL of Annex A of [ITU-T Q.816.2], including comments, can be obtained from TMF814's IDL files without any syntactical changes, except for pragmas, module names, and a few minor additional IDL constructs that do not at all affect the constructs of Annex A of [ITU-T Q.816.2], and with only moderate and reasonable modifications with regard to comments.

4) TMF814 follows the service-oriented interface design rules defined in clause 10 of [ITU-T X.780.2].

Evidence for any required detail can be provided by inspection of and appropriate references to (one or more sections of) the MTNM main deliverables and supporting documents as listed above.

6.2 Meeting service-oriented conformance requirements

TMF814 meets the general conformance requirements of clause 13.2 of [ITU-T X.780.2] since (as can be seen by inspection of the MTNM documentation and IDL files):

• it supports, according to a conformance profile (see below), the capabilities of the generic *Common_T* managed object class described in clause 8.5 of [ITU-T X.780.2] and the capabilities of the root *Common_I* service-oriented façade interface described in clause 9.3 of [ITU-T X.780.2];

• it meets the *service-oriented iterator* requirements specified in clause 9.4 of [ITU-T X.780.2];

• it implements an IDL interface compliant with the guidelines in [ITU-T X.780.2] (see above).

Figure 6-1 shows all of the MTNM managed object classes. They have light-weight inheritance from the generic *Common_T* MOC as shown by the straight grey arrows – to keep the figure clear the light-weight inheritance is only depicted for EMS and TMD. They are related through containment relationhips according to the MTNM managed object naming rules (see SD objectNaming.pdf). Recursive containment is possible for EQTH, CTP and LayeredTransmissionParameters.
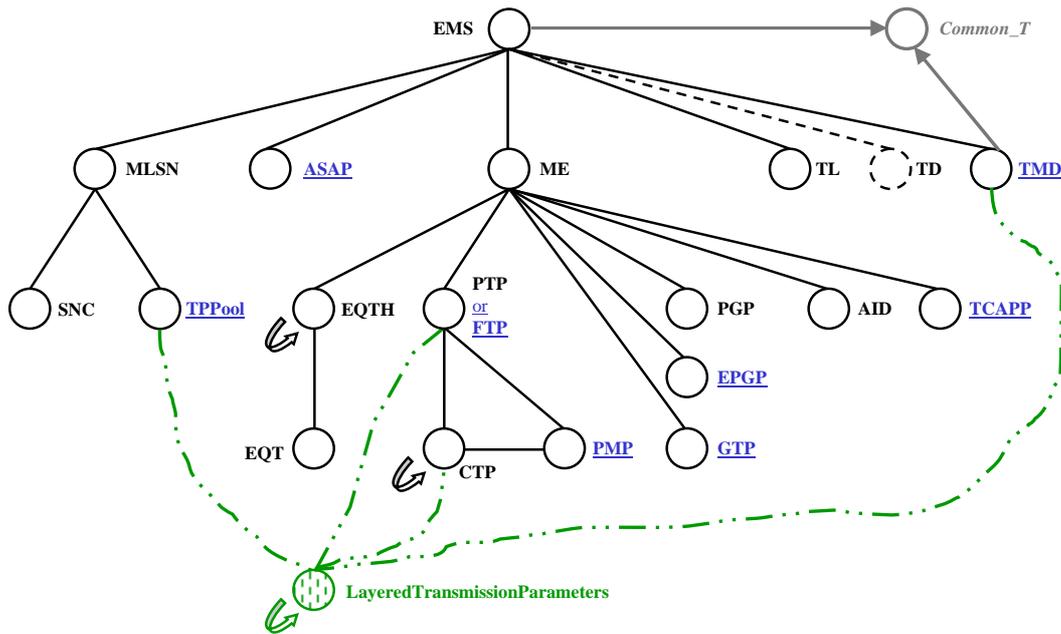
Figure 6-1 – The MTNM managed object classes derived from *Common_T*

MOCs that have been added in v3.0 are shown underlined in blue. The legend for Figure 6-1 is as follows:

AID	Alarm ID
ASAP	Alarm Severity Assignment Profile
CTP	Connection Termination Point
EMS	Element Management System
EPGP	Equipment Protection Group
EQT	Equipment
EQTH	Equipment Holder
FTP	Floating Termination Point
GTP	Group Termination Point
LayeredTransmissionParameters	Represents a structure holding transmission parameters per layer rate according to clause 8.4 of [ITU-T X.780.2]
ME	Managed Element
MLSN	Multi-Layer Subnetwork
PGP	Protection Group
PMP	Performance Monitoring Point
PTP	Physical Termination Point
SNC	Subnetwork Connection
TCAPP	Threshold Crossing Alert Parameter Profile
TD	Traffic Descriptor (deprecated in v3.0)
TL	Topological Link

TMD	Transmission Descriptor
TPPool	Termination Point Pool

Figure 6-2 shows all of the MTNM service-oriented façade interfaces. They inherit from the virtual root service-oriented façade interface *Common_I*, and are each considered a single SOA service according to clause 7.2.1.2 of [ITU-T Q.816.2]. The entire group is called TMF telecom services.
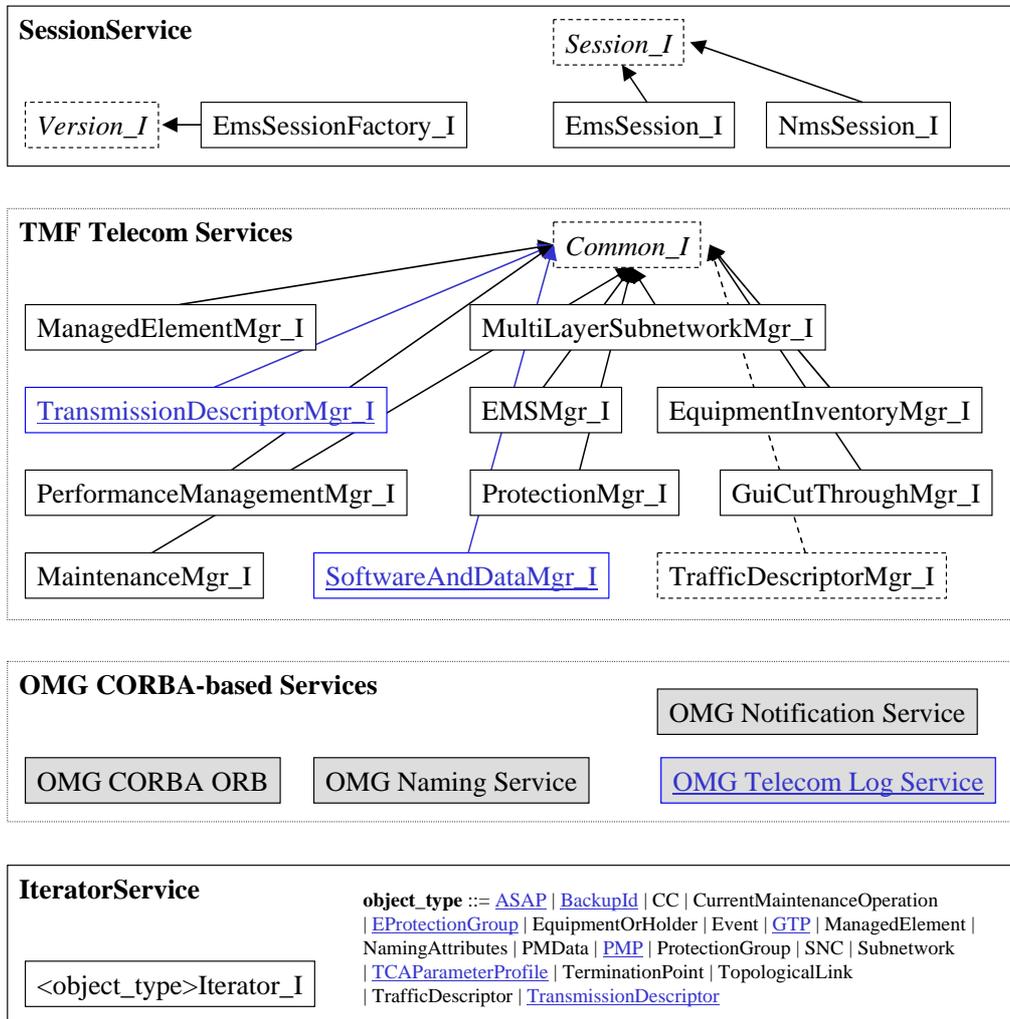

Figure 6-2 – The MTNM service-oriented façades derived from *Common_I*

Figure 6-2 also shows how the SessionService, as an SOA service, consists of three service interfaces. The IteratorService consists of one iterator interface per (managed) object type. The OMG CORBA-based services are also considered stand-alone SOA services. Services that have been added in v3.0 are shown underlined in blue.

TMF814 is X.780.2 basic profile conformant since it meets the required conformance points specified by clause 13.2.1 of [ITU-T X.780.2] for service-oriented interfaces:

1)   *Root Managed Object* requirements:

TMF814 supports the *Common_T* struct described in 8.5 of [ITU-T X.780.2] and defined in the CORBA IDL module *common* in Annex A of [ITU-T X.780.2] (i.e., all object types that model resources (managed object classes) shall be derived (directly or indirectly) from *Common_T* in a lightweight fashion according to 8.5 of [ITU-T X.780.2]) (see also Figure 6-1).

2) *Root façade (managing object)* requirements:

TMF814 supports the *Common_I* interface described in clause 9.3 of [ITU-T X.780.2] and defined in the CORBA IDL module *common* in Annex A of [ITU-T X.780.2] (see also Figure 6-2).

3) *Managed object naming and containment* requirements:

TMF814 adheres to the *guidelines for lightweight managed object naming* provided in clauses 10.3.2 and 10.5.4 of [ITU-T X.780.2].

4) *Managed object creation* requirements:

TMF814 supports, for each managed object class that can be created by managing systems, managed object creation by the service-oriented façade object(s) that is (are) responsible for access to and control of this managed object class (i.e., defines, for each such managed object class, a create operation of the unique façade interface assigned (in a steward role) to this MOC which is MOC-specific).

5) *Managed object deletion* requirements:

TMF814 supports for each managed object class that can be created by managing systems, managed object deletion by the service-oriented façade object(s) that is (are) responsible for access to and control of this managed object class (i.e., defines, for each such MOC, a delete operation of the unique façade interface assigned to this MOC whose semantics complies with the MOC-specific delete policy).

6) *Façade object naming* requirements:

TMF814 adheres to the *guidelines for service-oriented façade object naming* provided in clauses 10.3.3 and 10.5.4 of [ITU-T X.780.2] (and clause 6.4 of [ITU-T Q.816.2]).

9) *Exceptions* requirements:

TMF814 adheres to the use of the unique exception *ProcessingFailureException* with few exception codes as described in clause 8.6 of [ITU-T X.780.2], and defined and used in the IDL modules *globaldefs* and *common* in Annex A of [ITU-T X.780.2].

10) *Notifications* requirements:

TMF814 supports the OMG notification service as specified in clause 10.2.1 of [ITU-T Q.816.2].

TMF814 supports the *notifications* module described in clause 8.7 of [ITU-T X.780.2] and defined in the CORBA IDL provided in Annex A of [ITU-T X.780.2].

7) *Standard data types* requirements:

TMF814 uses the service-oriented IDL repertoire (see Figure 2 of [ITU-T X.780.2]), and the definitions of basic data types and typedefs described in clauses 8.2, 8.3 and 8.5 of [ITU-T X.780.2] and defined in the CORBA IDL modules *globaldefs* and *common* in Annex A of [ITU-T X.780.2].

11) *Capabilities* requirements:

TMF814 provides the lightweight two-level capability model to identify the supported operations of a given service-oriented façade (and maybe other capabilities) with a corresponding *Common_I.getCapabilities* operation – as defined in [ITU-T X.780.2], and with the session service operation *EmsSession_I.getSupportedManagers* for on-demand determination of the supported service-oriented façades themselves – as defined in [ITU-T Q.816.2].

12) *Multi-technology telecommunications management (MTTM)* requirements:

TMF814 provides the G.805/G.809-based *multi-technology capability* approach to telecommunications transmission technologies described in clause 8.4 of [ITU-T X.780.2] and defined in the CORBA IDL module *transmissionParameters* in Annex A of [ITU-T X.780.2] (see Figure 6-1), and specialises and evolves this generic approach as described in 10.4 of [ITU-T X.780.2].

13) *Service-oriented FM* requirements:

TMF814 supports the service-oriented FM features described in clauses 8.7.3 and 8.7.5 of [ITU-T X.780.2].

14) *Service-oriented PM* requirements*:*

TMF814 supports the service-oriented PM features described in clause 8.7.4 of [ITU-T X.780.2].

NOTE 1 – If implemented, TMF814 also meets entirely or partly some of the further optional conformance points specified by clause 13.2.1 of [ITU-T X.780.2].

Evidence for any required detail can be provided by inspection of, and appropriate references to, (one or more sections of) the MTNM main deliverables and supporting documents as listed above.

TMF814 is Q.816.2 basic profile conformant since it meets the required conformance points specified by clause 10.2.1 of [ITU-T Q.816.2] for service-oriented interfaces:

1) The *basic ORB* requirements:

TMF814 supports the mandatory ORB requirement specified in clause 8.1 of [ITU-T Q.816.2].

3) The *naming service* requirements:

TMF814 supports the Naming Service requirements specified in clause 8.2 of [ITU-T Q.816.2].

4) The *notification service* requirements:

TMF814 supports the OMG notification service, the mandatory notification service requirements specified in clause 8.3 of [ITU-T Q.816.2] and the notification service capabilities identified in Annexes C.2 and C.3 of [ITU-T Q.816].

15) The *session service* requirements:

TMF814 supports the session service requirements described in clause 9.1 of [ITU-T Q.816.2] and the session service interfaces defined in the CORBA IDL in Annex A of [ITU-T Q.816.2] taking compliance point 3 (see above) into consideration.

NOTE 2 – If implemented, TMF814 also meets the optional telecom log service requirements as specified by conformance point 5 of clause 10.2.1 of [ITU-T Q.816.2] including support of the OMG telecom log service.

Evidence for any required detail can be provided by inspection of, and appropriate references to, (one or more sections of) the MTNM main deliverables and supporting documents as listed above.

7 TMF814A overview – A lead-in to the MTNM CORBA interoperability

This clause provides an overview of (and serves as a lead-in to) the MTNM CORBA conformance and interoperability approach. The service-oriented CORBA TMN framework [ITU-T X.780.x] [ITU-T Q.816.x] may serve as an introduction to the modelling principles of the MTNM CORBA solution set that bring about the MTNM CORBA interoperability (see, e.g., clause 10.5 of [ITU-T X.780.2]).

The MTNM CORBA conformance templates and guidelines for interoperability include:

- functional interoperability statement (FIS) templates for data types, interfaces (support status of the interface and for each operation support status, parameter details and exception details) and notifications per TMF814 CORBA module (see Table 6-2 of [ITU-T M.3170.0] for a module overview);

- non-functional interoperability statement (NIS) templates with regard to iterator implementation issues and timing issues of operations, notifications and heartbeats;

- guidelines concerning interoperable usage of TMF814 with regard to nine more complicated and/or less constrained aspects of the MTNM specifications;

- feature descriptions and matrices for the v2.1 and v3.0 features (MTNM feature matrices):

    – The v2.1 matrix featuresMatrix.xls/v2.1 briefly describes the v2.1 features and maps them to operations, managed object classes, notifications, etc.

    – The v3.0 features (beyond v2.1) are described at some length in the supporting document FeatureSummaryVersion3.pdf and mapped in the v3.0 matrix featuresMatrix.xls/v3.0 to IDL operations, MOCs and other IDL constructs.

Equipment and OSS vendors may use the MTNM feature matrices for the detailed specification of (network technology-specific) MTNM product profiles. Service providers may use the MTNM feature matrices for requests for information (RFIs) or requests for proposals (RFPs).

[ITU-T X.781] specifies CORBA-based interface ICS (CIICS) proformas through support tables. There are an interface support table (across modules), an attribute support table (per interface), two operation support tables (per interface), and three data type support tables (parameter, return value and exception sub-tables per interface). The table columns and potential values for each entry are described in detail and instructions are given for completing each column. These support tables correspond to the FIS templates of TMF814A as compared in Table 7-1 below.

[ITU-T X.781] does not define analogues of NIS templates, nor interoperability guidelines, nor feature matrices, since it refers only to generic OMG IDL specifications and not to specific IDL specifications such as one of the paradigms of the ITU-T CORBA framework (fine-grained, coarse-grained, service-oriented) [ITU-T X.780.x] [ITU-T Q.816.x] or a fully fledged CORBA interface such as MTNM [TMF814 v3.0] [TMF814 v2.1].

Table 7-1 applies X.781 to MTNM by using TMF814A and thus provides ICS proformas as requested by clause 13.4.2 in Amendment 1 of [ITU-T M.3010] (see clause 9). Since MTNM extends the service-oriented framework paradigm (see clause 6), the templates of TMF814A related to the CORBA modules of ITU-T Recs X.780.2 and Q.816.2 could form the basis for developing a revision of X.781 that would provide more lightweight CIICS proformas for the service-oriented framework.

Table 7-1 – Comparison of X.781 support tables and TMF814A FIS templates

X.781 column	Relevant X.781 support table(s)	TMF814A column(s) or template identifier	Comments
Status	All	Status	Indicates the level of support required ("m", "o", "-")
Support	All	Support	Indicates the level of implementation ("Y", "N", "-")
Additional information	All	Various	All explanatory columns of TMF814A may be subsumed
Constraints and values	Attribute, second operation, all data type	Format	TMF814A distinguishes "FREE" and "FIXED" and generally refers to the IDL for details which [ITU-T X.781] lists explicitly (and redundantly)
Category	Second operation	N/A	
Field property	Second operation	N/A	
Index	All	N/A	TMF814A's lightweight approach does not need such a number system
Subindex	Second operation, all data type	N/A	
<table type> identifier	<table type> ::= Interface | Attribute | Operation | Data type	Data type name, attribute name, interface name, operation	The usage of (scoped) IDL names as identifiers corresponds directly
Derived interface	Interface	N/A	Refer to Figure 6-2

Table 7-1 shows that the TMF814A FIS templates can be used to develop X.781 support tables as needed. The TMF814A FIS templates include columns that are not present in any X.781 support table (e.g., "set by", "set when and how") but these could be subsumed under "additional information" as appropriate. The main systematic difference between the X.781 and TMF814A approaches is X.781's use of consecutive index and (nested) subindex numbers.

The detailed FIS templates, NIS templates, guidelines for interoperable usage and feature descriptions and matrices for the MTNM NML-EML interface shall be in accordance with [TMF814A v3.0], which extends [TMF814A v2.1].

NOTE – [TMF814A v3.0] incorporates [TMF814A v2.1] in a backward compatible fashion and so [TMF814A v2.1] is not a formal prerequisite for [TMF814A v3.0]. However, knowledge of the more readily accessible v2.1 may greatly simplify the approach to v3.0.

8   Referencing TMF814 and TMF814A

This Recommendation normatively references the TM Forum approved MTNM CORBA solution set (SS) v3.0 [TMF814 v3.0] which extends the MTNM CORBA SS v2.1 [TMF814 v2.1], and the MTNM implementation statement (IS) for CORBA v3.0 [TMF814A v3.0] which extends the MTNM IS for CORBA v2.1 [TMF814A v2.1], as well as the associated MTNM supporting documents, and points to a number of MTNM-related in-force ITU-T Recommendations specifying management and functional frameworks and architectures utilized by the MTNM approach to CORBA and functional modelling. It will be seen in clause 9 that these relationships imply that MTNM management systems are TMN-compliant and TMN-conformant as specified by [ITU-T M.3010]. An operations system (OS) claiming compliance to this Recommendation therefore needs also to comply with the referenced MTNM specifications, and such compliance will prove the OS to be TMN compliant and TMN-conformant.

Figure 8-1 shows how this Recommendation points to TM Forum approved documents and to related ITU-T Recommendations on TMN (NGNM) and functional (NG) architectures (with details):
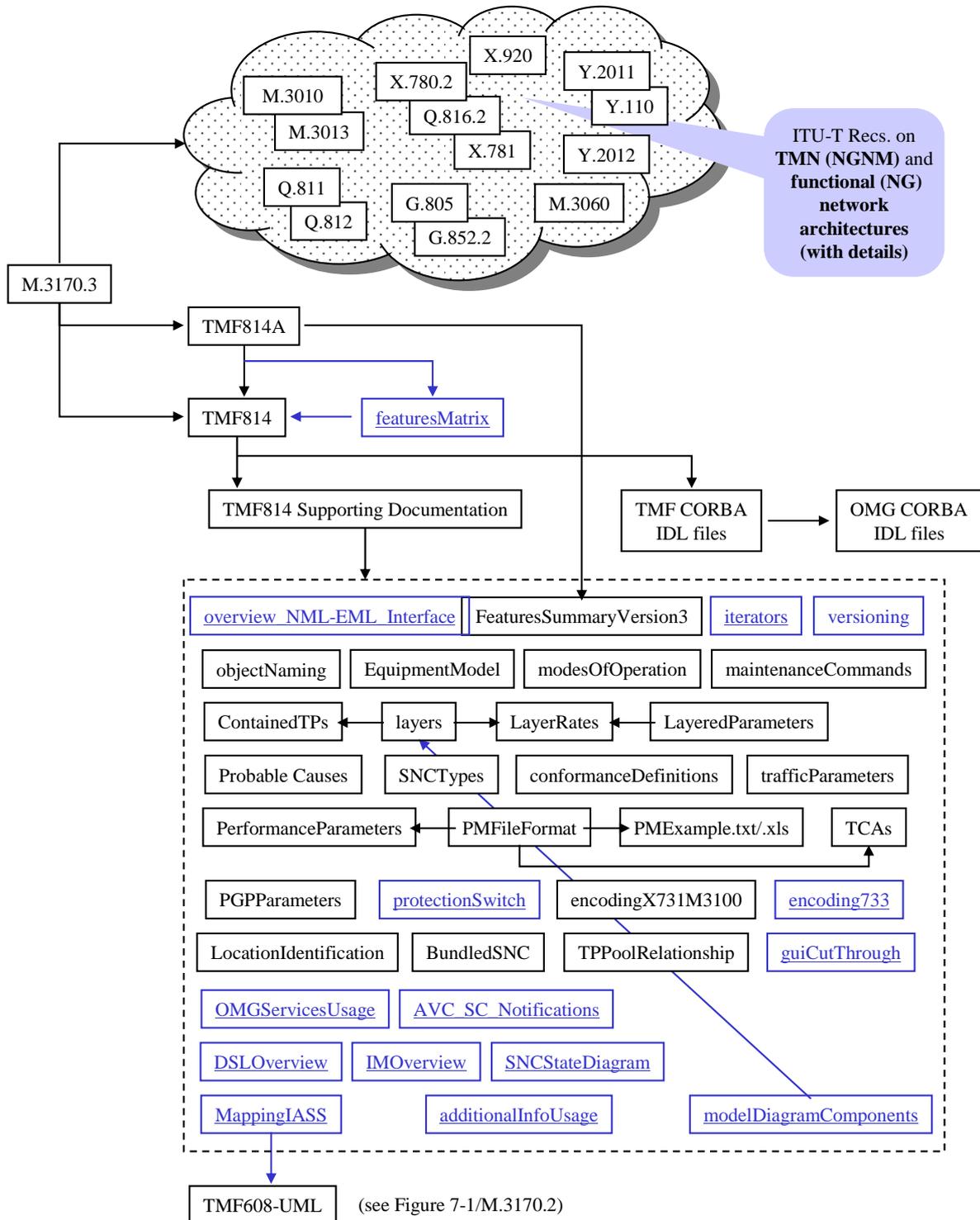
M.3010 M.3013 X.780.2 X.920 Q.816.2 X.781 Y.2011 Y.110 Y.2012 Q.811 Q.812 G.805 G.852.2 M.3060

ITU-T Recs. on **TMN (NGNM)** and **functional (NG) network architectures (with details)**

M.3170.3

TMF814A

TMF814 ← featuresMatrix

TMF814 Supporting Documentation

TMF CORBA IDL files → OMG CORBA IDL files

overview_NML-EML_Interface | FeaturesSummaryVersion3 | iterators | versioning

objectNaming | EquipmentModel | modesOfOperation | maintenanceCommands

ContainedTPs ← layers → LayerRates ← LayeredParameters

Probable Causes | SNCTypes | conformanceDefinitions | trafficParameters

PerformanceParameters ← PMFileFormat → PMExample.txt/.xls | TCAs

PGPParameters | protectionSwitch | encodingX731M3100 | encoding733

LocationIdentification | BundledSNC | TPPoolRelationship | guiCutThrough

OMGServicesUsage | AVC_SC_Notifications

DSLOverview | IMOverview | SNCStateDiagram

MappingIASS | additionalInfoUsage | modelDiagramComponents

TMF608-UML   (see Figure 7-1/M.3170.2)

Figure 8-1 – ITU-T and TM Forum documents linked by M.3170.3

At the TM Forum side the figure shows the SS and IS structures and looks inside the SD box (SS- and IS-relevant supporting documents according to Table 6-1 of [ITU-T M.3170.0]). Refer to clause 6.3 of [ITU-T M.3170.0] for an overview of the supporting documentation. Supporting

documents that are only packaged with TMF814 are coloured underlined in blue. Refer to clause 6.4 of [ITU-T M.3170.0] for an overview of the TMF CORBA IDL files and the OMG CORBA IDL files delivered with [TMF814 v3.0].

At the ITU-T side Figure 8-1 depicts an "ITU-T Recommendation cloud" with the directly SS- and IS-relevant ITU-T Recommendations (see clauses 6 and 7). The cloud encompasses TMN-related Recommendations. [ITU-T M.3010][ITU-T M.3013][ITU-T Q.811][ITU-T Q.812], NGNM-related Recommendations [ITU-T M.3060], the ITU-T framework for CORBA-based TMN interfaces [ITU-T X.780.x][ITU-T X.781][ITU-T Q.816.x][ITU-T X.920] and Recommendations on functional (NG) architectures [ITU-T G.805][ITU-T G.852.2][ITU-T Y.110][ITU-T Y.2011] [ITU-T Y.2012]. Note that the ITU-T NGN Management Focus Group (NGNMFG), a group sponsored by ITU-T's Study Group 4, identified the MTNM specifications as relevant to NGN management (see [b-MTNMFG]).

9   TMN compliance and TMN conformance

An MTNM implementation is an NMS (CORBA client) or an EMS (CORBA server) or both. Such an NMS or EMS is an operations system (OS) as defined by [ITU-T M.3010]. An OS is an architectural concept representing the physical realization of one or more OSFs (also known as a physical block) and exposing interfaces to other OSs or to managed resources. MTNM NMSs communicate via the MTNM interface with one or more EMS, and an MTNM EMS can have one or more clients.

Clause 13 of [ITU-T M.3010] defines TMN compliance and TMN conformance for general-purpose TMN (Q or X) interface implementation paradigms, namely CMIP/OSI systems management, CORBA framework (see Amendment 1 to [ITU-T M.3010]), and paradigms for further study (e.g., XML framework, Java framework). Interfaces are not interoperable between the paradigms. In the CORBA framework, more than one paradigm choice is provided for modelling: there are frameworks for fine-grained interfaces, coarse-grained interfaces, and service-oriented interfaces. These CORBA interfaces are interoperable and even miscible (which is not recommended though). According to Amendment 1 to [ITU-T M.3010], for the CORBA framework paradigms, any information modelling shall follow [ITU-T X.780.x] as appropriate and the framework(s) chosen shall be specified in the model.

TMN compliance and TMN conformance specify general and paradigm-specific criteria to be met by TMN systems such as MTNM EMSs and MTNM NMSs. The examination of criteria for the CORBA framework(s) applies to MTNM v3.0 and MTNM v2.1 operations systems since they are purely CORBA-based [TMF814 v3.0][TMF814 v2.1][TMF814A v3.0] [TMF814A v2.1].

TMN compliance requires the meeting of criteria with regard to:

- the TMN functional, information and physical architectures;
- TMN principles (logical layered architecture, TMN physical blocks, TMN interfaces);
- TMN functions (supported managed areas and associated management services).

Implementations of the MTNM NML-EML interface, i.e., MTNM systems which are MTNM EMSs/CORBA servers or MTNM NMSs/CORBA clients or both, are fully TMN compliant since:

- MTNM defines an information-specified q reference point according to clause 10 of [ITU-T M.3010] between the NML with TMN managers and the EML with TMN agents (see [ITU-T M.3170.2][TMF608 v3.0]);

    NOTE 1 – [TMF608 v3.0] defines an information-specified q reference point according to clause 10 of [ITU-T M.3010] (TMN information architecture) by using its own independent management information model. It should be noted that TMF608 considers the reference point to delineate and expose an external view of management functionality of a function block which is independent of

other function blocks (see Amendment 2 to [ITU-T M.3010] and [ITU-T M.3060]). Refer to the companion Recommendation [ITU-T M.3170.2] for details.

• An MTNM system is a TMN OS, namely an element-OS (see clauses 11.3 and 9.5.1.1 of [ITU-T M.3010]) or a network-OS (see clauses 11.3 and 9.5.1.2 of [ITU-T M.3010]).

• Supported TMN managed areas and associated TMN management services according to [b-ITU-T M.3200] are documented (see [ITU-T M.3170.1][TMF513 v3.0]).

NOTE 2 – [TMF513 v3.0] describes in its section 3 the business process view of the requirements to be satisfied through the MTNM NML-EML interface and shows that MTNM addresses the problems arising in the resource management and operations (RM&O) grouping of the eTOM [b-GB921 v6.1][b-GB921D v6.1] [b-ITU-T M.3050.x] (FAB approach). Supplement 3 to [ITU-T M.3050] shows how these business processes can be mapped to M.3400 management function sets [b-ITU-T M.3400] (FCAPS approach). [b-ITU-T M.3400] categorizes the function sets and their members according to their FCAPS application and specifies them together with generic end-to-end flow scenarios that relate them to TMN management services and TMN managed areas according to [b-ITU-T M.3200] and to TMN logical layers according to [ITU-T M.3010]. That way the requirements of the MTNM NML-EML interface are eventually mapped to TMN managed areas and associated TMN management services. Refer to the companion Recommendation [ITU-T M.3170.1] for details.

TMN conformance is testable (not just documented) and requires the meeting of criteria for TMN interfaces between physical blocks (such as MTNM OSs), namely:

• mandatory fulfilment of TMN interface protocol conformance criteria;

• claim, by level, of TMN interface information conformance per supported management functionality (if information modelling is implemented).

MTNM is TMN interface protocol-conformant since (see clause 6):

• MTNM systems support the CORBA protocols and services specified in [ITU-T Q.816.2];

• support of an OMG ORB (see Basic ORB and Advanced ORB requirements according to clause 10.2.1 of [ITU-T Q.816.2]) includes support of the Q.812 CORBA protocol profile [ITU-T Q.812] and the Q.811 IP protocol profiles (with Ethernet profile if applicable) [ITU-T Q.811];

• MTNM systems offer/provide (in case of EMS/CORBA server) or use/consume (in case of NMS/CORBA client) a TMN Q interface;

• the CORBA information modelling follows [ITU-T X.780.2] (i.e., the service-oriented paradigm choice of the CORBA framework) and complies with [ITU-T X.920].

MTNM is Level B TMN interface information-conformant since:

• the CORBA information models are defined using [ITU-T X.780.x] as appropriate – namely in [ITU-T X.780.2] (see clause 6);

• the managed object classes supported by the MTNM interface are specified in the *de facto* standards body TM Forum through TMF513 (see [ITU-T M.3170.1][TMF513 v3.0]), TMF608 (see [ITU-T M.3170.2][TMF608 v3.0]), and TMF814 (see clause 6);

• sub-classing and extending of MTNM CORBA managed object classes are fully specified in [ITU-T X.780.x] as appropriate – namely in [ITU-T X.780.2], and in the MTNM documentation;

• TMF814A provides ICS proformas which follow [ITU-T X.781] (see clause 7).

The applicability to MTNM management systems of certain M.3013 considerations for a TMN with regard to the physical architecture, system deployment and system operation (see [ITU-T M.3013]) is for further study. While major parts of [ITU-T M.3010] have been progressed to wider applicability in the context of NGN management (see [ITU-T M.3060]) such progress for [ITU-T M.3013] is for further study.

10 Multi-technology, multi-vendor and multi-service capabilities

TMF814 and TMF814A are wrapped jointly by this Recommendation according to Figure 8-1 since they collectively specify a highly interoperable CORBA-based NML-EML interface, known as MTNM CORBA. This high degree of interoperability of MTNM systems is also known as multi-vendor capability. It is based on TMF814's common usage and standardized extension of the service-oriented CORBA approach specified by Annex A of [ITU-T X.780.2], Annex A of [ITU-T Q.816.2], and clause 10.5 of [ITU-T X.780.2], which provides an agile vendor-independent two-part data model (behaviour and state of managed objects) that offers smart and standardized means for vendor-specific extensions when such extensions are needed in customer projects or for reasons of competitive differentiation.

The description of details of the recommended contents of CORBA-based vendor-specific ICS documents (if needed) such as a vendor-specific implementation statement (IS) as per TMF814A (see clause 7) or an interface implementation specification (IIS) as per TMF833 (see [b-TMF833 v1.0]) is for further study. The most important part of such a vendor-specific TMF814 documentation would be the publication of all MTNM naming details that are implemented at the interface according to the supporting document objectNaming.pdf.

The service-oriented CORBA paradigm (which encompasses the fine-grained and coarse-grained paradigms as less lightweight special cases) may be considered the consolidation of the (telecommunication) industry's approach to multi-technology CORBA-based network element and network management. To go beyond this consolidation means to go:

- beyond CORBA (in particular in XML direction);

- towards new network technologies;

- beyond the management of network elements and networks (in particular towards the management of, for example; service resources; QoS-determined network resources for traffic-engineered networks-based services; service lifecycles; the delivery of both telecom network-based services and content and application-based services); and

- to consider the evolution of traditional operations systems to general-purpose support systems. The generic SOA-based approach to two-part managed object modelling proposed by the service-oriented CORBA paradigm is considered flexible enough to meet all of these challenges. Details of how to make the service-oriented CORBA independent of CORBA and telecom networks are for further study.

Bibliography

The following references contain information that was used in the development of the M.3170-series Recommendations.

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[b-ITU-T M.3050.x]   ITU-T Reommandation M.3050.x (2004), *Enhanced Telecom Operations Map (eTOM)*.

NOTE – This series of Recommendations has the following structure:

M.3050.0 – eTOM – Introduction.

M.3050.1 – eTOM – The business process framework.

M.3050.2 – eTOM – Process decompositions and descriptions.

M.3050.3 – eTOM – Representative process flows.

M.3050.4 – eTOM – B2B integration: Using B2B inter-enterprise integration with the eTOM.

M.3050/Supplement 1 – eTOM – ITIL application note.

M.3050/Supplement 2 – eTOM – Public B2B Business Operations Map (BOM).

M.3050/Supplement 3 – eTOM to M.3400 mapping.

[b-ITU-T M.3400]   ITU-T Recommendation M.3400 (2000), *TMN management functions*.

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