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INTERNATIONAL TELECOMMUNICATION UNION

ITU-T M.3020

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(07/95)

MAINTENANCE

TELECOMMUNICATIONS MANAGEMENT NETWORK

TMN INTERFACE SPECIFICATION METHODOLOGY

ITU-T Recommendation M.3020
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(Previously "CCITT Recommendation")

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FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation M.3020 was revised by ITU-T Study Group 4 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 27th of July 1995.

NOTE

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

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ABSTRACT

This Recommendation is one of a series of Recommendations on the Telecommunications Management Network (TMN). It provides a methodology for deriving management information definitions, messages and protocol specifications for TMN interfaces. Emphasis is placed on multiple applications of the methodology and a reuse of previous results to build the specifications.

KEYWORDS

Information model; managed objects; management context; management functions; management goal; management role; management services; messages; protocols; specification methodology; task information bases; tasks; telecommunications resource; user requirements.

Recommendation M.3020

TMN INTERFACE SPECIFICATION METHODOLOGY

(revised 1995)

1 Introduction

1.1 Scope

This Recommendation describes the TMN interface specification methodology. It describes the processes to derive TMN interface specifications based on TMN users' requirements. Guidelines are given with the aim to describe TMN users' requirements uniquely and efficiently. They are written in the form of management services, which contain descriptions of management goals, roles, telecommunications resources and TMN management functions. TMN management function definition guidelines are given for a detailed description of the functional aspects of TMN management services.

1.2 Related Recommendations

The following Recommendations should be referred to in connection with this Recommendation:

- CCITT ITU-T Recommendation M.3000 (1994), *Overview of TMN Recommendations.*
- CCITT Recommendation M.3010 (1992), *Principles for a telecommunications management network.*
- CCITT Recommendation M.3100 (1992), *Generic network information model.*
- CCITT Recommendation M.3180 (1992), *Catalogue of TMN management information.*
- CCITT Recommendation M.3200 (1992), *TMN management services: overview.*
- CCITT Recommendation M.3400 (1992), *TMN management functions.*

1.3 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

ASN.1	Abstract Syntax Notation one
CMIS	Common Management Information Service
CMIP	Common Management Information Protocol
FTAM	File Transfer Access and Management
GDMF	Guidelines for the Definition of TMN Management Functions
GDMS	Guidelines for the Definition of Management Services
ISO	International Organization for Standardization
JCG	Joint Coordination Group
MD	Mediation Device
MOCS	Managed Object Conformance Statement
NE	Network Element

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OAM&P	Operations, Administration, Maintenance and Provisioning
OAM	Operations, Administration and Maintenance
OS	Operations System
OSI	Open Systems Interconnection
PSPDN	Packet Switched Public Data Network
PSTN	Public Switched Telephone Network
QA	Q-Adapter
SDH	Synchronous Digital Hierarchy
SM	Systems Management
SMF	System Management Function
TIB	Task Information Base
TMN	Telecommunications Management Network
WS	Work Station

1.4 Definitions

For the purposes of this Recommendation, the following definitions apply:

1.4.1 TMN user: That which requires the TMN management services in the support of its activities. It may be a human user applying for the use of services via some human-machine communication or it may be some computer-based organizational system requiring the capabilities of the TMN. (Unless identified as "TMN" user, the term "user" refers to a user of this methodology.)

1.4.2 TMN management service: A TMN management service addresses, as a reference, the relevant information on telecommunication management serving a specific management goal. It is always described from the TMN user's perception of the management requirements. TMN management information is derived from the comprehensive description of management context.

1.4.3 TMN management goals: TMN management goals are the telecommunications users' benefits obtained by carrying out management activities, using TMN management services.

1.4.4 TMN management context: TMN management context defines the environment where TMN management services are carried out. The definition includes the description of who manages the network, what in it is managed and how it can be managed. A template is given in Annex A to guide the users to arrive at a uniform definition. TMN management context shall be described by using three orthogonal components: TMN management roles, telecommunications resources and TMN management functions.

1.4.5 TMN management roles: TMN management roles define the activities which are expected of the staff/system to perform telecommunications management. TMN management roles are defined independent of other components, i.e. telecommunications resources and TMN management functions.

1.4.6 Telecommunications resources: Telecommunications resources are physical or logical entities requiring management, using TMN management services.

1.4.7 TMN management function: A TMN management function is a cooperative interaction between application processes in managing and managed systems for the management of telecommunications resources (physical and logical). This normally corresponds to one (sometimes a set of very few) CMIS operations or notifications. Typically, a TMN management function is the smallest part of such a cooperative interaction.

1.4.8 TMN management function set: TMN management function set is a grouping of TMN management functions that contextually belong together, i.e. they are related to a specific management capability (e.g. alarm reporting functions, traffic management control). The TMN management function set is the smallest reusable item of functional specification. The TMN management function set must be considered as a whole. It is similar to the requirements part of the OSI SMF (system management function).

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1.4.9 TMN management function set group: A grouping of TMN management function sets, being a mechanism to simplify the listing of TMN management function sets in order to satisfy particular user demands. TMN management function set groups are not subject to standardization.

1.4.10 TMN functional requirements: TMN functional requirements represent the detailed information by the modelling groups and define the management capabilities to be provided. These requirements describe the management concepts, the relevant resources and the functionality and information required to provide the desired management capabilities.

1.4.11 TMN management scenario: A TMN management scenario is a set of examples of management interactions using TMN management information definitions and TMN system management services and messages.

1.4.12 TMN management information schema: A TMN management information schema specifies the information model of a managed system as seen over a particular interface by a particular managing application or system.

1.5 Relationships between the TMN specification concepts

Figure 1 (TMN terminology relationships) shows the relationship of the terms used and explained in the following sections.

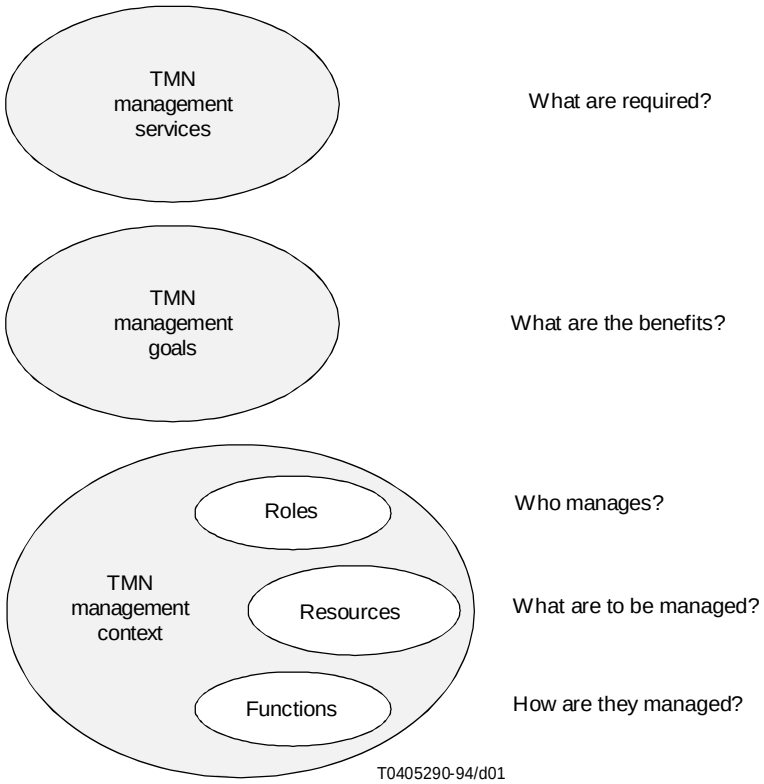

FIGURE 1/M.3020

Relationships between the TMN specification concepts

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1.5.1 Structure of TMN requirements

Users shall describe TMN requirements providing sufficient information to define the TMN management information model. They are described from the users' perspective, using human-understandable media, as a "source text" to be converted to machine knowledge. The detail required for information modelling may be reached in several steps for the complete TMN management service.

Orthogonality between the three components of the context of a management service, TMN management roles, telecommunications resources and TMN management functions, should be maintained in the descriptions of management context to avoid redundancy. Figure 2 shows the orthogonal relations of management components.

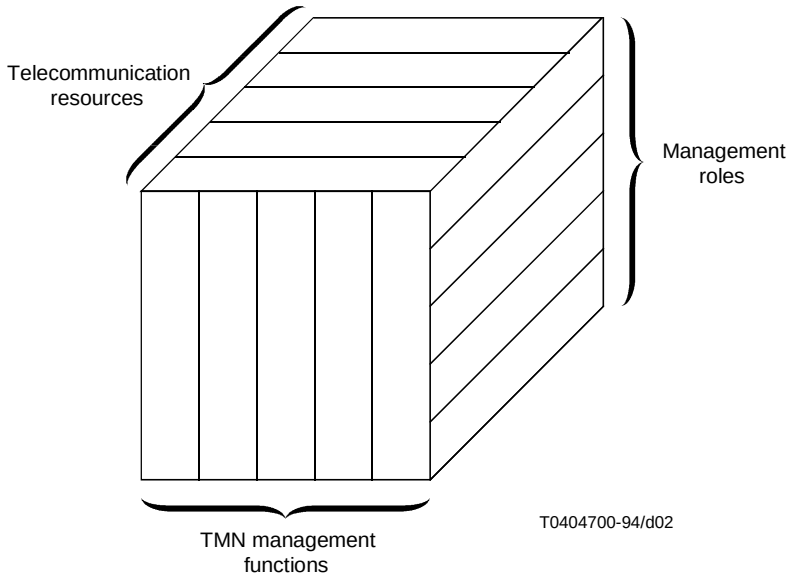

FIGURE 2/M.3020

Relationship of management context components

1.5.2 Structure of TMN management services functional aspects

TMN management functions are typically the smallest functional parts of a TMN management service. TMN management functions are grouped into standardized TMN management function sets for the purpose of information modelling. TMN management function sets can be used for one or more TMN management services. Figure 3 shows an example of a relationship between TMN management services and TMN management function sets. Each standardized TMN management service contains a certain list of TMN management function sets. In cases where this list is too long, it can be practical to assemble TMN management function sets into TMN management function set groups depending on applications. The same TMN management function set therefore can appear in various TMN management function set groups. The same kind of examples can be created for the relationship between TMN management function set groups and TMN management function sets, TMN management services and TMN management functions. Figure 4 illustrates the principle relationships. Figure 5 shows grouping principles and Figure 6 shows an application example.

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		TMN management services			
		Traffic management	Customer control services management	Customer administration	. . .
TMN management funtion sets	Alarm reporting functions	X	X		
	Alarm summary functions	X	X		
	Service provisioning		X	X	
	Testing function		X		
	. .				
	. .				

FIGURE 3/M.3020

An example of a relationship between TMN management services and TMN management function sets

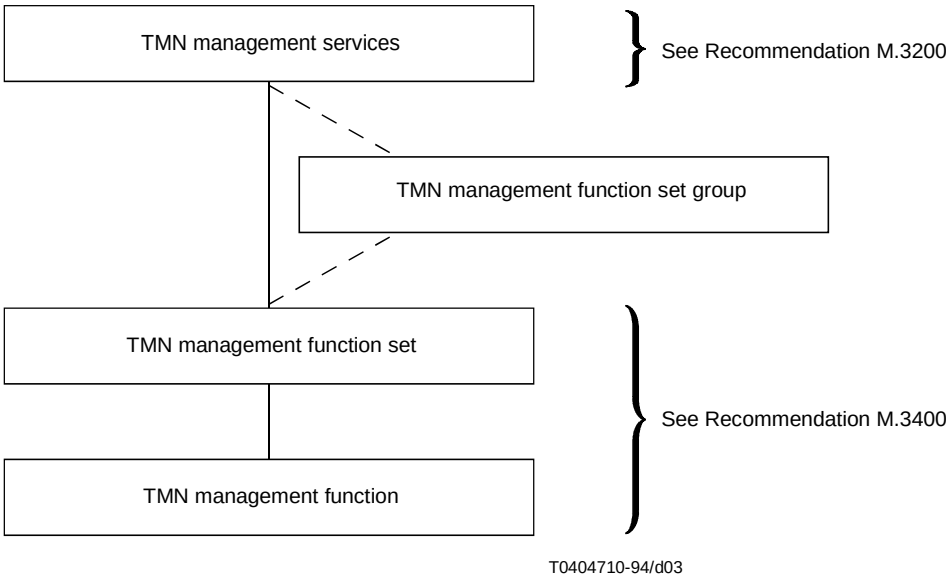


FIGURE 4/M.3020

Principal relationship between a TMN management service and its function set groups, function sets and functions

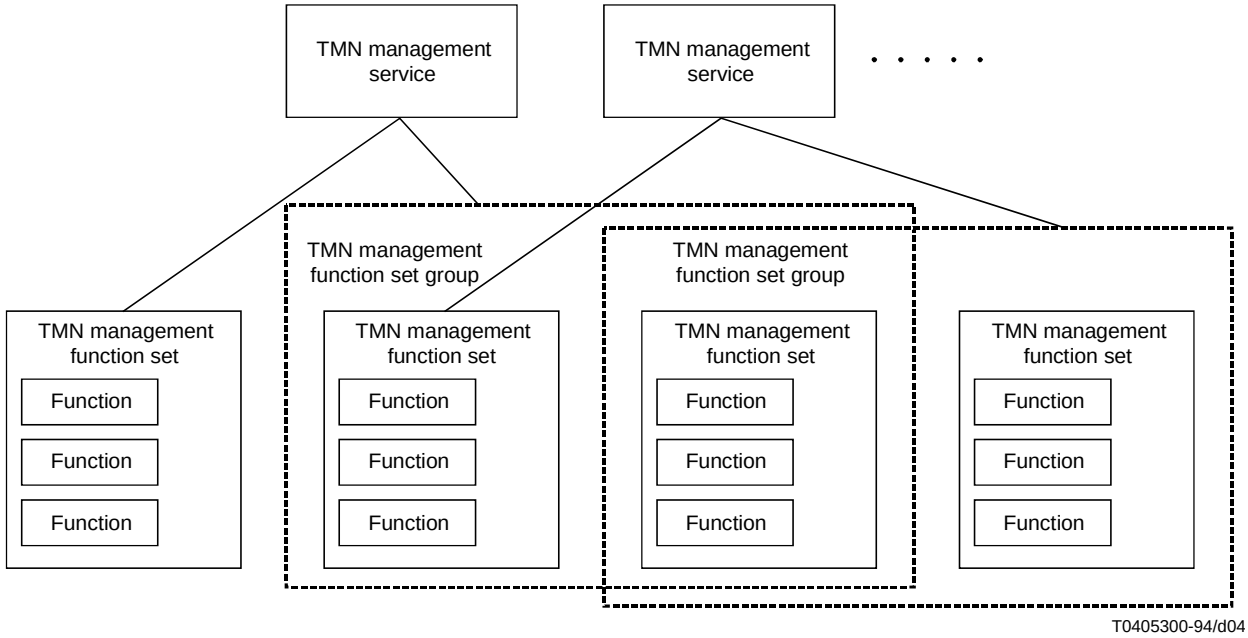


FIGURE 5/M.3020

Cross-relationship between management services and management functions

While performing the analysis of TMN management context, it is desirable to make maximal use of existing TMN management function sets available in Recommendation M.3400. This results in the reuse of a large amount of functional specifications and minimizes specification efforts.

If no existing functional specification exists to satisfy a TMN management function set requirement, a new TMN management function set is created with its TMN management functions and is included in Recommendation M.3400.

The management process requires information exchange between various TMN entities across standardized TMN interfaces. The information flow (operations on the involved managed objects, notifications emitted by the managed objects) uses the communication services OSI CMIS and FTAM.

In the case where OSI CMIS is chosen as a communication service, then the mapping of TMN management functions into CMIS (service mapping) requires a number of steps as shown in Figure 7. The steps associated with FTAM are for further study.

TMN management function sets and their corresponding management functions are supported by resource managed objects and/or support managed objects.

TMN management functions of a TMN management function set map to TMN Systems Management (SM) service. These TMN SM services are based on OSI and TMN defined System Management Functions (SMF).

The TMN SM services are applied to resource managed objects. If required, support managed objects can be used to support the TMN SM service.

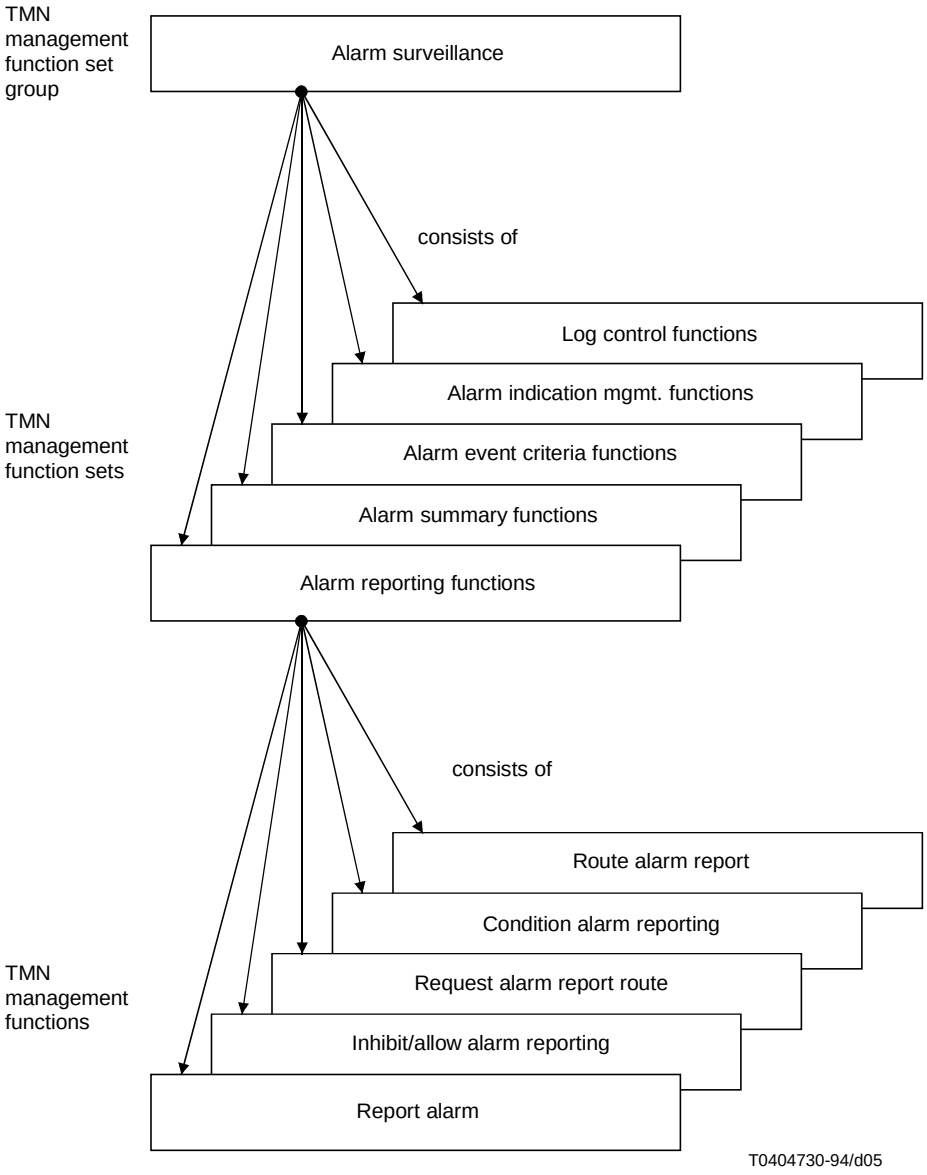


FIGURE 6/M.3020

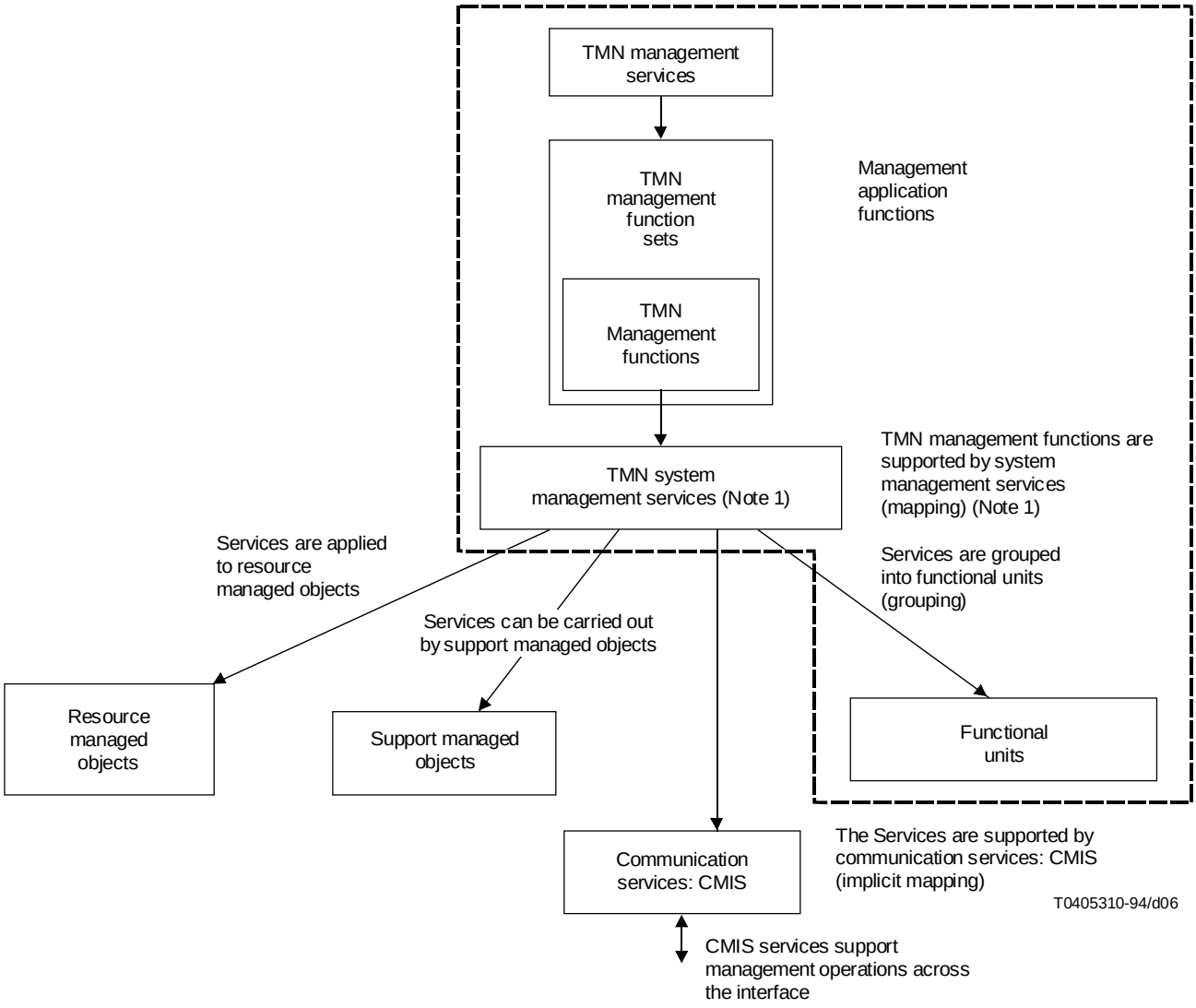
Example of relationship applied to "alarm surveillance"

The TMN SM services are grouped into functional units (grouping).

The TMN SM services are supported by CMIS or other services (implicit mapping).

CMIS services support management operations across management interfaces.

Figure 7 shows the relationship of the management application function (Recommendation M.3010) with TMN management function set, services and functional units.



NOTES

1 Based on ISO defined Systems Management Functions (SMF).

2 This example is based on CMIS services, but other services, such as FTAM may also be used.

FIGURE 7/M.3020

Relationship among TMN terms

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Figure 8 shows, as an example, the handling of the TMN management function set, "Alarm reporting functions" (in C.2.1/M.3200).

Figure 9 lists an example of a relationship based on Recommendation Q.821 concerned with alarm surveillance.

FIGURE 8/M.3020

Handling of "report alarm" – Example

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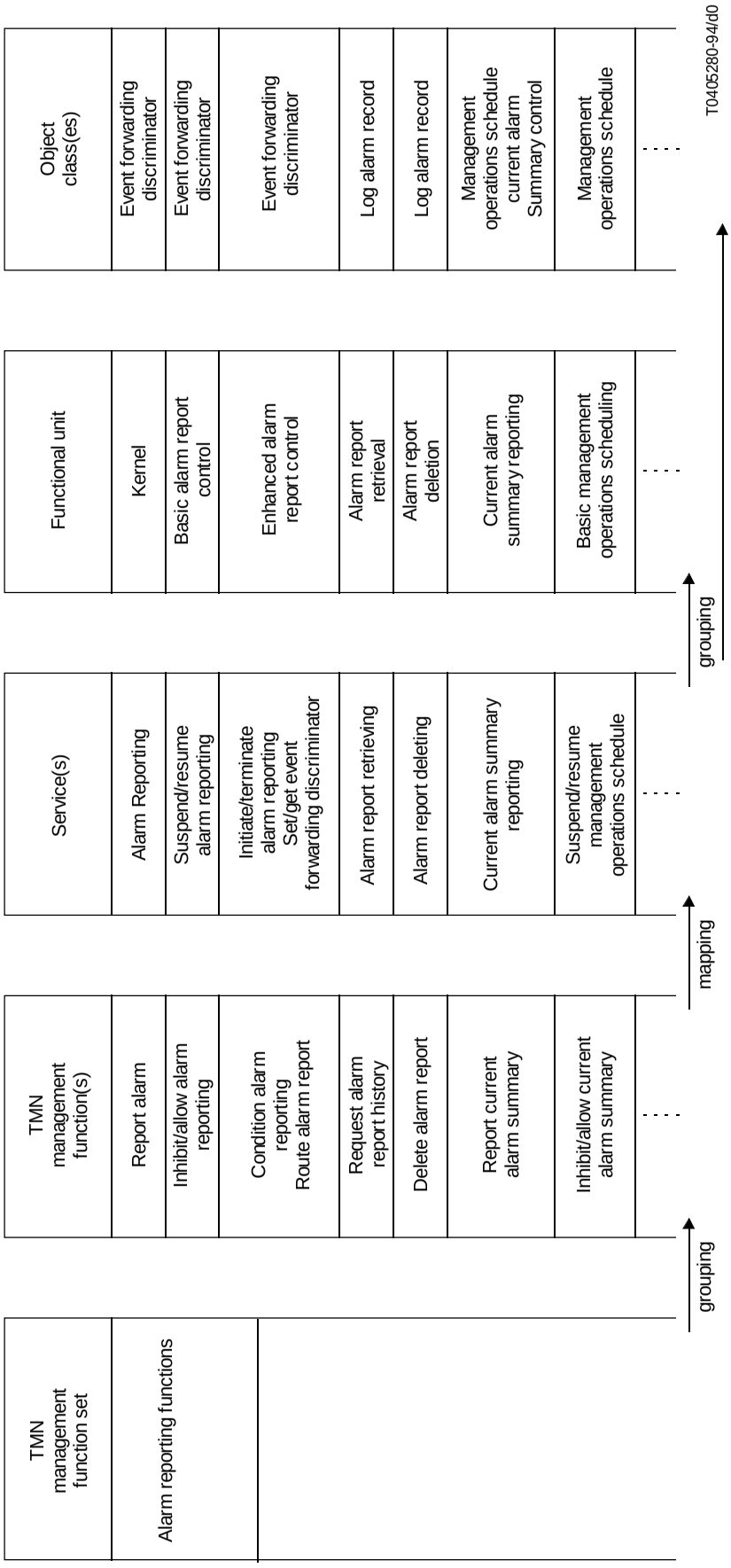

NOTE – Arrows shown here, are consistent with those in Figures 7 and 8.

FIGURE 9/M.3020

Example of service mapping (Recommendation Q.821)

1.6 TMN requirements template

Annex A, "Guidelines for the Definition of TMN Management Services (GDMS)" and Annex B, "Guidelines for the Definition of TMN Management Functions (GDMF)" contain TMN requirements templates. These are tools to describe TMN requirements, i.e. goal and context, in a consistent as well as efficient manner.

2 User guidelines

2.1 Guide to users of this Recommendation

2.1.1 Types of users

The methodology is intended for use by three different types of users:

a) *Coordinating user*

The ITU-T Study Group responsible for this methodology will specify the generic aspects of the TMN.

b) *Application specifying user*

ITU-T Study Groups with particular functional/equipment expertise and responsibilities will define specific aspects to the TMN, e.g. transmission-related aspects, traffic-related aspects.

c) *Protocol specifying user*

ITU-T Study Groups with protocol expertise and responsibilities will define specific aspects of TMN-related protocols.

This methodology only provides guidelines for the application specifying user. They are found in the following subclauses.

2.1.2 Guide for the application specifying user

2.1.2.1 Overview

The methodology is used to define management requirements, management services, management functions, information models and management protocols related to the management of telecommunications networks, equipment and services. It is designed to be used upon any clearly defined part of the network.

If the network as a whole is taken as the subject of the methodology, there is a need to define all the management information and operations upon that information which are necessary to manage the network as a whole. If just a digital switch is taken as the subject of the methodology, then the information and operations related to the digital switch will result. Therefore, the application specifying user should first have a clear understanding of what is to be the subject, i.e. the telecommunications resource of this pass of the methodology. A pass of the methodology usually requires visiting a subset of the tasks several times. A pass ends when the user of the methodology is of the opinion that the telecommunications resource is modelled sufficiently.

The execution of the methodology on the chosen telecommunications resources results in an information model. This information model is specified in terms of managed object classes with associated attributes, actions and notifications. The object classes represent all the necessary management aspects of the chosen telecommunications resources.

2.1.2.2 Purpose of the information (object) models

At first it may seem somewhat unclear what the purpose of these information (object) models are. In fact, these information models define very precisely the messages which can be used to manage remotely the chosen telecommunications resources (syntax) and the meaning (semantics) of the messages. In some cases these messages will be generated by a managing system, which is a computer-based system with an application program for managing the telecommunications resources. In other cases, these messages will be generated by the managed system to report to the managing system.

In many cases the CMIP protocol (Recommendation X.711 [1]) is the most appropriate protocol to transport the messages. The corresponding CMIS services (Recommendation X.710 [2]) provide the managing system with the M-SET (add, remove or replace values) service to let the managing system change the value of an attribute; the M-GET service to read the value of an attribute; the M-CANCEL-GET service to cancel one of the previously issued M-GETs; the M-ACTION service to request an object to perform a certain action; the M-CREATE service to create objects and the M-DELETE service to remove them. CMIS also provides the M-EVENT-REPORT service to let the telecommunications resources announce the occurrence of an event.

From the attribute specification, the contents of the CMIS M-SET, or the contents of the M-GET is derived. A similar statement applies to the message to ask for an object to be created, deleted or for messages to ask an object to execute one of its actions. In addition to these messages, initiated by the managing system, there are notifications that the telecommunications resource is capable of generating. From the notification specifications, the contents of the M-EVENT-REPORT is derived. It is therefore clear which messages are available to the managing system to manage the telecommunications resource and which messages are available to the telecommunications resource to notify the managing system of events that occur. The managing system and the telecommunications resource are both management information service users; both using CMIS to communicate with each other. The managing system has the manager role and the telecommunications resource has the agent role.

Because of this, these information models are in effect the means for specifying the interface between the telecommunications resource and the managing system. The telecommunications resource and the managing system can be developed independently of each other, since it is now known which messages they can expect from the other, and which messages they can use themselves to influence the other.

From the telecommunications resource's point of view, it is clear when it has to report or reply to the managing system. From the managing systems point of view, it is now clear under what kind of circumstances it will receive the event notifications and how it can get its information (monitoring). It is also clear what kind of influence it has over the telecommunications resource and how to effect it (control it), but it is not specified how the managing system should analyze the received information and react to it. In fact this last part, the analysis part, is not subject to standardization. TMN Recommendations provide for interoperability between managing systems and the telecommunications resource, but not for specification of the internal operation of the managing system.

In principle, the objects representing the telecommunications resource can be distributed over several systems. An object is conceptually as a whole, present in the telecommunications resource's management information base. At the present time it is not clear how the distribution aspect works in practice. Thus, at present, it is assumed that there is one system where the objects can be addressed. This system issues requests for changing of attribute values, for execution of actions, for creation of objects and for deletion of objects.

Thus, the managing system and the agent system can be developed independently by different manufacturers since the information model defines exactly how the communication (interoperability) between the two systems is to take place, how the messages are to look and what they mean.

2.1.2.3 Tasks

The relevant tasks for the application specifying user are as follows:

- Task 1: Describe the TMN management services and their goals from the TMN users' perspective.
- Task 2: Describe TMN management context.
- Task 3: Perform information modelling.
- Task 4: Consolidate available information.
- Task 5: Define management information schema.
- Task 6: Determine communication requirements.
- Task 7: Prepare documentation for protocol tasks.

This list of tasks and the numbering of the tasks do not imply a strict sequencing of the tasks. Tasks or combinations of tasks are performed in a multipass, iterative fashion. The goal of each pass is the specification of the management functions, object model and protocols for a specific pair of communicating TMN building blocks [Network Element (NE), Q-Adaptor (QA), Mediation Device (MD) Work Station (WS) and Operations System (OS)]. For each TMN building block, the type of building block (e.g. NE as a digital exchange) and its manager and/or agent role must be described.

As suggested above, a task or combination of tasks is performed in an iterative manner. In particular, the application tasks may be treated as two separate sub-processes since it is not necessary to define all TMN management services and management functions before starting on the object modelling for a particular aspect of the managed telecommunications network.

2.2 Responsibilities of the user

Under study.

3 Methodology

3.1 General considerations

The purpose of this methodology is to provide a description of the processes leading towards the definition of the TMN interfaces. The definition of each interface is contained in the functional profile, including an object model and protocol specifications supporting the TMN management services.

3.2 Application and structure of the methodology

The methodology is divided into two main areas of activity, application tasks and protocol tasks. Within each are a number of tasks which have been identified, as shown in Figure 10.

Each task has an associated information base. Each Task Information Base (TIB) contains the results of previous iterations of the methodology and represents the accumulated standardized way of performing a particular task in the methodology. Note that in general, the input to each task is derived from its associated TIB and the TIB of the preceding task and that the output to and from each task is reflected in its associated TIB. An exception is the generic or technology-specific information model (TIB X), which is the output to and from tasks 3, 4 and 5.

To ensure commonality between the outcome of each pass, it is important that each task within the methodology be based on the same task information base.

The tasks in this methodology are divided into application tasks (0 to 7) and protocol tasks (8 to 13) as shown in Figure 10. These tasks are to be performed in cooperation with the Study Groups with appropriate functional and technical expertise and responsibilities, led by the Study Groups responsible for TMN, for switching and signalling equipment and for transmission equipment. It is recommended that TMN management services, function sets and functions for any specific functional area be specified together by one Study Group and that messages and associated objects for any specific functional area be specified together by one Study Group. Further experience in such activities may lead to modifications in this methodology.

3.3 Detailed methodology

The details for the tasks and TIBs in Figure 10 are presented above.

The Task 0 “Generate guidelines” and the TIB 0 “Guidelines” are outside of the iterative portion of the methodology.

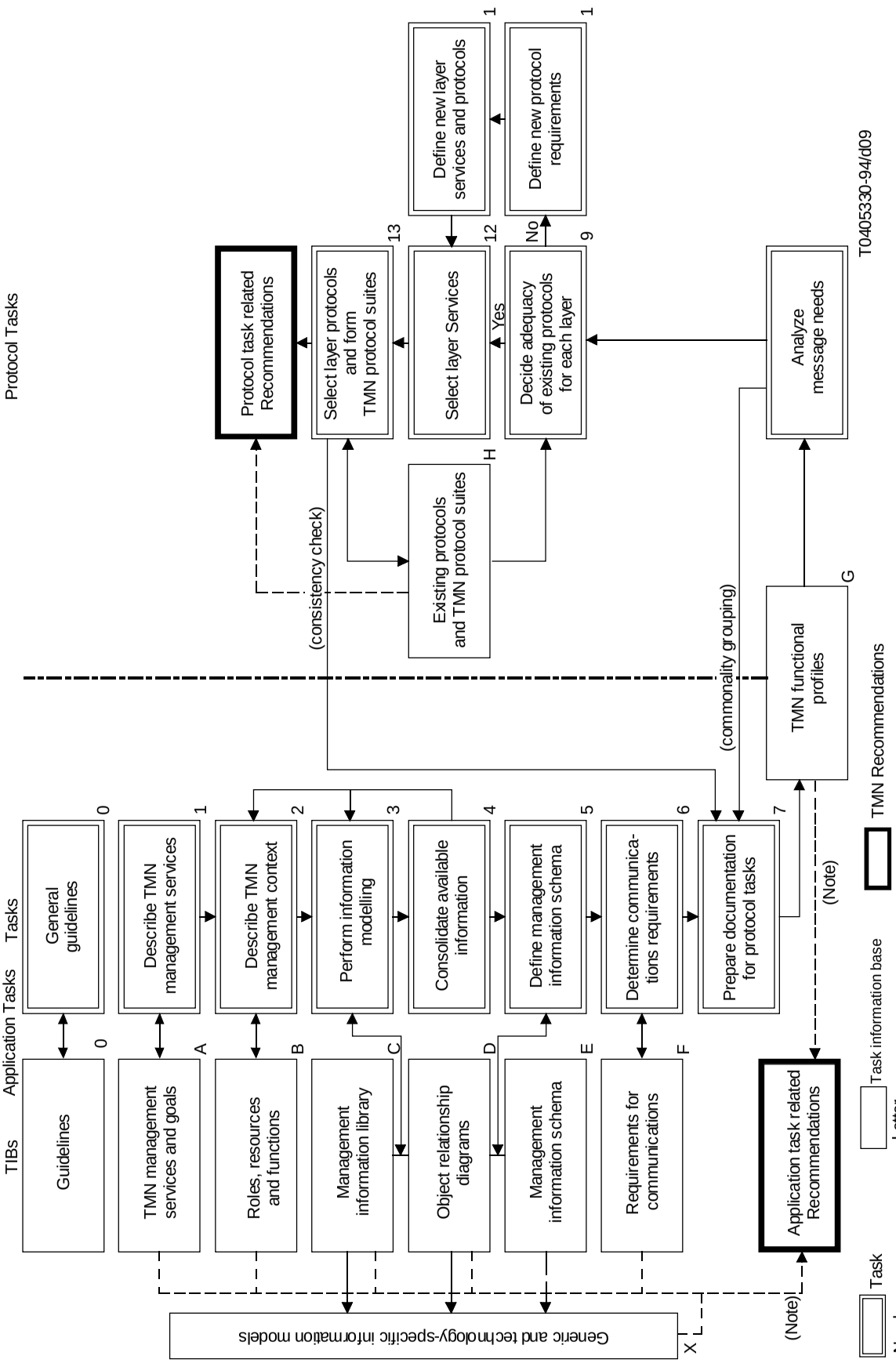

FIGURE 10/M.3020

TMN interface specification methodology

NOTE – The dotted lines show possible inputs to TMN Recommendations.

3.3.1 Task 0: Generate guidelines

Compile a list of relevant descriptive documents useful to the understanding of the methodology, particularly in the area of object-oriented modelling and management framework. Give some additional information on the relationship between the major phases of the methodology for guidance of individual groups who are performing the various tasks.

Note that this task is performed independently of any of the remaining tasks.

3.3.2 TIB 0: Guidelines

Reference to other documents such as:

- object-oriented modelling;
- OSI management framework;
- guidelines for the definition of managed objects;
- set of instructions for the groups performing the various tasks;
- principles for coordination between tasks.

3.3.3 Task 1: Describe TMN management services and their goals from the TMN users' perspective

Identify each area of management activity which is to be supported by the TMN in the form of a list of TMN management services. For each TMN management service, identify the TMN management goals and examples of benefits which TMN users obtain from these goals. Refer to the GDMS template in Annex A.

3.3.4 TIB A: TMN management services and goals

A complete list of TMN management services with a brief prose (natural language) description of each is provided. For each management service, a complete list of goals must be given.

The presently identified TMN management services are listed in Recommendation M.3200.

3.3.5 Task 2: Describe TMN management context

Develop management context. List roles, resources and TMN functions associated with a given TMN management service. Also specify their relationships, where possible in the form of scenarios. Refer to the GDMS template in Annex A and the GDMF template in Annex B.

3.3.6 TIB B: TMN management roles, telecommunications resources and TMN management functions (management function sets/function set groups)

List of descriptions of management roles, resources and TMN management functions (or function set/group) for that part of the TMN management service selected in task 1.

3.3.7 TIB X: Generic – and technology specific – information models

TIB X contains the generic – and technology – specific information models, including the object class hierarchies for these models. The model will be defined from analysis of telecommunication network architectures [Public Switched Telephone Network (PSTN), Packet Switched Public Data Network (PSPDN), Synchronous Digital Hierarchy (SDH), etc.]. The model (and class hierarchy) should contain those generic – and technology – specific object classes that are needed for further specification as well as support objects that are to be used in the definition of interfaces.

Specify Managed Object Conformance Statement (MOCS) proformas for the instantiable managed object classes defined in the model based on the guidelines given in Recommendation X.724 [5].

Note that the TIB X receives input from tasks 3, 4 and 5 via TIBs C, D and E.

3.3.8 Task 3: Perform information modelling

Using the generic-network information model including the object class hierarchy, identify existing and new object classes needed to support the TMN management functions assigned to that part of the TMN management service selected in task 1.

The process is as follows:

1) using TIBs C and D, analyze the generic – and technology – specific information models, including the object class hierarchy, to determine if existing object classes can satisfy the new functional requirements;

2) if necessary, create new object classes to satisfy the needs not met by the existing object classes;

3) modify the models to incorporate the new object classes.

The object model must provide for optional and vendor specific extensions. The contents of TIBs C, D and X are updated.

Specify Managed Object Conformance Statement (MOCS) proformas for the instantiable managed object classes defined in the model based on the guidelines given in Recommendation X.724 [5] (refer also to Annex C).

3.3.9 TIB C: Management information library

The object class hierarchy specifies the properties of the object classes that are needed for management. Extensive use of inheritance (super and subclasses) is needed to benefit the most from the reuse of specifications. The object classes are specified using the templates from Recommendation X.722 [3], structure of management information – Guidelines for the definition of managed objects. The templates defining the information model should be registered (according to the rules of Recommendation X.722) with a value for the ASN.1 object identifier. Annex C describes the procedure for assigning the registration values. For those object classes that are already specified in other ITU-T and ISO Recommendations, only a reference to the particular Recommendation and object class is needed. Naming is not a part, nor the purpose, of the object class hierarchy.

Object templates are specified in Recommendation M.3100 and other information model Recommendations.

3.3.10 TIB D: Object relationship diagrams

The generic network information model also depicts relationships between object classes in the form of entity relationship (E-R) diagrams. Object relationship diagrams are specified in Recommendation M.3100 and other information model Recommendations. Applicable managed objects (and their relationships) must be used in Task 4 to specify the management information schemas.

3.3.11 Task 4: Consolidate available information

For each TMN management function in the function list, check if it is supported by one or more object classes. A function in the function list is supported when:

– the monitoring part of the function can obtain all the necessary information from the objects; and/or

– the control part of the function has the necessary influence over the objects.

The monitoring part involves retrieving attribute values and receiving notifications. The control part involves creating and deleting objects, setting attribute values and executing actions. All constraints imposed by the management functions should be met.

If a management function is not supported by one or more of the existing object classes, then task 3 should be executed again: new object classes may be defined or existing object classes may be extended, e.g. by specialization, thereby creating a subclass.

Some object classes are defined only for the purpose of creating subclasses. Therefore, not all object classes have a relationship with one or more management functions.

For each object class in TIB C ("Object templates"), check if this object class provides a rationale to add any additional TMN management functions, or to modify any existing TMN management functions. If an additional TMN management function or modification of an existing TMN management function is required, task 2 should be re-executed.

This task forms part of the iterative process of building the set of management services and models. Management functions and object classes are added to the existing standardized set when requirements for them are defined.

3.3.12 Task 5: Define management information schema

Determine the management information schema for each type of managed system as seen by a particular managing application or system for that part of the TMN management service selected in 1. Check the schema from the managed system point of view.

3.3.13 TIB E: Management information schema

A management information schema specifies the information model of a managed system as seen over a particular interface by a particular managing application or system. This information model contains all the object classes that can and will be provided by that managed system to the managing application or system. In particular, it defines the naming structure for those object classes within the managed system. The management information schema defines all possible communication of information between the managing application or system and the managed system. TIB B is meant to be the repository of all such schemas.

For better design and understanding of the management information schemas, they must be accompanied by object relationship diagrams.

Management information schemas are specified in generic – and technology – specific information model Recommendations.

3.3.14 Task 6: Determine communication requirements

Create sets of communication requirements for the most likely communication scenarios. There may be requirements for simple transactions, file transactions, file transfer, file access or combinations of all types. Further, there may also be requirements of throughput, reliability, transit delay or naming schemas showing the required features. This process can proceed in parallel with the process in the other main parts of the methodology.

The properties described in Appendix I/M.3010 should be considered in this determination.

3.3.15 TIB F: Requirements for communication

Sets of communication requirements containing:

- nature of communications;
- frequency, service requirements for layer seven, delay, etc.

3.3.16 Task 7: Prepare documentation for protocol tasks

The results of previous tasks should be examined to prepare the communication to be used in accomplishing the protocol tasks.

3.3.17 TIB G: TMN functional profiles

The TMN functional profiles provide all the information necessary to perform the tasks associated with selecting and defining the protocols for the TMN interfaces. Included in the TMN functional profiles are the outputs from tasks 0 through 7 that are expected to be useful during these selections. Key outputs are the object model and communication requirements for specific pairs of communicating TMN entities.

3.3.18 Task 8: Analyze message needs

Analyze the TMN functional profiles to determine broad characteristics of the message needs. Messages between two systems may be defined as application layer protocols related to specific function subsets. It is not implied that functional profiles, e.g. for Q_x, always lead to a full seven layer OSI protocol suite and application layer structure. The analysis should determine if the functional profile chosen in TIB G leads to a minimal grouping of common messages. Iteration with task 6 may be necessary to achieve this.

3.3.19 Task 9: Decide adequacy of existing protocols for each layer

Evaluate from TIB H appropriate protocols from existing standard protocols which meet the needs defined in task 8. For each layer that is successful (as is expected for layers 1 through 6), skip tasks 10 and 11.

3.3.20 TIB H: Existing protocols and TMN protocol suites

The repository of existing standard protocol suites which task 8 draws from in order to minimize the number of protocols is provided. TIB H is updated to include protocols and protocol suites resulting from tasks 12 and 13.

Protocols, including management application protocols (messages), may be specified via separate stand-alone documents or may be identified by the selection of the appropriate International Standardized Profiles.

3.3.21 Task 10: Define new protocol requirements

a) If a layer protocol in task 8 is not adequate to meet the message needs defined in task 8, additional/amended layer protocol requirements are defined.

b) In the case of the application layer, application protocol requirements aimed at the specific message needs of task 8 are specified.

3.3.22 Task 11: Define new layer services and protocols

Corresponding to task 10 a), appropriate new/amended layer (N – 1) services to support layer (N) are defined. Corresponding protocol mechanisms are amended or defined. Corresponding to task 10 b), application protocols aimed at the specific message needs chosen by task 8 are specified.

3.3.23 Task 12: Select layer services

Select the service requirement from layer (N – 1) to N, for 1 through 6 (as appropriate) from the output of tasks 9, 10 and 11. In the case of the application layer, identify the Application Service Elements (ASEs) necessary to support the specific management ASEs.

3.3.24 Task 13: Select layer protocols and form protocol suites

Select all layer protocols (1 through 7) from tasks 9 through 12 and define families of protocol suites including coding of information content, to support the specific management function(s). Ensure consistency of output from task 13 with that of task 7 and iterate through appropriate tasks as necessary. Identify the text to be included in the TMN protocol Recommendations and Recommendation X..220 [4].

Specify or reference Protocol Implementation Conformance Statement (PICS) proformas.

3.4 TMN interface specifications

TMN interface specifications are described in TMN Recommendations, reflecting the contents of TIBs. They can be categorized into two groups from the viewpoint of methodology. The one is application task-related Recommendations (e.g. M.3200-Series Recommendations) and the other is protocol task-related Recommendations (e.g. Recommendations Q.811 and Q.812).

The contents of TIBs A-G are utilized to develop the first group and the content of TIB H is used to develop the second group of Recommendations (see Figure 10).

The first group covers the TMN subject areas of TMN management services, TMN management functions and TMN management information models. The second group covers the TMN subject areas of communication protocols, TMN systems management services and conformance statements.

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Annex A

Guidelines for the Definition of TMN Management Services (GDMS)

(This annex forms an integral part of this Recommendation)

A.1 Introduction

The following are guidelines for the Definition of Management Services (GDMS). The GDMS endeavours to clearly establish the objectives of task 1 of the TMN methodology, provide direction on the structure and contents of TIB A and B (M.3200-Series Recommendations) and suggest useful tips/tools in performing tasks 1 and 2.

It is imperative that the telecommunications management experts express TMN requirements in a complete and uniform way. The following template is provided to document these requirements. A major objective of the TMN methodology is to create TMN management services that reuse existing TMN management information models and TMN management function sets.

A.2 GDMS template

A.2.1 Management service description

Use Recommendation M.3200, subclause "TMN management services prose descriptions" as a possible source.

A.2.2 Management goals

This subclause should give a clear description of the TMN users benefit, i.e. the reason for performing this management service. Background and context should be added as necessary, but the explanatory and descriptive part and descriptions should be separated. Supporting background information, where required, should be placed in an annex.

A.2.3 Management context description

The objective of a TMN management context description is to capture, in a uniform way, relevant information on the management of a certain telecommunication area. The objective is to document the relevant information that leads to the definition of TMN management function sets and their corresponding functions.

TMN management context can be described by using the orthogonal three components: roles, resources and functions.

A.2.3.1 Roles

This subclause should provide a prose description of the roles identified for this management context in sufficient detail to allow the supporting functions to be determined (e.g. planning, maintenance, installation, testing, etc.).

Roles should be listed in TIB B.

A.2.3.2 Telecommunications resources

This subclause provides a description of the logical and physical telecommunication resources which must be modelled by a (some) managed object(s). These should be clearly defined and stored in TIB B. Management layers of the network (element, network, service, business) can be used as a classification guide. See Recommendation M.3010 for a description of these layers.

A.2.3.3 TMN management functions

This subclause should provide a description of TMN management functions (function sets/function set groups) to be used in achieving the management goals. They should be stored in TIB B. Guidelines for defining these TMN management functions are found in Annex B.

A.2.4 Management scenarios

This subclause should provide examples of management interaction using TMN management information definition and TMN systems management services and messages.

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A.2.5 Architecture

The following need to be allocated in the physical and functional TMN architecture:

- management function sets (see Recommendation M.3400);
- management functions (related to Recommendation M.3400);
- applicable reference points (for example q, x, f);
- applicable interfaces (for example Q, F, X).

Annex B

Guidelines for the Definition of TMN Management Functions (GDMF)

(This annex forms an integral part of this Recommendation)

B.1 Introduction

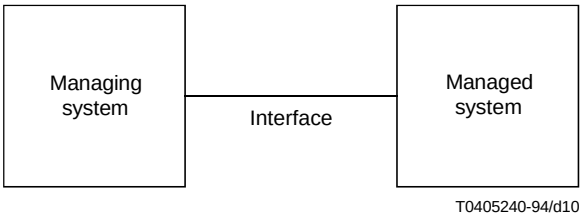
The following are guidelines for the definition of TMN management functions which provide directives for the definition of TMN management function sets for the TMN. The GDMF endeavours to clearly establish the objectives for this part of task 2 of the TMN methodology, provide direction on the structure and contents of this part of TIB B (Recommendation M.3400) and suggest useful tips/tools.

It is imperative that the telecommunication management experts express TMN requirements in a complete and uniform way. Today, telecommunication management requirements are documented in a variety of ways; different expert groups use different approaches and documentation structures. The TMN management functions (Recommendation M.3400) attempt to provide a uniform approach to documenting telecommunication management functional requirements for the TMN. A major objective of task 2 of the TMN methodology is to create reusable TMN management function sets for different TMN management services so as to minimize specification efforts.

B.2 TMN management function

The TMN management function is the smallest functional part of the TMN management service. It represents an interaction between two cooperating systems in order to achieve a management goal.

B.2.1 General model



A TMN management function is associated with management functionality in the managed system which is performed on behalf of the managing system. TMN management functions can be triggered by events internal to the managed system (e.g. report alarm) or may be invoked by the managing system (e.g. Recommendation M.3201).

B.3 TMN management function sets

The TMN management function set is a grouping of TMN management functions that contextually belong together. The TMN management function set is the smallest reusable item of functional specification. The TMN management function set must be considered as a whole.

A TMN management function set should fully support the functional requirements for a group of TMN management functions that contextually belong together, i.e. they are related to a specific management capability (e.g. alarm reporting functions, traffic control).

In order to provide modelling experts with a clear understanding of what a TMN management function set is all about, the telecommunication management experts must:

1) Provide any context information useful to better understand the management goal and/or management concepts behind a set of TMN management functions.

2) Describe the managed system functionality associated with the TMN management functions (e.g. what does report alarm mean, what does apply traffic control mean).

3) Identify the resource(s) (and their relationships) affected by the TMN management functions. TMN management functions refer to and/or operate on resources of the managed system, e.g. report alarm (resource failed), apply traffic control (trunk group).

4) Provide a brief description of the TMN management function (e.g. report alarm – NE notifies TMN of alarm information upon the occurrence of an alarm).

5) Describe the management information that flows between the systems for each TMN management function.

This information can be completed by referencing management services descriptions using the GDMS template which provide further details. The information for items 2 through 5 usually will be applicable to a group of TMN management functions which are closely related. These elements put together express the functional requirements to be satisfied by an information model. Examples of this type of functional definition can be found in Recommendation M.3400. It must be possible to map a TMN management function to one or more message(s) supported by one or more object(s) of an information model that claims to support this TMN management function.

B.4 GDMF template

B.4.1 TMN management function set description

It provides function set name and prose description.

B.4.2 Management requirements

A description of the management goals and concepts behind the described TMN management function set.

B.4.3 Functional model

A description of the following:

- a brief description of the TMN management function set;
- the functionality associated with the TMN management function set;
- identification of the resources affected by the TMN management function set.

B.4.4 TMN management functions

For each TMN management function, the following is provided:

- a summary description;
- a detailed description of the management information that flows between the managing system and the managed system.

Annex C

TMN object identifier assignment rules

(This annex forms an integral part of this Recommendation)

C.1 TMN object identifier structure

Annex C/X.680[1)] defines the first few arcs of the object identifier structure to be used for information items in ITU Recommendations. All objects identifiers are structured as in Figure C.1 which is a graphical depiction of the following information:

(0) itu-t[2)]
    (0) recommendation
        (1) a
        (2) b
        (3) c

        .....
        (7) g
            (774) g774
        .....
        (13) m
            (3100) m3100

        .....
        (14) n

        .....

For example, the object identifier of Recommendation M.3100 is:

{ itu-t(o) recommendation(0) m(13) m3100(3100) }

The leaves of the above structure represent ITU-T Recommendations. The following TMN substructure is to be used beneath each such leaf representing a Recommendation. This substructure is derived from the rules defined in Recommendation X.722.

(0) informationModel
    (0) standardSpecificExtension
    (2) asn1Module
    (3) managedObjectClass
    (4) package
    (5) parameter
    (6) nameBinding
    (7) attribute
    (8) attributeGroup
    (9) action
    (10) notification
    (11) -- *the next two nodes are reserved for use with GRM*
    (12)
(1) protocolSupport
    (0) applicationContext
(2) managementApplicationsSupport
    (0) standardSpecificExtension
    (1) functionalUnitPackage
    (2) asn1Module
(127) dot -- *for parts of a Recommendation (see C.2)*

---

1) Annex C/X.208 provides the equivalent definitions.

2) The name “ccitt” was used in Recommendation X.208 (ASN.1) to construct the object identifier hierarchy. New Recommendations should use “itu-t” which is synonymous with “ccitt”.

It is recommended that value references be defined within an ASN.1 module for the leaves of the above TMN substructure as follows, e.g. for managedObjectClass:

<recommendation>ObjectClass OBJECT IDENTIFIER
:: = { itu-t(o) recommendation(0) <recommendation series letter>(number)
<recommendation>(number) informationModel(0)
managedObjectClass(3) }

Example:

m3100ObjectClass OBJECT IDENTIFIER
:: = { itu-t(o) recommendation(0) m(13) m3100(3100) informationModel(0)
managedObjectClass(3) }

For management information to be communicated or to be reusable in other templates, the template defining that information must be registered. Each such management information template to be registered is identified with an object identifier.

As an example, an object class in M.3100 called exampleObjectClass will have an object identifier assigned as follows:

exampleObjectClass MANAGED OBJECT CLASS
.
.
.
REGISTERED AS { m3100ObjectClass 5 };

The same approach should be followed for the other leaves of the TMN substructure.

Included in the Abbreviation clause of the Recommendation the value references and the sequences of values of the object identifier of that value reference, for example:

m3100ObjectClass { itu-t(o) recommendation(0) m(13) m3100(3100)
informationModel(0) objectClass(3) }

C.2 TMN object identifier structure extended for Recommendation "parts"

The structure in C.1 should also be used for Recommendations that use part numbers as shown below:

(0) itu-t
(0) recommendation
(1) a
(2) b
(3) c

.....
(7) g
(774) g774
(127) dot
(1) part1
.....
(13) m
(3100) m3100

.....
(14) n

.....

For example, the object identifier for Recommendation G.774.01 is:

{ itu-t(o) recommendation(0) g(7) g774(774) dot(127) part1(1) }

The substructure below this level is as defined in Recommendation X.722 and outlined in C.1 above.

An example:

g774dot1ObjectClass OBJECT IDENTIFIER ::=

{ itu-t(o) recommendation(0) g(7) g774(774) dot(127) part1(1) informationModel(0)
managedObjectClass(3) }

As an example, an object class in Recommendation G.774.01 called exampleObjectClass will have an object identifier assigned as follows:

exampleObjectClass MANAGED OBJECT CLASS

.
.
.

REGISTERED AS { g774dot1ObjectClass 5 };

References from other documents should be in the following format:

"Recommendation G.774.01: 1994"

C.3 TMN assignment procedures

The following assignment procedures are recommended:

1) An item of management information is only assigned one object identifier and is defined in only one document. If some item of management information is required in a Recommendation, and the item is already defined elsewhere, a reference to the existing template shall be used. The reference to a template shall identify the Recommendation and date published with the template-label, e.g. "Recommendation M.3100: 1992": example Object Class. Each Recommendation should also include the following statement:

   "When referencing the definitions for the templates in this Recommendation by other documents, the prefix, e.g. "Recommendation M.3100: 1992", should be used to identify the source for the definitions."

2) Each Study Group is responsible (registration authority) for the registration of object identifiers for its Recommendations within the arcs of the TMN substructure defined above.

3) Each Study Group should identify an individual, preferably the editor, who is responsible for the allocation of object identifiers for each TMN Recommendation. The identification of each such individual should be sent to the JCG on TMN which will maintain the list.

C.4 Object identifier allocation for a TMN application context

It should be noted that the following object identifier for a TMN application context is defined and registered in Recomemndation M.3100 and should be used by all TMN applications:

The object identifier value:

{ itu-t(o) recommendation(0) m(13) m3100(3100) protocolSupport(1)
applicationContext(0) tmnApplicationContextOne(1) }

is assigned to the application context that has the same capabilities as the systems application context in Recommendation X.701, but also supports the integer encoding for ProbableCause as defined in Recommendation M.3100.

Figure C.1 depicts the "upper" part of the TMN object identifier structure.

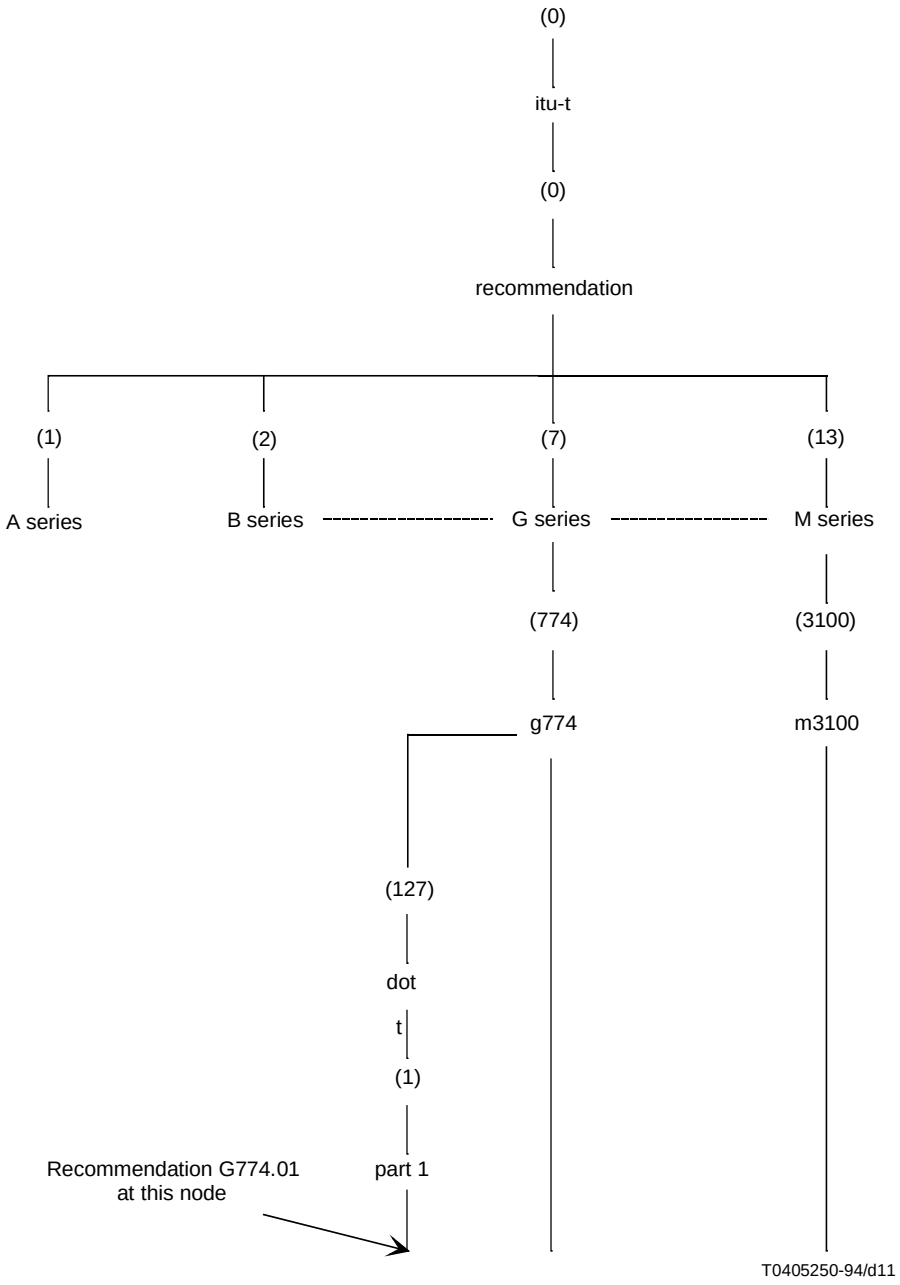


FIGURE C.1/M.3020

Graphical representation of the objet identifier tree

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References

The following 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: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] CCITT Recommendation X.711 (1991), *Common management information protocol specification for CCITT applications*.

[2] CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications*.

[3] CCITT Recommendation X.722 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definitions of managed objects.*

[4] ITU-T Recommendation X.220 (1993), *Use of X.200-Series protocols in CCITT applications*.

[5] ITU-T Recommendation X.724 (1993), *Information technology – Open Systems Interconnection – Structure of management information: Requirements and guidelines for implementation conformance statement proformas associated with OSI management*.