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MAINTENANCE : TELECOMMUNICATIONS MANAGEMENT NETWORK

TMN INTERFACE SPECIFICATION METHODOLOGY

Recommendation M.3020

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

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CCITT NOTE

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Recommendation M.3020

TMN INTERFACE SPECIFICATION METHODOLOGY

(1992)

Abstract

This Recommendation is one of a series of Recommendations on the Telecommunication Management Network (TMN). It provides a methodology for describing functional 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 functions;

– management services;

– management service components;

– messages;

– protocols;

– tasks;

– task information bases;

– user requirements.

1 Introduction

1.1 *Scope*

This Recommendation describes the TMN interface specification methodology. It's initial focus is on the preparation of TMN functional specifications where it attempts to tie together the other TMN Recommendations in the series. These specifications are based on user requirements in the form of TMN management services, TMN management services components, and TMN management functions. From them are derived management messages and associated managed objects.

1.2 *Related Recommendations*

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

– Recommendation M.3010 Principles for a Telecommunications Management Network;

– Recommendation M.3100 Generic Network Information Model;

– Recommendation M.3180 Catalogue of TMN Management Information;

– Recommendation M.3200 TMN Management Services;

– Recommendation M.3400 TMN Management Functions.

1.3 *Definitions*

The relationships among the following definitions are graphically depicted in Figure 1/M.3020.

1.3.1 **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 higher level organizational system requiring the capabilities of the TMN.

1.3.2 **TMN management service**

An area of management activity which provides for the support of operations, administration, and maintenance of the network being managed (e.g. management of transmission paths). It is always described from the user perception of the OAM requirements.

1.3.3 **TMN management service component**

The constituent parts of a TMN management service stating the requirements for actions to be performed on the managed network.

Examples

Change customer service details, perform traffic measurements, etc.

1.3.4 **TMN management function**

A TMN management function is the smallest part of the TMN management service as perceived by the user of the service. In reality it will generally consist of a sequence of actions on a defined managed object or objects.

1.3.5 **managed object**

The (OSI) management of a resource within the OSI environment that may be managed through the use of OSI management protocol(s).

1.3.6 **operation (System Management)**

An operation on a managed object to effect a (System Management) action.

1.3.7 **notification**

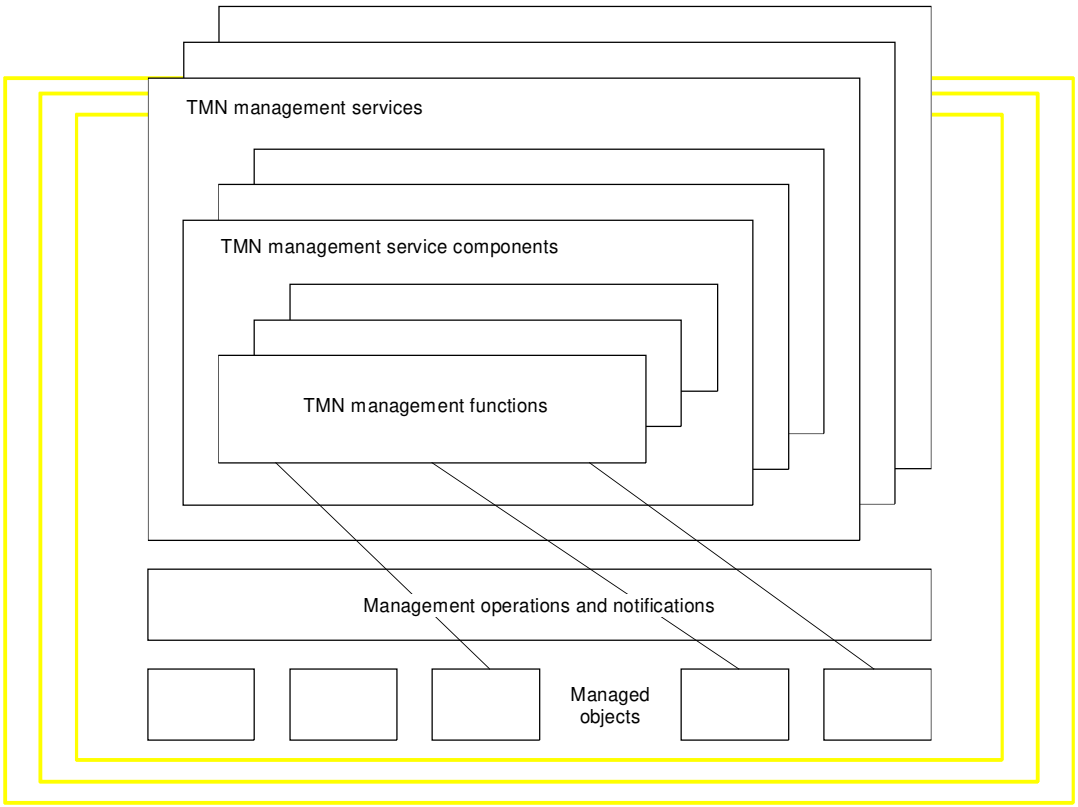
Information emitted by a managed object relating to an event that has occurred within the managed object.

1.3.8 **attribute (of a managed object)**

Information concerning a managed object used to describe (either in part or in whole) that managed object. This information consists of an attribute type and its corresponding attribute value (for “single-valued” attributes) or values (for “multi-valued” attributes).

1.3.9 **managed object class**

Instances of managed objects that share the same management operations, attributes and notifications are said to be in the same managed object class.



Example of TMN terminology

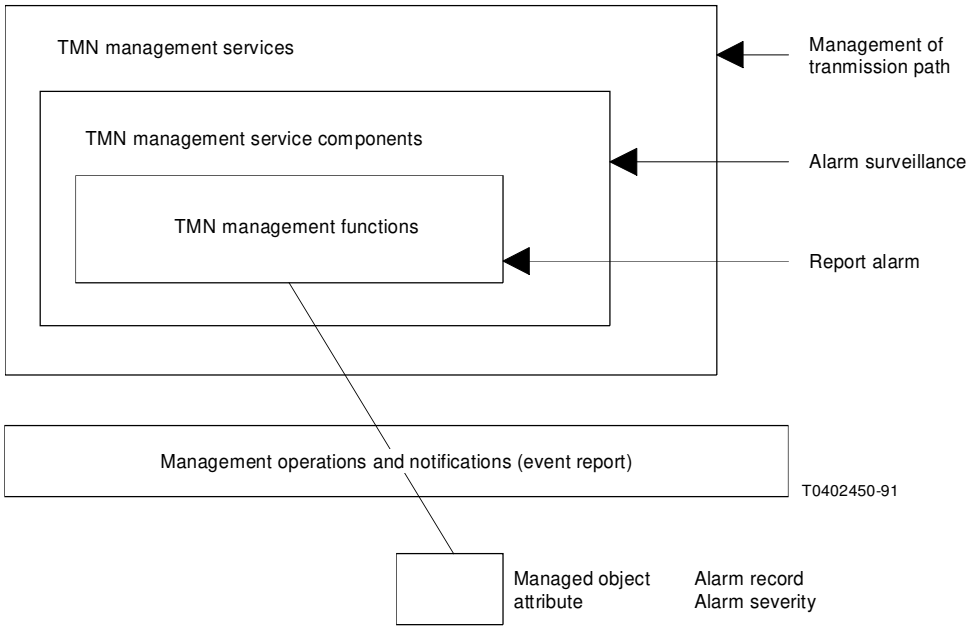


FIGURE 1/M.3020

TMN definition relationships

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 CCITT Study Group responsible for this methodology will specify the generic aspects of the TMN.

b) *application specifying user*

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

c) *protocol specifying user*

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

2.1.2 *Guide for the coordinating user*

Under study.

2.1.3 *Guide for the application specifying user*

2.1.3.1 *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. The methodology can be used upon sub-networks, parts of sub-networks, as well as the networks as a whole.

If the network as a whole is taken as the subject of the methodology, there is a defining of 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 network 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 feels that the network resource is modelled sufficiently.

After the execution of the methodology on the chosen network resource, an information model of it will result. 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 resource.

2.1.3.2 *Purpose of the information (object) models*

At first it may seem somewhat unclear what the purpose of these information (object) models is. In fact, these information models define very precisely the messages which can be used to manage remotely the chosen network resource (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 resource. 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] [ISO 9596]) is the most appropriate protocol to transport the messages. The corresponding CMIS services (Recommendation X.710 [2] [ISO 9595]) 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 network resource 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 network 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 network resource and which messages are available to the network resource to notify the managing system of events that occur. The managing system and the network resource are both Management Information Service users (see Recommendation M.3010); both using CMIS to communicate with each other. The managing system has the Manager role and the network resource has the Agent role.

Because of this, these information models are in effect the means for specifying the interface between the resource and the managing system. The 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 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 resource and how to effect it (control), but it is not specified how the managing system should analyse 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 resource, but not for specification of the internal operation of the managing system.

In principle the objects representing the network resource can be distributed over several systems. An object is conceptually as a whole, present in the 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 system 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.

2.1.3.3 *Tasks*

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

- Task 1: Describe the TMN management services;
- Task 2: Select and assign TMN management functions;
- Task 3: Object modelling;
- Task 4: Consolidation;
- 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 entities [Network Element (NE), Q-Adaptor (QA), Mediation Device (MD) and Operation System (OS)]. For each TMN entity, the type of entity (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.

2.1.4 *Guide for the protocol specifying user*

Under study.

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 OAM requirements.

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 2/M.3020.

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 from each task is reflected in its associated TIB.

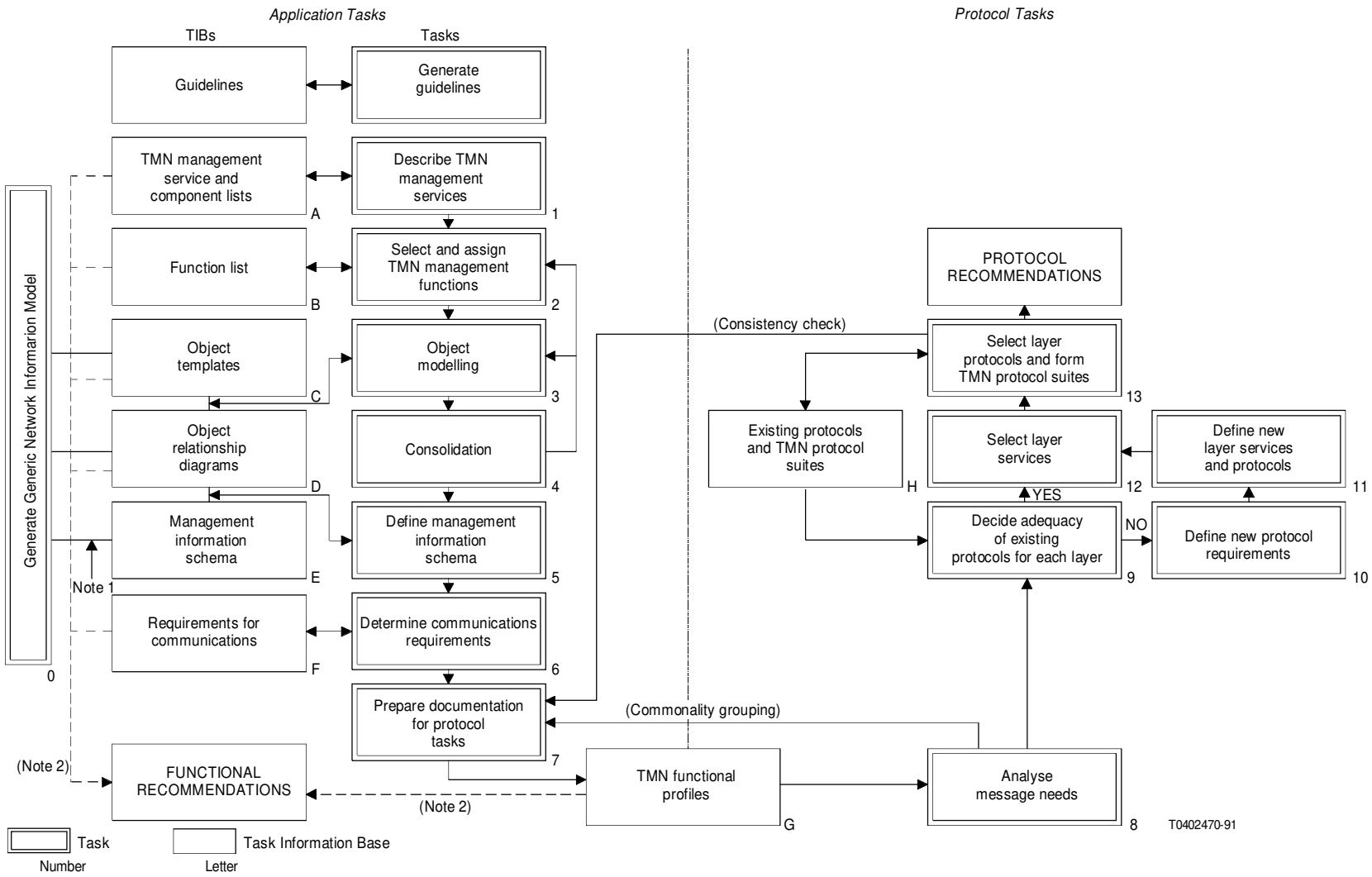
To ensure commonality between the outcome of each pass, it is important that each task within the methodology be based on the same task information base.

The tasks in this methodology are divided into Application Tasks (0 to 7) and Protocol Tasks (8 to 13) as shown in Figure 2/M.3020. 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, components 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 Task and TIBs in Figure 2/M.3020 are presented below.

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



Note 1 – The need for this link is for further study.

Note 2 – The dotted lines show possible inputs to new Recommendations related to Application Tasks.

FIGURE 2/M.3020

TMN interface specification methodology

3.3.1 *Task 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 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.

3.3.2.1 *Task 0 : Generate Generic Network Information Model*

Specify a Generic Network Information Model, including the object class hierarchy for that model. 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 network object classes that are needed for further specification as well as support objects that are to be used in the definition of interfaces.

Note that the task receives input from, and provides outputs to, TIBs C, D, and E.

As suggested in § 2 above, this task may be treated as a separate sub-process to be iterated independently of the tasks below.

3.3.2.2 *Task 1: Describe TMN management services as perceived by TMN users*

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 application service, identify the TMN management service components which are grouped under the service. Refine and augment TIB A as needed.

3.3.2.3 *TIB A: TMN management services and components list*

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

TMN management services and components are specified in Recommendation M.3200.

3.3.2.4 *Task 2: Select and assign TMN management functions*

Expand each TMN management component into TMN management functions. Define the TMN functional requirements taking into account the OSI management categories. Identify the OSI management services to be associated with each transaction-oriented function.

3.3.2.5 *TIB B: Function list*

A complete list of possible TMN general and management functions that can be used to perform Task 2 is provided. Recommendation M.3400 presents an initial list of possible TMN management functions.

3.3.2.6 *Task 3: Object modelling*

Using the Generic Network Information Model including the object class hierarchy, identify existing and new object classes needed to support each TMN management function.

The process is as follows:

1) using TIBs C and D, analyse the Generic Network Information Model, 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 model to incorporate the new object classes.

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

3.3.2.7 *TIB C: Object templates*

The object class hierarchy specifies the properties of the object classes that are needed for management. Extensive use of inheritance (super and sub-classes) is needed to benefit the most from the reuse of specifications. The object classes are specified using the templates from Recommendation X.722 [3] [ISO 10165-4], Structure of Management Information – Guidelines for the definition of managed objects. For those object classes that are already specified in other CCITT 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. The hierarchy only specifies the properties of object classes.

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

3.3.2.8 *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.

3.3.2.9 *Task 4: Consolidation*

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 by defined, or existing object classes may be extended, e.g. by specialization, thereby creating a sub-class.

Some object classes are defined only for the purpose of creating sub-classes. 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.

3.3.2.10 *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. Check the schema from the managed system point of view.

3.3.2.11 *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. It also 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.

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

Management information schemas are specified in Recommendation M.3100 and other information model Recommendations.

3.3.2.12 *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.

3.3.2.13 *TIB F: Requirements for communication*

Sets of communication requirements containing:

– nature of communications;

– frequency, service requirements for layer 7, delay, etc.

3.3.2.14 *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.

3.3.2.15 *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.

3.3.2.16 *Task 8: Analyse message needs*

Analyse 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.

3.3.2.17 *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.

3.3.2.18 *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.

3.3.2.19 *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.

3.3.2.20 *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.

3.3.2.21 *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.

3.3.2.22 *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].

References

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

[2] CCITT Recommendation X.710 *Common management information service definition for CCITT application.*

[3] CCITT Recommendation X.722 *Information Technology – Open systems interconnection – Structure of management information: guidelines for the definitions of managed objects.*

[4] CCITT Recommendation X.220 *Use of X.200 – Series protocols in CCITT applications.*