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INCLUDING TMN AND NETWORK MAINTENANCE

Telecommunications management network

Management interface specification methodology

Recommendation ITU-T M.3020



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Recommendation ITU-T M.3020

Management interface specification methodology

Summary

Recommendation ITU-T M.3020 describes the management interface specification methodology (MISM). It describes the process to derive interface specifications based on user requirements, analysis and design (RAD). Guidelines are given on RAD using unified modelling language (UML) notation; however, other interface specification techniques are not precluded. The guidelines for using UML are described at a high level in this ITU-T Recommendation.

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Recommendation ITU-T M.3020

Management interface specification methodology

1 Scope

This Recommendation describes the management interface specification methodology (MISM). It describes the process to derive machine-machine interface specifications based on user requirements, analysis and design (RAD). Guidelines are given on RAD using unified modelling language (UML) notation; however, other interface specification techniques are not precluded. The guidelines for using UML are described in this Recommendation. An interface specification addresses management service(s) defined in [ITU-T M.3200] and/or supporting the management processes defined in [ITU-T M.3050.x] series. Such a specification may support part of or one or more management services. The management services comprise of management functions. These functions may reference those defined in [ITU-T M.3400] or the processes defined in [ITU-T M.3050.x] series, specialized to suit a specific managed area, or new functions may be identified as appropriate.

The methodology is applicable to both the traditional manager/agent style of management interfaces [ITU-T M.3010] and the service oriented architecture (SOA) principles adopted for the management architecture of next generation networks [ITU-T M.3060].

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 M.3010] Recommendation ITU-T M.3010 (2000), *Principles for a telecommunications management network*.
- [ITU-T M.3050.0] Recommendation ITU-T M.3050.0 (2007), *Enhanced Telecom Operations Map (eTOM) – Introduction*.
- [ITU-T M.3050.x] ITU-T M.3050.x (2007) series of Recommendations, *Enhanced Telecom Operations Map (eTOM)*.
- [ITU-T M.3060] Recommendation ITU-T M.3060/Y.2401 (2006), *Principles for the Management of Next Generation Networks*.
- [ITU-T M.3200] Recommendation ITU-T M.3200 (1997), *TMN management services and telecommunications managed areas: overview*.
- [ITU-T M.3400] Recommendation ITU-T M.3400 (2000), *TMN management functions*.
- [ITU-T Q.812] Recommendation ITU-T Q.812 (2004), *Upper layer protocol profiles for the Q and X interfaces*.
- [ITU-T X.680] Recommendation ITU-T X.680 (2015) | ISO/IEC 8824-1:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation*.

- [ITU-T X.681] Recommendation ITU-T X.681 (2015) | ISO/IEC 8824-2:2015, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification*.
- [ITU-T X.501] Recommendation ITU-T X.501 (2016) | ISO/IEC 9594-2:2016, *Information technology – Open Systems Interconnection – The Directory: Models*.
- [ITU-T X.722] Recommendation ITU-T X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects*.
- [ITU-T Z.100] Recommendation ITU-T Z.100 (2016), *Specification and Description Language (SDL) – Overview of SDL-2010*.
- [OMG UML1] Object Management Group (2011), *Unified Modeling Language (OMG UML), Infrastructure, Version 2.4.1*.
- [OMG UML2] Object Management Group (2011), *Unified Modeling Language (OMG UML), Superstructure, Version 2.4.1*.

A list of non-normative references can be found in the Bibliography.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

- 3.1.1 **user** [ITU-T M.3010]
- 3.1.2 **management service** [ITU-T M.3010]
- 3.1.3 **management function set** [ITU-T M.3010]
- 3.1.4 **activity diagram** [OMG UML1]
- 3.1.5 **actor** [OMG UML1]
- 3.1.6 **association** [OMG UML1]
- 3.1.7 **class** [OMG UML1]
- 3.1.8 **class diagram** [OMG UML1]
- 3.1.9 **classifier** [OMG UML1]
- 3.1.10 **collaboration diagram** [OMG UML1]
- 3.1.11 **composition** [OMG UML1]
- 3.1.12 **modelElement** [OMG UML1]
- 3.1.13 **sequence diagram** [OMG UML1]
- 3.1.14 **state diagram** [OMG UML1]
- 3.1.15 **stereotype** [OMG UML1]
- 3.1.16 **use case** [OMG UML1]
- 3.1.17 **reference point** [ITU-T M.3060]
- 3.1.18 **distinguished name** [ITU-T X.501]

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 agent: Encapsulates a well-defined subset of management functionality. It interacts with managers using a management interface. From the manager's perspective, the agent behaviour is only visible via the management interface.

NOTE – Considered equivalent to IRPAgent [b-3GPP TS 32.150].

3.2.2 information object class: Describes the information that can be passed/used in management interfaces and is modelled using the stereotype "Class" in the UML meta-model. For a formal definition of information object class and its structure of specification, see Annex B.

3.2.3 information service: Describes the information related to the entities (either network resources or support objects) to be managed and the way that the information may be managed for a certain functional area. Information services are defined for all IRPs.

NOTE – Considered identical to the definition of information service found in [b-3GPP TS 32.150].

3.2.4 information type: Specification of the type of input parameters of operations.

3.2.5 integration reference point: An architectural concept that is described by a set of specifications for the definition of a certain aspect of the management interface, comprising a requirements specification, an information service specification, and one or more solution set specifications.

NOTE – Considered identical to the definition of IRP found in [b-3GPP TS 32.150].

3.2.6 lower camel case: It is the practice of writing compound words in which the words are joined without spaces. Initial letter of all except the first word shall be capitalized. Examples: 'managedNodeIdentity' and 'minorDetails' are the lower camel case (LCC) for "managed node identity" and "minor details" respectively.

3.2.7 management goals: High-level objectives of a user in performing management activities.

3.2.8 management interface: The realization of management capabilities between a manager and an agent, allowing a single manager to use multiple agents and a single agent to support multiple managers.

NOTE – Q, C2B/B2B and Itf-N (3GPP) are examples of management interfaces.

3.2.9 management role: Defines the activities that are expected of the operational staff or systems that perform telecommunications management. Management roles are defined independent of other components, i.e., telecommunications resources and management functions.

3.2.10 management scenario: A management scenario is an example of management interactions from a management service.

3.2.11 manager: Models a user of agent(s) and it interacts directly with the agent(s) using management interfaces.

Since the manager represents an agent user, it gives a clear picture of what the agent is supposed to do. From the agent perspective, the manager behaviour is only visible via the management interface.

NOTE – Considered equivalent to IRPManager [b-3GPP TS 32.150].

3.2.12 matching information: Specification of the type of a parameter (possibly reference to IOC or attribute of IOC).

3.2.13 naming attribute: It is a class attribute that holds the class instance identifier.

NOTE – See examples of naming attribute in [b-3GPP TS 32.300].

3.2.14 protocol-neutral specification: Defines the management interfaces in support of management capabilities without concern for the protocol and information representation implied or required by, e.g., CORBA and XML.

3.2.15 protocol-specific specification: Defines the management interfaces in support of management capabilities for one specific choice of management technology (e.g., CORBA).

NOTE – Considered equivalent to solution set [b-3GPP TS 32.150].

3.2.16 telecommunications resources: Telecommunications resources are physical or logical entities requiring management, using management services.

3.2.17 upper camel case: It is the lower camel case except that the first letter is capitalized. Examples: 'ManagedNodeIdentity' and 'MinorDetails' are the upper camel case (UCC) for "managed node identity" and "minor details" respectively.

3.2.18 well known abbreviation: An abbreviation can be used as the modelled element name or as a component of a modelled element name. The abbreviation, when used in such manner, must be documented in the same document where the modelled element is defined.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ADM	Administrative (usage: requirements category)
ASN.1	Abstract Syntax Notation One
CM	Conditional-Mandatory
CO	Conditional-Optional
CON	Conceptual (usage: requirements category)
CORBA	Common Object Request Broker Architecture
DN	Distinguished Name
FUN	Functional (usage: requirements category)
GDMO	Guidelines for the Definition of Managed Objects
IDL	Interface Definition Language
IOC	Information Object Class
IRP	Integration Reference Point
IS	Information Service
LCC	Lower Camel Case
MCC	Mobile Country Code
MISM	Management Interface Specification Methodology
MNC	Mobile Network Code
NE	Network Element
NON	Non-functional (usage: requirements category)
OO	Object Oriented
OSI	Open Systems Interconnection
RDN	Relative Distinguished Name
SDL	Specification and Description Language

SOA	Service Oriented Architecture
SS	Solution Set
SNC	Sub Network Connection
TP	Termination Point
TS	Technical Specification
UCC	Upper Camel Case
UML	Unified Modelling Language
WKA	Well Known Abbreviation
XML	Extensible Markup Language

5 Conventions

Clause A.1 contains conventions applicable to the requirements phase.

Clause B.1 contains conventions applicable to the analysis phase.

6 Requirements for methodology and notational support

In developing the methodology and choosing a notation, the following requirements apply:

- 1) The methodology, including the choice of notation, shall support the capture of all the relevant requirements of the problem space, namely telecommunications management.
- 2) The methodology facilitates the production of requirements, its corresponding Analysis|Information Services and their corresponding Design Specifications|Solution Sets.
- 3) The notation shall facilitate unambiguous generation of the specification in the target management protocol profile. The methodology does not address possible choices of protocol services (e.g., CORBA Security Service).
NOTE – Management protocols applicable for ITU-T use are specified in [ITU-T Q.812].
- 4) The methodology shall allow specification of mandatory and optional items in all three phases. It also specifies the relation of mandatory|optional items between the three phases.
- 5) It should be possible to generate, from the protocol-neutral specification (Analysis|IS), interoperable language specific definitions, i.e., Design|SS (for example UML to interface definition language (IDL), UML to GDMO/ASN.1).

7 Methodology

7.1 General considerations

The purpose of this methodology is to provide a description of the processes leading towards the definition of machine-machine management interfaces.

7.2 Application and structure of the methodology

The management interface specification methodology (MISM) specifies a three-phase process with features that allow traceability across the three phases. The three phases apply industry-accepted techniques using object oriented analysis and design principles. The three phases are requirements, analysis and design. The techniques should allow the use or development of commercially available support tools. Different techniques may be used for the phases depending on the nature of the problem.

7.3 Detailed methodology

7.3.1 General

The requirements and analysis phases produce UML specifications. The design phase uses network management paradigm specific notation. The outputs of the 3 phases are:

- Requirements phase – Requirements.
- Analysis phase – Implementation independent specification.
- Design phase – Technology specific specification.

Initially, the design phase will be developed using a manual or customized approach. When interoperable protocol specific definition can be generated by tools, then UML notation can be applied to the design phase.

The clauses below describe the three phases.

7.3.2 Requirements

The requirements for the problem being solved fall into two classes. The first class of requirements is referenced here as business requirements. A subject matter expert on the topic shall be able to determine that the requirements adequately represent the needs of the management problem being solved. The second class is referred to as specification requirements. These requirements shall provide sufficient details so that the interface definition in the analysis and design phases can be developed. As final interface definitions must be traceable to the requirements, it may be necessary to have interaction between the three phases. Any ambiguity in the requirements will have to be resolved by this interaction to assure that an implementable specification can be developed.

Human-computer interface data may be specified in the second class of requirements. These requirements may have great impact on concepts and data designed in the subsequent phases. For more details, see Appendix I.

Different techniques may be used to specify the two classes of requirement. Irrespective of the technique, the readability of the requirements is critical. The requirements themselves are not required to be in a machine-readable notation as long as readability and traceability are possible. Enumerating requirements is the recommended solution to delineate the different requirements for traceability.

The requirements phase includes identifying aspects such as security policy, scope of the problem domain in terms of the applications, resources, and roles assumed by the resources. The requirements specify roles, responsibilities, and the relationships between the constituent entities for the problem space. Different techniques, including textual representation, may be used to specify the business level requirements. In order to facilitate traceability of these requirements to the design and implementation phases, enumerating requirements is recommended.

The problem must be bounded with a specific scope. One way to determine the scope is by using the management services identified in [ITU-T M.3200] and function sets identified in [ITU-T M.3400]. Requirements are specified using the resources being managed and management functions. An alternative to the management services approach is described in [ITU-T M.3050.x] "enhanced Telecom Operations Map (eTOM)" which provides a business process based approach.

The relationship between the [ITU-T M.3200] and [ITU-T M.3050.x] approaches is described in [ITU-T M.3050.0].

Management functions must be grouped and supported within applications that address specific business needs, so the linkage between the eTOM processes, the [ITU-T M.3200] management services, the [ITU-T M.3400] management function sets and management functions is important to assist in making this grouping clear and effective. Augmenting [ITU-T M.3400] may be required in order to meet the business requirements of the problem.

UML use cases and scenarios should be used to interact with subject matter experts in capturing the business level requirements. The requirements should also identify the failure conditions visible to the business process.

NOTE – It is not required that every requirement be expressed as a use case.

The requirements produced must be complete and detailed. The recursive nature of the methodology is used to achieve this completeness. The completeness of the requirements (clear and well-documented) drives the analysis and design phases.

Guidelines and template for requirement structure and identification are described in clause A.1.2.

Use cases are goals that are fulfilled through a sequence of steps. Each step can be considered as a sub-goal of the use case. As such each step represents either another use case (subordinate use case) or an autonomous action that is at the lowest level of the case decomposition.

Guidelines and template for use cases are described in clause A.1.2.

7.3.3 Analysis

In the analysis phase, the requirements are used to identify the interacting entities, their properties and the relationships among them. This allows the interfaces offered by the entities to be defined. In the UML notation, these entities become classes. The class descriptions along with the interfaces exposed should be traceable to the requirements. The relationship among the classes, defined in the analysis specification, and the classes in the design specification is not necessarily one to one.

This phase should take into account the needs of human-computer interface data (i.e., the information model must contain sufficient information so that designs can be developed based on the analysis results).

This Recommendation gives high-level guidance on the use of UML notation to support management interface specification; however, Specification and Description Language (SDL) [ITU-T Z.100] might be used to augment the UML definitions.

The analysis phase should be independent of design constraints. For example, the analysis may be documented using object oriented (OO) principles even though the design may use a non-object-oriented technology. The information specified in the analysis phase includes class descriptions, data definitions, class relationships, interaction diagrams (sequence diagrams and/or collaboration diagrams), state transition diagrams and activity diagrams. The class definitions include specification of operations, notifications, attributes and behaviour captured as notes or textual description.

Protocol-neutral common management services (if available) – or other existing services – should be reused during the analysis phase in order to support management interface harmonization.

Guidelines and template for use cases are described in Annex A.

The analysis template uses information type as one characteristic to describe information object class (IOC) attributes and operation/notification parameters. The valid information type(s) that can be used and their semantics are defined in Annex E.

7.3.4 Design

7.3.4.1 General

In the design phase, an implementable interoperable interface specification is produced. This will involve the selection of a target specification language. The design phase specifications are dependent on the specific management paradigm (e.g., IDL for CORBA interfaces).

This phase distinguishes three kinds of specifications of data: management paradigm (e.g., extensible markup language (XML)) dependent design of data to be communicated across multiple interfaces (e.g., fault and performance), messages (e.g., alarm report) to be communicated over each



individual interface, and encoding method of the data (e.g., compressed XML) consistent with a particular paradigm.

The selection of a specific management paradigm is addressed in other ITU-T Recommendations. An overview is provided in the following clauses.

In the design phase, it is recommended that the UML descriptions from the requirements and analysis phases be referenced to augment behavioural specification. For example, the behaviour definition of guidelines for the definition of managed objects (GDMO) can reference state charts, sequence diagrams and class definition in the analysis phase. If required, additional UML diagrams describing interactions between entities, corresponding to specific protocol paradigms, may be included.

As additional paradigms are adopted for use by management, the notations/languages defined by these paradigms will be used.

7.3.4.2 CORBA

In the context of common object request broker architecture (CORBA) based management, the information model is defined using IDL.

7.3.4.3 GDMO

In the context of the paradigm based on open systems interconnection (OSI) systems management [ITU-T X.722], the design specification is the information model specification using GDMO templates for managed object classes, attributes, behaviour, notifications, actions, naming instances of the class, and error/exception specifications. The syntax of the information is specified using Abstract Syntax Notation One (ASN.1) notation [ITU-T X.680].

In GDMO, 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 [ITU-T X.722]. The templates defining the information model should be registered (according to the rules of [ITU-T X.722]) with a value for the ASN.1 object identifier. For those object classes that are already specified in other ITU-T Recommendations and ISO standards, 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.

7.3.4.4 XML

For further study.

8 Management interface specifications

A management interface specification includes the requirements, analysis and design specifications discussed in clause 7. A structure for specifying these specifications is provided in Annexes A, B and C.

These techniques and supporting notations are also applicable when designing a system to the management interface specifications, even though system design is not considered as part of the ITU-T management Recommendations. They assist in describing how the interface specifications are applied in managing the resources within a system such as a network element (NE).

9 Traceability in MISIM process

In order to achieve traceability between requirements, analysis and design, it is necessary that appropriate identification be assigned. Traceability is supported through references between entities specified within each phase and between phases. Traceability is from design|solution set to analysis|information services and from analysis|information services to requirements. Traceability is

further applicable between artifacts of the requirements specification and between artifacts of the analysis|information service, e.g., between use cases and textual requirements. Requirements should be identified as described in clause 7.3.2. The analysis phase output specifies for the various use cases further detailed information requirements. The design phase should point to the various diagrams and text in the analysis phase output. The pointer may be in terms of a reference to the appropriate clauses.

Traceability from the design phase to subject matter level requirements is usually indirect. This is required because the output of the phases is defined to different level of details.

Guidelines for traceability between the requirements phase and the analysis phase are described in Annex B.

The following mechanism for traceability with requirements, etc., specified in other documents (possibly not following the advocated identification schema) is recommended:

forum/body "::<" document ID "::<" id

where "id" could be one of:

- 1) requirement ID;
- 2) use case ID;
- 3) requirement title/text;
- 4) use case title;
- 5) subclause of the document which uniquely identifies a requirement or use case.

Examples:

3GPP::32.111-1::getAlarmList

ITU-T::M.3016::1.5.1.2

10 Documentation structure

Even though there are three phases, the documentation of the interface may combine their outputs into one or more documents. It is recommended that the requirements and analysis be combined and separate design documents are developed for each specific network management protocol paradigm.

Annex A

Requirements

(This annex forms an integral part of this Recommendation.)

A.1 Conventions

A.1.1 Use of UML notation for requirements

A.1.2 Use case template

A.1.3 Requirements categories

A.2 Requirements template

1 Concepts and background

2 Business level requirements

2.1 Requirements

2.2 Actor roles

2.3 Telecommunication resources

2.4 High-level use cases

3 Specification level requirements

3.1 Requirements

3.2 Actor roles

3.3 Telecommunication resources

3.4 Use cases

A.3 Simplified requirements template

1 Concepts and background

2 Requirements

The following are guidelines for specification of requirements.

The normal (or full format) requirements template is found in clause A.2. In addition, a simplified requirements template is defined and found in clause A.3.

A.1 Conventions

A.1.1 Use of UML notation for requirements

Table A.1 identifies the correspondence between management concepts and UML notation. This Recommendation specifies the high-level concepts and notations to be used in the different phases. Stereotypes are used to extend UML notation. The approved stereotypes for use within the management environment are included in this Recommendation (see Annex C).

Table A.1 – Requirements concepts

Management concept	UML notation	Comment
user	Actor	A user is modelled as an actor.
management role	Actor	An actor plays a role. It is normally advisable to only model a single role for each actor.
management function	use case	A management function is modelled by one or more use cases.
management function set	use case	A management function set is a composite use case with each management function (potentially) modelled as a separate use case.
management service	use case	A management service is modelled as a high-level use case.
management scenario	sequence diagram	Sequence diagrams are preferred over collaboration diagrams.
telecommunication resource type	Class	The class diagrams depict the property details of the telecommunications resource type, at the level of detail appropriate to the phase of the methodology.
management goals	–	Management goals are captured as textual descriptions as there is no applicable UML notation.

A.1.2 Use case template

When use cases are provided, the conventions and templates in Table A.2 should be followed.

Table A.2 – Use case template

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal ^(*)	This is the objective/end result the use case strives to achieve and should be a concise statement of what the use case should achieve in a successful scenario. There may be a statement about priority relative to other use cases and required performance of the use case, e.g.: • Real Time. • Near real time. • Not real time.	
Actors and roles ^(*)	The names of actors/roles involved in the use case including role characteristic for each actor.	
Telecom resources	The names of the telecommunication resources involved in the use case.	
Assumptions	A description of the environment providing a context for the use case. Assumptions are mutually exclusive to pre-conditions. Assumptions are concerned with static properties.	
Pre-conditions	A list of all system and environment conditions that must be true before the use case can be triggered. Pre-conditions are mutually exclusive to assumptions. Pre-conditions are related to dynamic properties and can result in an exception. This is never the case with assumptions.	

Table A.2 – Use case template

Use case stage	Evolution/Specification	<<Uses>> Related use
Begins when	The name of the single event that triggers the start of the use case. Optional and normally not used to specify triggers such as "when the manager must retrieve information".	
Step 1 ^(*) (M O)	A use case describes a list of steps (manual and automated) that are necessary to accomplish the goal of the use case. Steps may invoke other use cases. Steps are numbered for traceability. Each step is identified as being mandatory (M) or optional (O). Sub-steps are identified relative to the containing step, e.g.: Step n Step n.1 Step n.2 where n.1 and n.2 are sub-steps of step n.	Reference to a used use case.
Step n (M O)	Steps added as necessary and in a logical sequence.	
Ends when ^(*)	The list of event(s) that indicates the use case completion. NOTE – In this context, "event" should be considered in the most general sense and not limited to, e.g., notifications exchanged across a management interface. As an example, the completion of processing can be considered an event that indicates completion of a use case.	
Exceptions	A summary list of exception conditions and faults detected by the use case during its operation.	
Post-conditions	A list of all system and environmental conditions that must be true when the use case has completed. The statement of post-conditions determines if the use case is expected to be fully successful, partially successful or even to have failed in order to be completed.	
Traceability ^(*)	Requirements or use case exposed by the use case.	
NOTE – Fields marked with "*" are mandatory for all use case specifications. Other fields are only mandatory when relevant for the specific use case.		

A.1.3 Requirements categories

It is useful to classify requirements in different categories. The following categories are considered relevant for MISM:

- Conceptual (CON) – Identifies a concept, data type, relationship, format, or structure.
- Functional (FUN) – Identifies a functional capability, dynamic situation, a sequence, timing parameters, or an interaction.
- Non-functional (NON) – Non-functional requirements, including abnormal conditions, error conditions and bounds of performance.
- Administrative (ADM) – System administration and operational requirements not related to the use cases normal operations.

Requirements should be written based on the following template:

REQ-Label-Category-Number {Category, number} Details {Source Citation}

where "Label" is an abbreviation for the Recommendation (or part thereof). The set of labels is not finite and not subject for standardization.

Guidelines on requirements numbering can be found in Appendix III.

A.2 Requirements template

1 Concepts and background

Define major goals and objectives and the applicable management interfaces (and reference points) for this specification. Use [ITU-T M.3200] categorization as a source for identifying the management service(s) supported by this interface.

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

1.a SubClauseTitle

SubClauseTitle is the name of the subclause.

"a" represents a number, starting at 1 and increasing by 1 with each new subclause.

The use of subclauses is optional.

2 Business level requirements

2.1 Requirements

2.1.a SubSetTitle

SubSetTitle is the name of a sub-set of the business level requirements.

"a" represents a number, starting at 1 and increasing by 1 with each new sub-set.

The use of sub-sets is optional and all business level requirements can be stated in subclause 2.1 (requirements).

List major requirements in text, and identify use cases with actor/role and resources. The high-level use cases (subclause 2.4 below) should bring out the business level requirements and are distinguished from the specification requirements by not refining to lower levels. Clause 2.4 contains many examples of what makes up the high-level use cases. Policy-related information (e.g., security, persistence) are candidates for inclusion at this level. Numbering the requirements is required for traceability.

Requirements should be specified as described in clause A.1.3. Within a requirements specification, it is suggested that requirements be written in the sequence of clause A.1.3 (either for the entire specification or for each sub-set).

Use of requirements categories is optional, and – when used – a subset of the categories can be applied.

As an example, conceptual requirement number 23 in Recommendation tagged 'SM' would be specified as follows:

Identifier	Definition
REQ-SM-CON-23	A Service Order consists of a name, address, phone number, service description and an optional FAX number for contacts {T1M1.5 Document 246 11/96}

One or more tables can be used with supportive text between tables as necessary.

2.2 Actor roles

A textual description of the actor (see clause 3) is included here.

2.3 Telecommunication resources

Textual description of the relevant resources (see clause 3) required to support the use cases are presented here.

2.4 High-level use cases

A high-level use case diagram may be presented. In order to understand the use case by subject matter experts, they should be augmented with a textual description for each use case. The description should serve two purposes: to capture the domain experts' knowledge and to validate the models in analysis and design phases with respect to the requirements. An example of a high-level use case diagram is given in Appendix I.

2.4.a UseCaseName

UseCaseName is the name of the use-case.

"a" represents a number, starting at 1 and increasing by 1 with each new definition of a use case.

This subclause is repeated for each high-level use case defined for the interface specification requirements.

The high-level use cases may identify the various function sets defined in [ITU-T M.3400] or the management processes defined in [ITU-T M.3050.x]. These use cases may be further refined as described in the specification level requirement subclause below by using stereotypes such as "include" and "extend".

If appropriate, sequence diagrams may be used. However, at the high-level requirements these diagrams are not expected to be used. When the use cases at this level are further decomposed in the next level of requirements, these diagrams may be more suitable.

The traceability of the next level of requirements from this level may be identified by how each function set is further refined with new use cases.

A set of use case tables, using the template defined in Table A.2, may be used to represent the significant capabilities studied at a level of abstraction appropriate to the problem being analysed.

The level of detail, and extent of coverage provided in the use cases is dependent upon the authoring team's familiarity with the subject matter and is therefore subjective. The lower levels of details are most likely an indication of analysis rather than requirements capture.

It is permitted to develop successively more detailed analysis of each step of a higher abstraction level use case by referring to the more detailed use case in the table cell reserved for this purpose. It is emphasized this does not have to be done, and is subjective depending upon the need of the author/group.

The following list is provided to aid the initial identification of suitable use cases:

- What is the main purpose of the system?
- What types of people/system need to interact with the system?
- How can these people/systems be grouped or abstracted to roles?
- What are the start up, normal running, failure and recovery aspects of the system?
- What types of reports or data may be needed from the system?
- Which special activities are required (e.g., based on times of day and network loads)?

It is useful to document use cases in a common manner. The following structure is suggested:

- <use case table> (see Table A.2)
- <optional sequence diagram(s)>
- <optional state chart(s)>

3 Specification level requirements

3.1 Requirements

The business level requirements are further refined here using management functions from [ITU-T M.3400]. Since [ITU-T M.3400] is not exhaustive enough to address all management services for all managed areas, it is expected that new functions will be required. The new functions should be included in the requirements as described below.

3.1.a SubSetTitle

SubSetTitle represents the name of a subset of specification level requirements.

"a" represents a number, starting at 1 and increasing by 1 with each new sub-set.

The use of sub-sets is optional and all specification level requirements can be stated in subclause 3.1 (requirements).

List major detailed and concrete requirements in text, and identify use cases with actor/role and resources. The use cases in subclause 3.4 should bring out specification level requirements with lower level details and be more implementation-oriented compared to the business level use case requirements. Numbering the requirements is required for traceability.

Requirements should be specified as described in clause A.1.3. Within a requirements specification, it is suggested that requirements be written in the sequence of clause A.1.3 (either for the entire specification or for each sub-set).

Use of requirements categories is optional, and – when used – a subset of the categories can be applied. As an example, functional requirement number 33 in a Recommendation tagged 'OM' would be specified as follows:

Identifier	Definition
REQ-OM-FUN-33	A pending operation can be cancelled by the initiator.

One or more tables can be used with supportive text between tables as necessary.

Specification level requirements should follow the conventions and templates defined in clause A.1.

3.2 Actor roles

A list of all actors and textual description of actors not already defined in the business level requirements is included here.

3.3 Telecommunication resources

A list of all passive resources and textual description of resources not already defined in the business level requirements is presented here.

3.4 Use cases

The high-level use cases are further refined here using several specification level use cases, each of which will be further explained in detail in a subclause as described below.

3.4.a UseCaseName

UseCaseName is the name of the use-case.

"a" represents a number, starting at 1 and increasing by 1 with each new definition of a use case.

If appropriate, sequence and state chart diagrams may be used.

NOTE – Guidelines and criteria for use of sequence diagrams and state chart diagrams are for further study.

Use case specifications should follow the conventions and templates defined in clause A.1.

A.3 Simplified requirements template

The simplified requirements template is an alternative template for use in cases when only the textual requirements are required. A separate template is defined to avoid ambiguity that would result by adding options in the full-form template described in clause A.2.

1 Concepts and background

Define major goals and objectives and the applicable management interfaces (and reference points) for this specification. Use [ITU-T M.3200] categorization as a source for identifying the management service(s) supported by this interface.

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

1.a SubClauseTitle

SubClauseTitle is the name of the subclause.

"a" represents a number, starting at 1 and increasing by 1 with each new subclause.

The use of subclauses is optional.

2 Requirements

2.a SubSetTitle

SubSetTitle is the name of a sub-set of the business level requirements.

"a" represents a number, starting at 1 and increasing by 1 with each new sub-set.

The use of sub-sets is optional and all business level requirements can be stated in clause 2 (requirements).

List major requirements in text, and identify use cases with actor/role and resources. The use cases should bring out high-level requirements and are distinguished from the specification requirements by not refining to lower levels. Policy-related information (e.g., security, persistence) are candidates for inclusion at this level. Numbering the requirements is required for traceability.

Requirements should be specified as described in clause A.1.3. Within a requirements specification, it is suggested that requirements are written in the sequence of clause A.1.3 (either for the entire specification or for each sub-set).

Use of requirements categories is optional, and – when used – a subset of the categories can be applied.

As an example, conceptual requirement number 23 in a Recommendation tagged 'SM' would be specified as follows:

Identifier	Definition
REQ-SM-CON-23	A Service Order consists of a name, address, phone number, service description and an optional FAX number for contacts {T1M1.5 Document 246 11/96}

One or more tables can be used with supportive text between tables as necessary.

Annex B

Analysis

(This annex forms an integral part of this Recommendation.)

B.1 Conventions

B.1.1 Mandatory, optional and conditional qualifiers

B.2 Analysis template

1 Concepts and background

1.a SubClauseTitle

2 Model

2.1 Imported and associated information entities

2.1.1 Imported information entities and local labels

2.1.2 Associated information entities and local labels

2.2 Class diagram

2.2.1 Relationships

2.2.2 Inheritance

2.3 Class definitions

2.3.a InformationObjectClassName

2.3.a.1 Definition

2.3.a.2 Attributes

2.3.a.3 Attribute constraints

2.3.a.4 Notifications

2.3.a.5 State diagram

2.4 Attribute definitions

2.4.1 Attribute properties

2.4.2 Constraints

2.5 Common notifications

2.5.1 Alarm notifications

2.5.2 Configuration notifications

2.6 System state model

3 Interface definition

3.1 Class diagram representing interfaces

3.2 Generic rules

3.b Interface InterfaceName (supportQualifier)

3.b.a Operation OperationName (supportQualifier)

3.b.a.1 Definition

3.b.a.2 Input parameters

3.b.a.3 Output parameters

3.b.a.4 Pre-condition

- 3.b.a.5 *Post-condition*
- 3.b.a.6 *Exceptions*
 - 3.b.a.6.c *exceptionName*
- 3.b.a.7 *Constraints*
- 3.b.b *Notification NotificationName (supportQualifier)*
 - 3.b.b.1 *Definition*
 - 3.b.b.2 *Input parameters*
 - 3.b.b.3 *Triggering event*
 - 3.b.b.3.1 *From state*
 - 3.b.b.3.2 *To state*
 - 3.b.b.4 *Constraints*
- 3.c *Scenario*
- B.3 *IOC properties, inheritance and import*
 - B.3.1 *Property*
 - B.3.2 *Inheritance*
 - B.3.3 *Import*

The following are guidelines for specification of the results of the analysis phase.

The analysis template is based on the 3rd Generation Partnership Project (3GPP) information service [b-3GPP TS 32.157] and augmented to meet additional requirements on the methodology (e.g., traceability).

For a management interface specification, both subclauses 2.2 and 2.3 of "Analysis" template indicated in clause B.2 shall be used. For an information model (e.g., a network resource model), only subclause 2.2 shall be used.

The analysis template uses Information Type as one characteristic to describe IOC attributes and operation/notification parameters. The valid Information Type(s) that can be used and their semantics are defined in Annex E.

An example of the use of this template can be found in Appendix II.

The constructs "Analysis|Information Service" and "Design|Solution" sets are used to denote the equivalent, but differently named, specifications developed by ITU-T and 3GPP.

B.1 Conventions

B.1.1 Mandatory, optional and conditional qualifiers

This clause defines a number of terms used to qualify the relationship between the Analysis|Information service, the Design|Solution sets and their impact on the interface implementations. The qualifiers defined in this clause are used to qualify agent behaviour only. This is considered sufficient for the specification of the management interfaces.

Analysis specification|IS specifications define IOC attributes, interfaces, operations, notifications, operation parameters and notification parameters. They can have the following support/read/write qualifiers: M, O, CM, CO, C.

Definition of qualifier M (Mandatory):

- Used for items that shall be supported.

Definition of qualifier O (Optional):

- Used for items which may or may not be supported.