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The present document is part 5 of a multi-part TS covering the 3rd Generation Partnership Project: Technical Specification Group Services and System Aspects; Telecommunication Management; Configuration Management, as identified below:

Part 1:	"3G Configuration Management: Concept and Requirements";
Part 2:	"Notification Integration Reference Point: Information Service Version 1";
Part 3:	"Notification Integration Reference Point: CORBA Solution Set Version 1:1";
Part 4:	"Notification Integration Reference Point: CMIP Solution Set Version 1:1";
Part 5:	**"Basic Configuration Management IRP: Information Model version 1";**
Part 6:	"Basic Configuration Management IRP CORBA Solution Set Version 1:1";
Part 7:	"Basic Configuration Management IRP CMIP Solution Set Version 1:1";
Part 8:	"Name Convention for Managed Objects".

Still missing for Release 99:

Part 6:	"Basic Configuration Management IRP CORBA Solution Set Version 1:1";
Part 7:	"Basic Configuration Management IRP CMIP Solution Set Version 1:1";

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Contents

Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The present document is part 5 of a multi-part TS covering the 3rd Generation Partnership Project: Technical Specification Group Services and System Aspects; Telecommunication Management; Configuration Management, as identified below:

Part 1: "3G Configuration Management: Concept and Requirements";

Part 2: "Notification Integration Reference Point: Information Service Version 1";

Part 3: "Notification Integration Reference Point: CORBA Solution Set Version 1:1";

Part 4: "Notification Integration Reference Point: CMIP Solution Set Version 1:1";

Part 5: "Basic Configuration Management IRP: Information Model version 1";

Part 6: "Basic Configuration Management IRP CORBA Solution Set Version 1:1";

Part 7: "Basic Configuration Management IRP CMIP Solution Set Version 1:1";

Part 8: "Name Convention for Managed Objects".

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Version x.y.z

where:

x the first digit:

1 presented to TSG for information;

2 presented to TSG for approval;

3 or greater indicates TSG approved document under change control.

y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

Configuration Management (CM), in general, provides the operator with the ability to assure correct and effective operation of the 3G network as it evolves. CM actions have the objective to control and monitor the actual configuration on the Network Element (NEs) and Network Resources (NRs), and they may be initiated by the operator or functions in the Operations Systems (OSs) or NEs.

CM actions may be requested as part of an implementation programme (e.g. additions and deletions), as part of an optimisation programme (e.g. modifications), and to maintain the overall Quality of Service. The CM actions are initiated either as a single action on a NE of the 3G network or as part of a complex procedure involving actions on many NEs.

The interface Itf-N, defined in 3G TS 32.102 [2], for CM is built up by a number of Integration Reference Points (IRPs) and a related Name Convention, which realise the functional capabilities over this interface. The basic structure of the IRPs is defined in 3G TS 32.101 [1] and 3G TS 32.1012 [2]. For CM, a number of IRPs (and the Name Convention) are

defined herein, used by this as well as other Technical Specifications for Telecom Management produced by 3GPP. All these are included in Parts 2 and onwards in the 3G TS 32.106.

The present document constitutes Part 5 of 32.106 (3G TS 32.106-5) - “Basic Configuration Management IRP: Information Model version 1”.

1 Scope

The present document (Basic Configuration Management (CM) IRP: Information Model) defines an Integration Reference Point (IRP) through which an 'IRPAgent' (typically an Element Manager or Network Element) can communicate basic Configuration Management related information to one or several 'IRPManagers' (typically Network Managers). This version of the IRP is mainly intended for "passive management" of high-level network configuration and status information as required by a Network Manager.

This is based on the assumption that all of the detailed CM actions, including fault correction after one or more alarms, are performed by an Element Manager, which knows the vendor-specific NRM and configuration and which is launched by the NM when necessary. The NM is then assumed to give as input all relevant information, e.g. the DN of an alarmed object, to the EM application, which knows exactly how to handle it. This may also involve a GUI application of the EM (e.g. Web-based) to be launched, displaying the detailed configuration to the NM operator and allowing him to directly read or modify the configuration. A large portion of these CM actions actually require such detailed knowledge of the underlying vendor-specific NRMs, which the multi-vendor NM applications have no knowledge of, as they are not standardised.

The present document is divided in three main parts:

1. specifies a generic IRP Information Service with operations and notifications to be used by an 'IRPManager' to retrieve information on managed objects maintained by a 'IRPAgent'.

2. specifies a generic Network Resource Model, NRM (also referred to as a Management Information Model - MIM) with definitions of Managed Object classes.

3. defines the UMTS management NRM by reusing this generic model, by direct reuse or sub-classing.

The Configuration Management (CM) area is very large. The intention is to split the specification of the related interfaces in several IRPs. In addition to the subject IRP, it is expected that IRPs will be defined for functional areas like Security management, Software management, Network & Service provisioning, etc. An important aspect of such a split is that the Network Resource Models (NRMs) defined in different IRPs are consistent. The Basic CM IRP here provides a base for all CM-related resource modelling.

To summarize, the Basic CM IRP has three main purposes:

(1) to define an interface for retrieval of Configuration Management information,

(2) to define a generic Network Resource Model that constitutes a base from which other (more specialized) resource models can inherit, and

(3) to define the applied UMTS management Network Resource Model.

2 References

The following documents contain provisions, which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3G TS 32.101: "3G Telecom Management principles and high level requirements".

[2] 3G TS 32.102: "3G Telecom Management architecture".

[3] 3G TS 32.106-2: "Telecommunication Management; Configuration Management; Part 2: Notification Integration Reference Point; Information Service version 1".

[4] ITU-T Recommendation M.3100 (07/95): "Generic Network Information Model".

[5] ITU-T Recommendation M.3100 Corrigendum 1 (07/98)".

[6] ITU-T Recommendation M.3100 Amendment 1 (03/99)".

[7] ITU-T Recommendation X.710 (1991): "Common Management Information Service Definition for CCITT Applications".

[8] ITU-T Recommendation X.721 (02/92): "Information Technology - Open Systems Interconnection – Structure of Management Information: Definition of Management Information".

[9] ITU-T Recommendation X.730 (01/92): "Information Technology - Open Systems Interconnection – Systems Management: Object Management Function".

[10] ITU-T Recommendation X.731 (02/92): "Information Technology - Open Systems Interconnection - Systems Management: State Management Function".

[11] ITU-T Recommendation X.732 (01/92): "Information technology - Open Systems Interconnection - Systems Management: Attributes for Representing Relationships".

[12] ETS 300 622 (GSM 12.20): “Digital cellular telecommunications system (Phase 2); Base Station System (BSS) Management Information, June 1996".

[13] 3G TS 32.106-8: "Name Convention for Managed Objects".

[14] 3G TS 32.106-1: "3G Configuration Management: Concepts and requirements".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply. For terms and definitions not found here, please refer to 3G TS 32.101 [1], 3G TS 32.102 [2] and 3G TS 32.106-1 [14].

Association: In general it is used to model relationships between Managed Objects. Associations can be implemented in several ways:

(1) name bindings expressed in the Distinguished Name of the Managed Objects;

(2) reference attributes of the participating Managed Objects;

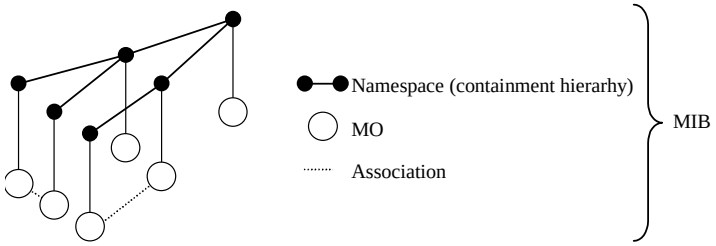
(3) dedicated association objects with references to the participating Managed Objects.

This IRP stipulates that containment associations shall be expressed through name bindings, but it does not stipulate the implementation for other types of associations. These are specified as separate entities in the object models (UML diagrams), but they could very well be implemented e.g. through reference attributes of the participating MOs. This kind of implementation decisions is Solution Set specific.

Distinguished Name: A Distinguished Name (DN) is used to uniquely identify an MO within a name space.
A DN is built from a series of "name components" (Relative Distinguished Names, RDN) denoting a containment hierarchy. The semantics and syntax of a DN and RDN is described in 3G TS 32.106-8 [13].

Managed Object (MO): In the context of the present document, a Managed Object (MO) is a software object that encapsulates the manageable characteristics and behaviour of a particular Network Resource. The MO is instance of a MO class defined in a MIM/NRM. An MO class has attributes that provide information used to characterize the objects that belong to the class (the term “attribute” is taken from TMN and corresponds to a “property” according to CIM). Furthermore, a MO class can have operations that represent the behaviour relevant for that class (the term “operation” is taken from TMN and corresponds to a “method” according to CIM).

Management Information Base (MIB): A MIB is an instance of an NRM and has some values on the defined attributes and associations specific for that instance. In the context of the present document , a MIB consist of (1) a Name space (describing the MO containment hierarchy in the MIB through Distinguished Names), (2) a number of Managed Objects with their attributes and (3) a number of Associations between these MOs. Also note that TMN (X.710 [7]) defines a concept of a Management Information Tree (also known as a Naming Tree) that corresponds to the name space (containment hierarchy) portion of this MIB definition.



Management Information Model (MIM): Also referred to as NRM – see the definition below.

Name space: A name space is a collection of names. The IRP name convention 0 restricts the name space to a hierarchical containment structure, including its simplest form - the one-level, flat name space. All Managed Objects in a MIB shall be included in the corresponding name space and the MIB/name space shall only support a strict hierarchical containment structure (with one root object). A Managed Object that contains another is said to be the superior (parent); the contained Managed Object is referred to as the subordinate (child). The parent of all MOs in a single name space is called a Local Root. The ultimate parent of all MOs of all managed systems is called the Global Root.

Network Resource Model (NRM): A model representing the actual managed telecommunications network resources that a System is providing through the subject IRP. An NRM describes Managed Object Classes, their associations, attributes and operations. The NRM is also referred to as “MIM” (see above), which originates from the ITU-T TMN.

Relative Distinguished Name (RDN): It uniquely identifies an object instance within the scope of the parent (containing) object. It is built up of a naming attribute and its value. See also the definition of Distinguished Name above.

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

CIM	Common Information Model
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CORBA	Common Object Request Broker Architecture
DMTF	Distributed Management Task Force
DN	Distinguished Name
EM	Element Manager
FM	Fault Management
GDMO	Guidelines for the Definition of Managed Objects
IDL	Interface Definition Language
IEC	International Electro-technical Commission
IETF	Internet Engineering Task Force
IRP	Integration Reference Point
ISO/IEC	International Standards Organization
ITU-T	International Telecommunication Union, Telecommunication Sector
MIB	Management Information Base
MIM	Management Information Model
MIT	Management Information Tree (or Naming Tree)
MOC	Managed Object Class
MOF	Managed Object Format
MOI	Managed Object Instance
NE	Network Element
NR	Network Resource

NRM	Network Resource Model
OSI	Open System Interconnection
PM	Performance Management
RDN	Relative Distinguished Name
SMI	Structure of Management Information
SNMP	Simple Network Management Protocol
SS	Solution Set
TMN	Telecommunications Management Network
UML	Unified Modeling Language
UMTS	Universal Mobile Telecommunications System
WBEM	Web-Based Enterprise Management
XML	EXtensible Markup Language

4 System Overview

4.1 System Context

Figures 1 and 2 identify system contexts of the subject IRP in terms of its implementation called IRPAgent and the user of the IRPAgent, called IRPManager. For a definition of IRPManager and IRPAgent, see 3G TS 32.106-2 [3].

IRPAgent implements and supports the Basic CM IRP. IRPAgent can be a Network Element (NE) (see Figure 1), or it can be an Element Manager (EM) or a mediator that interfaces one or more NEs (see Figure 2). In the latter case, the interfaces (represented by a thick dotted line) between the EM and the NEs are not subject of this IRP.

An IRPManager using this IRP shall choose one of the two System Contexts defined here, for each NE. For instance, if an EM is responsible for managing a number of NEs, the NM shall access this IRP through the EM and not directly to those NEs. For another IRP though, the System Context may be different.

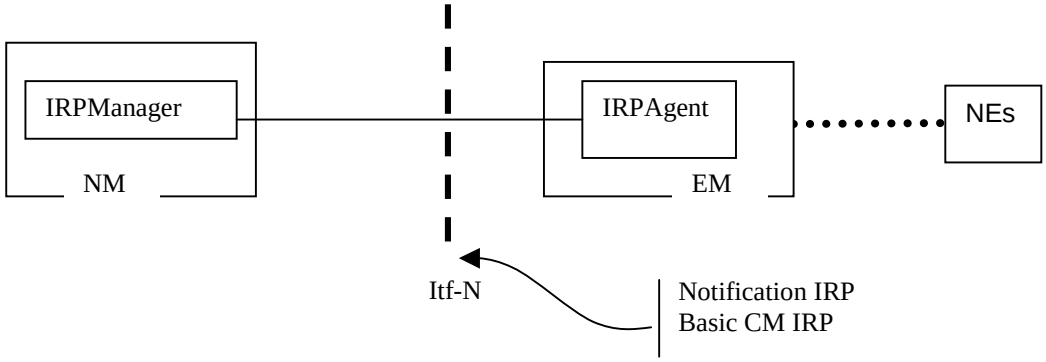


Figure 1: System Context A

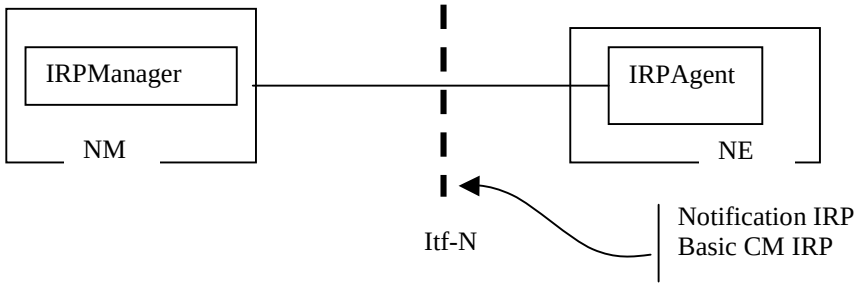


Figure 2: System Context B

4.2 Compliance rules

For general definitions of compliance rules related to qualifiers (Mandatory/Optional/Conditional) for *operations*, *notifications and parameters* (of operations and notifications) please refer to 3G TS 32.102 [2].

The following defines the meaning of Mandatory and Optional MOCs, attributes in these MOCs and associations between MOCs, in Solution Sets to the Basic CM IRP:

- The IRPManager shall support all mandatory MOCs/attributes/associations. The IRPManager shall be prepared to receive information related to mandatory as well as optional MOCs/attributes/associations without

failure; however the IRPManager does not have to support handling of the optional MOCs/attributes/associations.

- The IRPAgent shall support all mandatory MOCs/attributes/associations. It may support optional MOCs/attributes/associations.

5 Modelling approach

This clause identifies the modelling approach adopted and used in this IRP.

As previously described, the IRP is structured in:

(1) an IRP Information Model (the subject document) that specifies the interface in a protocol neutral manner, and

(2) a number of IRP Solution Sets that provide the actual realization of the operations and notifications defined in the IRP Information Model for each protocol environment.

Figure 3 shows the structure of the Basic CM IRP (including a number of possible Solution Sets).

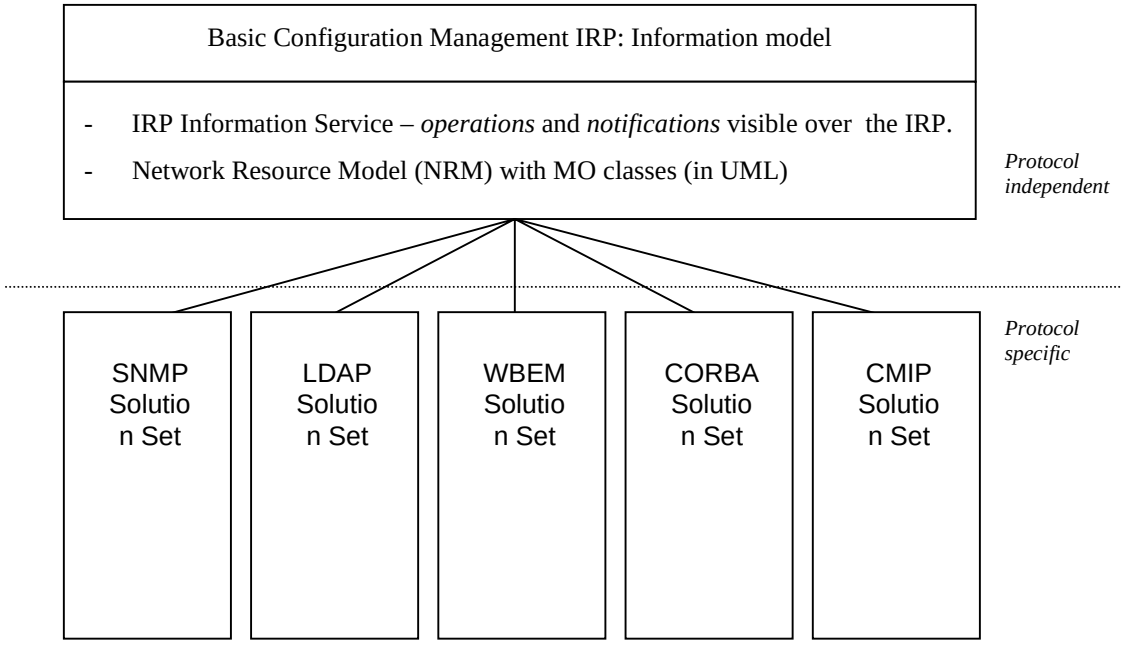


Figure 3: Basic CM IRP Structure with example Solution Sets

As shown in figure 3, the IRP Information Model consists of two main parts:

1. **The IRP Information Service**
   This is a specification of the *operations* and *notifications* that are visible over the IRP. These operations are generic in the sense that they do not specify the Managed Objects that are retrieved/manipulated over the interface.

2. **The Network Resource Model (NRM)**
   This is a protocol-independent model that specifies a number of Managed Object classes (with attributes, operations and associations), which are relevant in the context of the subject IRP. Each Solution Set shall provide an implementation of this resource model with:

   (1) references to standard models that are applicable for the corresponding protocol environment, and

   (2) extensions to these standard models for the parts of the NRM that are not covered.

The modelling approaches for these two aspects of the IRP are somewhat different and are described separately in the next two subclauses.

5.1 IRP Information Service modelling approach

The IRP Information Service of the subject IRP specifies a number of protocol-independent operations and notifications that are needed by an IRPManager to retrieve CM information from an IRPAgent.

The operations and notifications of the IRP Information Service are mainly based on the principles of the Common Management Information Service (CMIS) defined in ITU-T X.710 [7] and ITU-T X.721 [8] (M-GET etc.). Note however, that the Information Service of the subject IRP is focused on the operations and notifications needed for basic CM purposes and thus only covers a subset of the operations/notifications defined in ITU-T X.710 [7]/ITU-T X.721 [8].

It is expected that most Solution Sets will implement the operations and notifications by mapping them to standard operations (and possibly standard notifications) that are applicable in the corresponding protocol environment. The CMIP Solution Set should for instance map the operations to the more generic operations defined in CMIS, an SNMP Solution Set should map the operations to applicable SNMP operations, and the CORBA Solution Set should map the operations to applicable OMG/CORBA services.

5.2 Network Resource modelling approach

The NRM defined in the subject IRP bases its design mainly on work captured in ITU-T Recommendation M.3100 [4], [5], [6]. However, as described in the Scope of the present document (clause 1): The model is highly simplified for the purpose of the NM, based on the assumption that all of the detailed CM actions, including fault correction after one or more alarms, are performed by an Element Manager which knows the vendor-specific NRM and configuration, and which is launched by the NM when necessary.

Moreover, the classes defined herein are very basic, only for the necessary support of Fault Management (FM) and Performance Management (PM), which means that they contain very few attributes – basically only for naming.

In addition, also some basic associations between some of the classes are defined.

The NRM is split into a generic and an UMTS-specific part.

Detailed mapping to the actual standard model is described in each Solution Set. It is important to note that if one selects a specific management protocol, one should also as base use existing *de-facto* conventions and standard resource models that are applicable to that protocol environment. Examples:

- SNMP Solution Sets (SMI-specifications) should be consistent with existing standard SNMP MIB-modules in order to function in an SNMP environment.
- CMIP Solution Sets (GDMO-specifications) should be based on standard models like X.721 and M.3100 in order to function in an OSI/TMN environment.
- WBEM Solution Sets (MOF/XML-specifications) should be based on CIM to function in a WBEM environment.

NOTE: CORBA Solution Sets are special in the sense that no such corresponding de-facto standard models exist, and CORBA/IDL is transparent to any model. Thus, one has full freedom to choose the same model for the CORBA Solution Set to this IRP, as the IRP Information Model defined herein.

Finally, all solution sets shall of course be consistent with the IRP Information Model defined herein.

6 IRP Information Model

6.1 Introduction

As already introduced in the previous clause, the present clause defines the Basic CM IRP Information Model in the form of the IRP Information Service and the Network Resource Model (split into a generic and a UMTS-specific part).

The corresponding Solution Set documents provide protocol dependent object models. They provide the actual realization of the operations and notifications defined in this subclause in each protocol environment. One may find that the operation names and operation parameters defined in the protocol-neutral model differ from those defined in the Solution Sets (e.g. due to mappings to existing standard models that are applicable for a specific Solution Set).

6.2 IRP Information Service

This subclause specifies the *operations* and *notifications* that are visible over this IRP. These operations are generic in the sense that they do not specify the MOs that are retrieved/manipulated over the interface.

6.2.1 Interfaces

Figure 4 illustrates the operations and notifications defined as interfaces implemented and used by IRPAgent and IRPManager, described using UML notation (Interface in IRP Information Model is identical to concepts conveyed by stereotype <<interface>> of UML). Parameters and return status are not indicated.

Two interfaces are defined. One is called `BasicCmIRPOperations`. This interface defines operations implemented by IRPAgent and used (or called) by IRPManager. The other is called `BasicCmIRPNotifications`. This interface defines notifications implemented by IRPManager and used by IRPAgent.

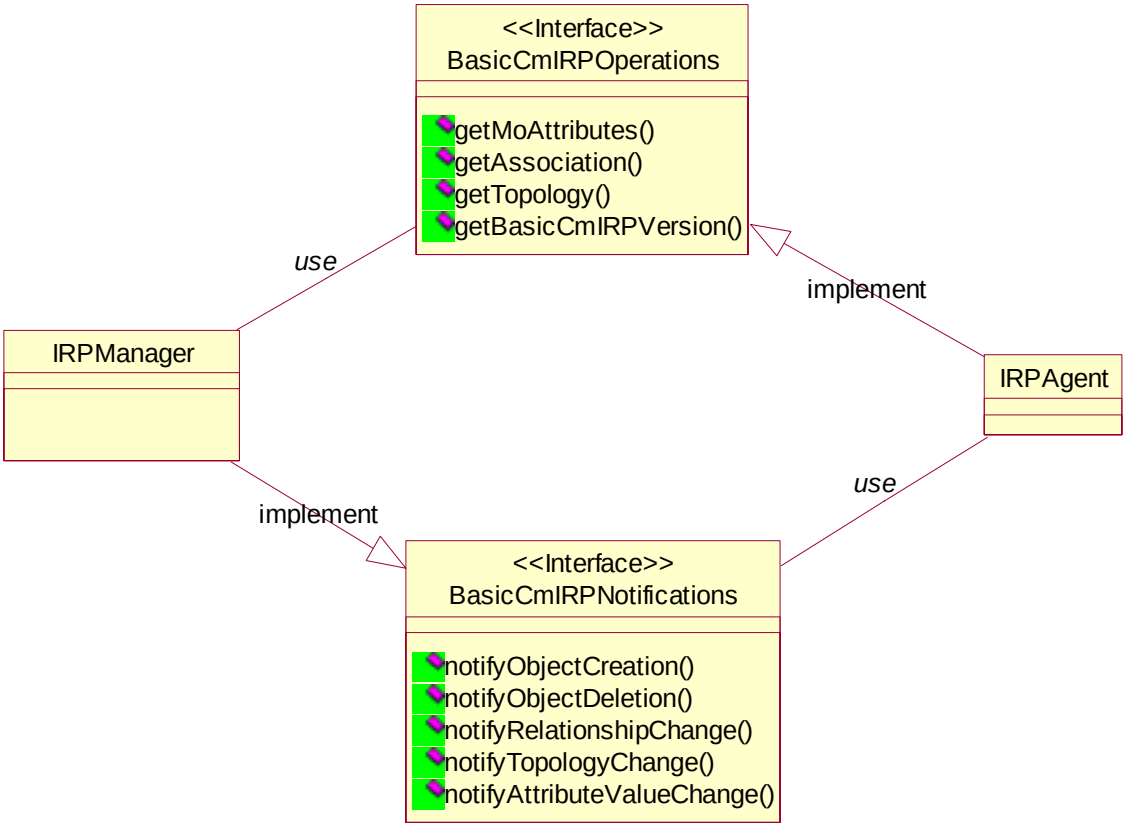


Figure 4: UML Interface Class Diagram

6.2.2 Operations

6.2.2.1 Operation getMoAttributes (M)

This operation is invoked by IRPManager to request the retrieval of management information (Managed Object attribute names and values) from the MIB maintained by IRPAgent. One or several Managed Objects may be retrieved - based on the containment hierarchy. The operation corresponds to the M-GET service defined by CMIS (ITU-T X.710 [7]).
A Solution Set may choose to split this operation in several operations (e.g. operations to get “handlers” or “iterators” to

Managed Objects fulfilling the scope/filter criteria and other operations to retrieve attribute names/values from these "handlers").

Table 1: Parameters of `getMoAttributes`

Name	Qualifier	Purpose
baseObjectInstance	Input, M	The MO where the search starts. This is a full Distinguished Name according to 3G TS 32.106-8 [13].
scope	Input, M	This parameter defines how many levels of the containment hierarchy to search (i.e. apply the filter defined below). The search starts from the MO given by the baseMO parameter. The levels of search that may be performed are: • the base object alone (default); • the n-th level subordinates of the base object; • the base object and all of its subordinates down to and including the n-th level; • the base object and all of its subordinates.
filter	Input, M	This parameter defines a filter test to be applied to the scoped Managed Object(s). If the filter is not specified, all of the managed objects included by the scope are selected. The actual syntax and capabilities of the filter is a Solution Set specific. However, each Solution Set support a filter consisting of one or several assertions that may be grouped using the logical operators AND, OR and NOT. Each assertion is a logical expression of attribute existence, attribute value comparison ("equal to X, less than Y" etc.) and MO Class.
managedObjectClass	Output, M	For each returned MO: The class of the MO.
managedObjectInstance	Output, M	For each returned MO: The name of the MO. This is a full Distinguished Name according to 3G TS 32.106-8 [13].
attributeList	Output, M	For each returned MO: A list of name/value pairs for the MO attributes.
associationList	Output, O	For each returned MO: A list of associations where the MO participates, including the association type and direction. However, associations may be implemented differently in different Solution Sets (as described in subclause 1.3). Some Solution Sets may e.g. use reference attributes in the MOs themselves – and then this `associationList` parameter is not needed.
status	Output, M	(a) Operation succeeded, or (b) Operation failed because of specified or unspecified reason.

6.2.2.2 Operation getTopology (O)

This (optional) operation is only intended for retrieval of the topology information (containment relations) for the MIB.

The output parameter 'topology' of the operation shall contain a list of all Managed Object instances in the MIB maintained by IRPAgent (or a subset starting from a given base object) including containment information (naming tree).

The structure and format of the output parameter 'topology' are Solution Set dependent.

Table 2: Parameters of `getTopology`

Name	Qualifier	Purpose
baseObject Instance	Input, M	The MO where the search starts. This is a full Distinguished Name according to 3G TS 32.106-8 [13].
scope	Input, O	This parameter gives a value N defining how many levels of the containment hierarchy from the baseObjectInstance to include in the result. The levels of inclusion that may be performed are: • the base object alone (default); • the n-th level subordinates of the base object; • the base object and all of its subordinates down to and including the n-th level; • the base object and all of its subordinates.
topology	Output, M	A list of all Managed Object instances in the MIB maintained by IRPAgent (or a subset starting from a given base object) including containment information (naming tree).
status	Output, M	(a) Operation succeeded, or (b) Operation failed because of specified or unspecified reason.

6.2.2.3 Operation getAssociation (O)

This operation is used to get information of which Managed Objects that have associations (other than containment) with a given Managed Object.

The need for this operation in a certain Solution Set is dependent on which approach is taken for the implementation of associations. These different approaches (through reference attributes or association objects) are described in subclause 3.1.

The structure and format of the output parameter 'associationList' are Solution Set dependent.

Table 3: Parameters of `getAssociation`

Name	Qualifier	Purpose
baseObject Instance	Input, O	The MO for which the associations are requested. This is a full Distinguished Name according to 3G TS 32.106-8 [13].
associationList	Output, M	A list of associations where the MO participates, including the association type and direction.
status	Output, M	(a) Operation succeeded, or (b) Operation failed because of specified or unspecified reason.

6.2.2.4 Operation getBasicCmIRPVersion (M)

IRPManager wishes to find out the Notification IRP SS versions supported by IRPAgent. IRPAgent shall respond with a list of supported Basic CM IRP SS versions. Since the present document defines the first IRP version, implementation of IRPAgent in compliance to this version shall return with one version number in the list.

Table 4: Parameters of `getBasicCmIRPVersion`.

Name	Qualifier	Purpose
versionNumberList	Output, M	It indicates one or more SS version numbers supported by the IRPAgent. This shall in release 99 contain only one version number.
status	Output, M	(a) Operation succeeded in that `versionNumberList` contains valid result. (b) Operation failed. Output parameter `versionNumberList` may contain invalid result.

6.2.3 Notifications

6.2.3.1 General

Operations related to subscription to notifications are defined in the Notification IRP IS (see 3G TS 32.106-2 [3]).

The mandatory notifications specified below (as part of the Information Service) shall be supported by all Managed Objects.

6.2.3.2 Notification notifyObjectCreation (O)

IRPAgent notifies the subscribed IRPManager that a new Managed Object has been created and that the new object satisfies the filter constraint expressed in IRPManager's `subscribe` operation (see 3G TS 32.106-2 [3]). This notification is based on the `objectCreation` notification type specified in ITU-T X.721 [8] and ITU-T X.730 [9] (difference compared to these specifications are indicated in the description below).

Having object creation notifications may give the impression that when a management information tree (a complete MIB or parts of a MIB) is created (e.g. when the IRPAgent is set up for the first time or due to major re-equipment), the management network will be flooded with object creation notifications of any auto-instantiated objects. However, this is not the intention and ITU-T M.3100 [4], [5], [6] specifies that IRPAgent shall suspend the event forwarding for the time of the equipping in order to avoid the flood of notifications, and resume the event forwarding after the changes have been done. The consequence of this approach is however that IRPManager is never informed about the changes and the approach is thus not recommended.

When a MIB subtree is created, IRPAgent may either send `notifyObjectCreation` notifications for each Managed Object in the subtree, or send one `notifyTopologyChange` notification (to avoid event flooding).

When a MIB subtree is created, there are two alternative IRPAgent implementations:

- IRPAgent issues `notifyObjectCreation` notifications for each Managed Object in the subtree.
- IRPAgent issues one `notifyTopologyChange` notification indicating the base object of the subtree.

The second approach is recommended in order to avoid event flooding. Note that the `notifyObjectCreation` notification is optional (as the `notifyTopologyChange` notification can be used instead).

Table 5: Parameters for `notifyObjectCreation`

Name	Qualifier	Purpose
notificationId	Input, O	A unique identifier that distinguishes this notification from other notifications emitted from the IRPAgent. Defined in 3G TS 32.106-2 [3].
correlatedNotifications	Input, O	A set of notifications that are correlated to the subject notification. Defined in 3G TS 32.106-2 [3].
eventTime	Input, M	The event occurrence time. Defined in 3G TS 32.106-2 [3].
eventType	Input, M	An identification of the event type carried in the notification. Defined in 3G TS 32.106-2 [3].
extendedEventType	Input, M	Defined in 3G TS 32.106-2 [3]. Not used in this version of this IRP; thus set to Null.
systemDN	Input, O	The Distinguished Name (DN) of IRPAgent that originally detected the network event and generated the notification. Defined in 3G TS 32.106-2 [3].
sourceIndicator	Input, O	This parameter, when present, indicates the source of the operation that led to the generation of this notification. It can have one of the following values: • resource operation: The notification was generated in response to an internal operation of the resource; • management operation: The notification was generated in response to a management operation applied across the managed object boundary external to the managed object; • unknown: It is not possible to determine the source of the operation.
managedObjectClass	Input, M	The class of the created MO.
managedObjectInstance	Input, M	The Distinguished Name of the created MO.
attributeList	Input, O	The attributes (name/value pairs) of the created MO.

6.2.3.3 Notification notifyObjectDeletion (O)

IRPAgent notifies the subscribed IRPManager of a deleted Managed Object. The IRPAgent invokes this notification because the subject notification satisfies the filter constraint expressed in the IRPManager `subscribe` operation (see 3G TS 32.106-2 [3]). This notification is based on the `objectCreation` notification type specified in ITU-T X.721 [8] and ITU-T X.730 [9] (difference compared to these specifications are indicated in the description below).

Note that when a Managed Object is deleted, all subordinate Managed Objects (i.e. the complete subtree of the MIB) are also deleted. Furthermore, all associations where the Managed Object participates are deleted.

When a MIB subtree is deleted, there are two alternative IRPAgent implementations:

- IRPAgent issues `notifyObjectDeletion` notifications for each Managed Object in the subtree.
- IRPAgent deletes the subtree (except the base object of the subtree) and issues one `notifyTopologyChange` notification, then deletes the base object and issues one `notifyObjectDeletion` notification.

The second approach is recommended in order to avoid event flooding.

Table 6: Parameters for `notifyObjectDeletion`

Name	Qualifier	Purpose
notificationId	Input, O	A unique identifier that distinguishes this notification from other notifications emitted from the IRPAgent. Defined in 3G TS 32.106-2 [3].
correlatedNotifications	Input, O	A set of notifications that are correlated to the subject notification. Defined in 3G TS 32.106-2 [3].
eventTime	Input, M	The event occurrence time. Defined in 3G TS 32.106-2 [3].
eventType	Input, M	An identification of the event type carried in the notification. Event types are specific to a particular notification category. Defined in 3G TS 32.106-2 [3].
extendedEventType	Input, M	Defined in 3G TS 32.106-2 [3]. Not used in this version of this IRP; thus set to Null.
systemDN	Input, O	The Distinguished Name (DN) of IRPAgent that originally detected the network event and generated the notification. Defined in 3G TS 32.106-2 [3].
sourceIndicator	Input, O	This parameter, when present, indicates the source of the operation that led to the generation of this notification type. It can have one of the following values: • resource operation: The notification was generated in response to an internal operation of the resource; • management operation: The notification was generated in response to a management operation applied across the managed object boundary external to the managed object; • unknown: It is not possible to determine the source of the operation.
managedObjectClass	Input, M	The class of the deleted MO.
managedObjectInstance	Input, M	The Distinguished Name of the deleted MO.
attributeList	Input, O	The attributes (name/value pairs) of the deleted MO.

6.2.3.4 Notification notifyAttributeValueChange (O)

IRPAgent notifies the subscribed IRPManager of a change of one or several attributes of a Managed Object in the NRM. The IRPAgent invokes this notification because the subject notification satisfies the filter constraint expressed in the IRPManager `subscribe` operation (see 3G TS 32.106-2 [3]). This notification is based on the `attributeValueChange` notification type specified in ITU-T X.721 [8] and ITU-T X.730 [9] (difference compared to these specifications are indicated in table 7).

Table 7: Parameters for notifyAttributeValueChange

Name	Qualifier	Purpose
notificationId	Input, O	A unique identifier that distinguishes this notification from other notifications emitted from the IRPAgent. Defined in 3G TS 32.106-2 [3].
correlatedNotifications	Input, O	A set of notifications that are correlated to the subject notification. Defined in 3G TS 32.106-2 [3].
eventTime	Input, M	The event occurrence time. Defined in 3G TS 32.106-2 [3].
eventType	Input, M	An identification of the event type carried in the notification. Event types are specific to a particular notification category. Defined in 3G TS 32.106-2 [3].
extendedEventType	Input, M	Defined in 3G TS 32.106-2 [3]. Not used in this version of this IRP; thus set to Null.
systemDN	Input, O	The Distinguished Name (DN) of IRPAgent that originally detected the network event and generated the notification. Defined in 3G TS 32.106-2 [3].
sourceIndicator	Input, O	This parameter, when present, indicates the source of the operation that led to the generation of this notification type. It can have one of the following values: • resource operation: The notification was generated in response to an internal operation of the resource; • management operation: The notification was generated in response to a management operation applied across the managed object boundary external to the managed object; • unknown: It is not possible to determine the source of the operation.
managedObjectClass	Input, M	The class of the changed MO.
managedObjectInstance	Input, M	The Distinguished Name of the changed MO.
attributeValueChange Definition	Input, M	The changed attributes (name/value pairs) of the MO (with both new and old values).

6.2.3.5 Notification notifyRelationshipChange (O)

IRPAgent notifies the subscribed IRPManager of a change of one or several associations between Managed Object. The IRPAgent invokes this notification because the subject notification satisfies the filter constraint expressed in the IRPManager `subscribe` operation (see 3G TS 32.106-2 [3]). This notification is optional and is based on the `relationshipChange` notification type specified in ITU-T X.721 [8] and ITU-T X.730 [9].

Note that the `relationshipChange` notification type specified in ITU-T X.721 [8] / ITU-T X.730 [9] is used to report the change in the value of reference attributes of one Managed Object. The semantics of our `notifyRelationshipChange` notification is somewhat modified to be able to support different types of association implementations (as described in subclause 1.3).

Table 8: Parameters for notifyRelationshipChange

Name	Qualifier	Purpose
notificationId	Input, O	A unique identifier that distinguishes this notification from other notifications emitted from the IRPAgent. Defined in 3G TS 32.106-2 [3].
correlatedNotifications	Input, O	A set of notifications that are correlated to the subject notification. Defined in 3G TS 32.106-2 [3].
eventTime	Input, M	The event occurrence time. Defined in 3G TS 32.106-2 [3].
eventType	Input, M	An identification of the event type carried in the notification. Event types are specific to a particular notification category. Defined in 3G TS 32.106-2 [3].
extendedEventType	Input, M	Defined in 3G TS 32.106-2 [3]. Not used in this version of this IRP; thus set to Null.
systemDN	Input, O	The Distinguished Name (DN) of IRPAgent that originally detected the network event and generated the notification. Defined in 3G TS 32.106-2 [3].
managedObjectClass	Input, M	The class of the MO for which the relationship has changed.
managedObjectInstance	Input, M	The Distinguished Name of the MO for which the relationship has changed.
sourceIndicator	Input, O	This parameter, when present, indicates the source of the operation that led to the generation of this notification type. It can have one of the following values: • resource operation: The notification was generated in response to an internal operation of the resource; • management operation: The notification was generated in response to a management operation applied across the managed object boundary external to the managed object; • unknown: It is not possible to determine the source of the operation.
relationshipChange Definition	Input, M	A list of changed associations. The encoding is Solution Set dependent and can for instance contain a list of changed reference attributes (according to X.721/X.730) or a list of association instances.

6.2.3.6 Notification notifyTopologyChange (O)

IRPAgent notifies the subscribed IRPManager of an unspecified change of a complete MIB sub-tree. The IRPAgent invokes this notification because the subject notification satisfies the filter constraint expressed in the IRPManager `subscribe` operation (see 3G TS 32.106-2 [3].).

This notification is intended to indicate large changes of a MIB (or portions of it) where it is unnecessary (and very resource consuming) to send individual notifications for each created, deleted and/or changed Managed Object. The IRPManager is requested to perform a synchronization of the MIB through a `getTopology and subsequent getMoAttributes` operations. The reason for this notification may for instance be a larger reconfiguration by an element manager, or that a network element has been reset (and rebuilt its MIB), or that the "DN prefix" of the MIB has changed.

Table 9: Parameters for `notifyTopologyChange`

Name	Qualifier	Purpose
notificationId	Input, O	A unique identifier that distinguishes this notification from other notifications emitted from the IRPAgent. Defined in 3G TS 32.106-2 [3].
correlatedNotifications	Input, O	A set of notifications that are correlated to the subject notification. Defined in 3G TS 32.106-2 [3].
eventTime	Input, M	The event occurrence time. Defined in 3G TS 32.106-2 [3].
eventType	Input, M	An identification of the event type carried in the notification. Event types are specific to a particular notification category. Defined in 3G TS 32.106-2 [3].
extendedEventType	Input, M	Defined in 3G TS 32.106-2 [3]. Not used in this version of this IRP; thus set to Null.
systemDN	Input, O	The Distinguished Name (DN) of IRPAgent that originally detected the network event and generated the notification. Defined in 3G TS 32.106-2 [3].
managedObjectClass	Input, M	The class of the top MOI of the rebuilt MIB sub-tree. Defined in 3G TS 32.106-2 [3].
managedObjectInstance	Input, M	The top MOI of the rebuilt MIB sub-tree. This is a full Distinguished Name according to [13].
sourceIndicator	Input, O	This parameter, when present, indicates the source of the operation that led to the generation of this notification type. It can have one of the following values: • resource operation: The notification was generated in response to an internal operation of the resource; • management operation: The notification was generated in response to a management operation applied across the managed object boundary external to the managed object; • unknown: It is not possible to determine the source of the operation.

6.3 Generic Network Resource Model (NRM)

This subclause defines the generic managed object classes supporting the Basic CM IRP. These object classes are protocol environment neutral and the model does not define the syntax or encoding of the operations and parameters.

6.3.1 Managed Object Class (MOC) diagrams

6.3.1.1 Inheritance hierarchy

Figure 5 shows the inheritance hierarchy for the generic MO classes defined in this IRP.

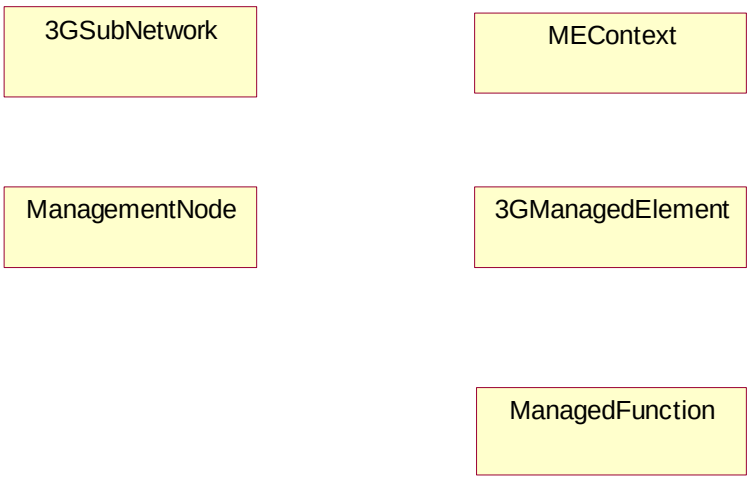
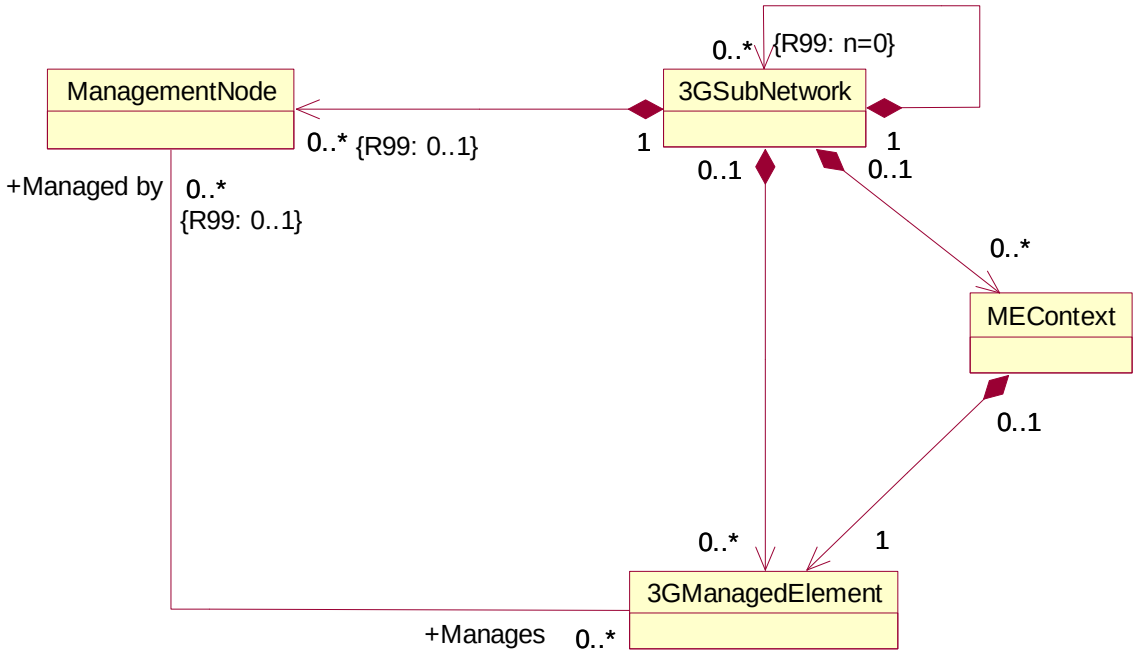


Figure 5: Generic NRM Inheritance Hierarchy

6.3.1.2 Containment/Naming and Association diagram

Figure 6 shows the containment/naming hierarchy and the associations of the generic MO classes defined by this IRP.



NOTE: 3GManagedElement may be contained in either a 3GSubNetwork or an MEContext instance, or have no parent instance at all.

Figure 6: Generic NRM Containment/Naming and Association diagram

Each Managed Object is identified with a distinguished name (DN) according to 3G TS 32.106-8 [13] that expresses its containment hierarchy. As an example, the DN of a Managed Element instance could have a format like:

```
network=Sweden, meContext=MEC-Gbg-1, managedElement=RNC-Gbg-1.
```

6.3.2 Managed Object Class definitions

6.3.2.1 MOC 3GSubNetwork (M)

This managed object class represents a set of managed entities as seen over the Itf-N.

A 3GSubNetwork may have 0...N instances. It shall be present if either a ManagementNode or multiple 3GManagedElements are present (i.e. ManagementNode and multiple 3GManagedElement instances shall have 3GSubNetwork as parent). Restriction in R99: N=1.

Table 10: Attributes of `3GSubNetwork`

Name	Qualifier	Description
subNetworkId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of the `3GSubNetwork` object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ- ONLY, M	A user-friendly (and user assigned) name of the associated object.

6.3.2.2 MOC 3GManagedElement (M)

This managed object class represents telecommunications equipment or TMN entities within the telecommunications network that performs managed element functions, i.e. provides support and/or service to the subscriber. A managed element communicates with a manager (directly or indirectly) over one or more interfaces for the purpose of being monitored and/or controlled. Managed elements may or may not additionally perform element management functionality. A managed element contains equipment that may or may not be geographically distributed. A Managed Element is often referred to as a "network element". This class is similar to the 3G`ManagedElement` class specified in ITU-T M.3100 [4], [5], [6].

A 3GManagedElement can be contained in either a 3GSubNetwork or in an MEContext instance. A single 3GManagedElement seen over the Itf-N may also exist stand-alone with no parent at all.

Table 11: Attributes of 3G `ManagedElement`

Name	Qualifier	Description
managedElementId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of the 3G`ManagedElement` object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
	READ-ONLY, M	The type of managed element, e.g. MSC, HLR, MSC/VLR, RNC, NodeB etc.
userLabel	READ-ONLY, M	A user friendly name of this object.
vendorName	READ-ONLY, M	The name of the 3G Managed Element vendor.
userDefinedState	READ-ONLY, M	An operator defined state for operator specific usage. (See also Note below)
locationName	READ-ONLY, M	The physical location of this entity (e.g. an address).

NOTE: In addition to the userDefinedState, state management attributes are expected to be included in the next release.

6.3.2.3 MOC MEContext (O)

This Managed Object Class (MOC) is introduced mainly for naming purposes. It may support creation of unique DNs in scenarios when some managed elements have the same RDNs due to the fact that they have been manufacturer pre-configured.

MEContext have 0..N instances. It may exist even if no 3GSubNetwork exists. Every instance of MEContext contains exactly one 3GManagedElement.

Table 12: Attributes of MEContext

Name	Qualifier	Description
meContextId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.

6.3.2.4 MOC ManagementNode (M)

This managed object class represents a telecommunications management system (EM) within the TMN that contains functionality for managing a number of Managed Elements (MEs). The management system communicates with the MEs directly or indirectly over one or more interfaces for the purpose of monitoring and/or controlling these MEs.

This class has similar characteristics as the 3GManagedElement. The main difference between these two classes is that the ManagementNode has a special association to the managed elements that it is responsible for managing.

Table 13: Attributes of `ManagementNode`

Name	Qualifier	Description
managementNodeId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ-ONLY, M	A user-friendly name of this object.
vendorName	READ-ONLY, M	The name of the Management Node vendor.
userDefinedState	READ-ONLY, M	An operator defined state for operator specific usage.
locationName	READ-ONLY, M	The physical location of this entity (e.g. an address).

6.3.2.5 MOC ManagedFunction (M)

This Managed Object class is similar to the class `gsmManagedFunction` defined in GSM 12.20 and is provided for sub-classing only. It provides the attributes that are common to functional MO classes. Note that a managed element may contain several managed functions. The ManagedFunction may be extended in the future if more common characteristics to functional objects are identified.

Table 14: Attributes of `ManagedFunction`

Name	Qualifier	Description
userLabel	READ-ONLY, M	A user-friendly name of the associated object.

6.3.3 Associations

6.3.3.1 Association ManagedBy (M)

This association is used to represent relationships between one or more MEs and the management system(s) that are responsible for managing the MEs.

6.3.3.2 Association Manages (M)

This association is used to represent relationships between a management system and the managed elements that it manages.

6.4 UMTS Network Resource Model (NRM)

This subclause defines the UMTS NRM for the Basic CM IRP, for the scope of this release. Most of the MOCs are here reused from the generic NRM in subclause 6.3, and to that the UMTS specific MOCs are added.

These object classes are protocol environment neutral and the model does not define the syntax or encoding of the operations and parameters.

The model described in this subclause allows for managed elements to be defined for management purposes according to the functionality contained within them. As an example, a single implementation of a combined MSC and VLR may be required. However, in the implementation it is required to create a single interface for the management of this element. This is expected to be achieved by instantiating a 3G Managed Element Managed Object Instance which contains the "mscFunction" MOC, the "vlrFunction" MOC (as in the GSM 12.xx-series of specifications), and other generic or non-UMTS specific MOCs as appropriate to define the manageable capability of that managed element.

6.4.1 Managed Object Class diagrams

6.4.1.1 Inheritance hierarchy

Figure 7 shows the inheritance hierarchy for the UMTS NRM.

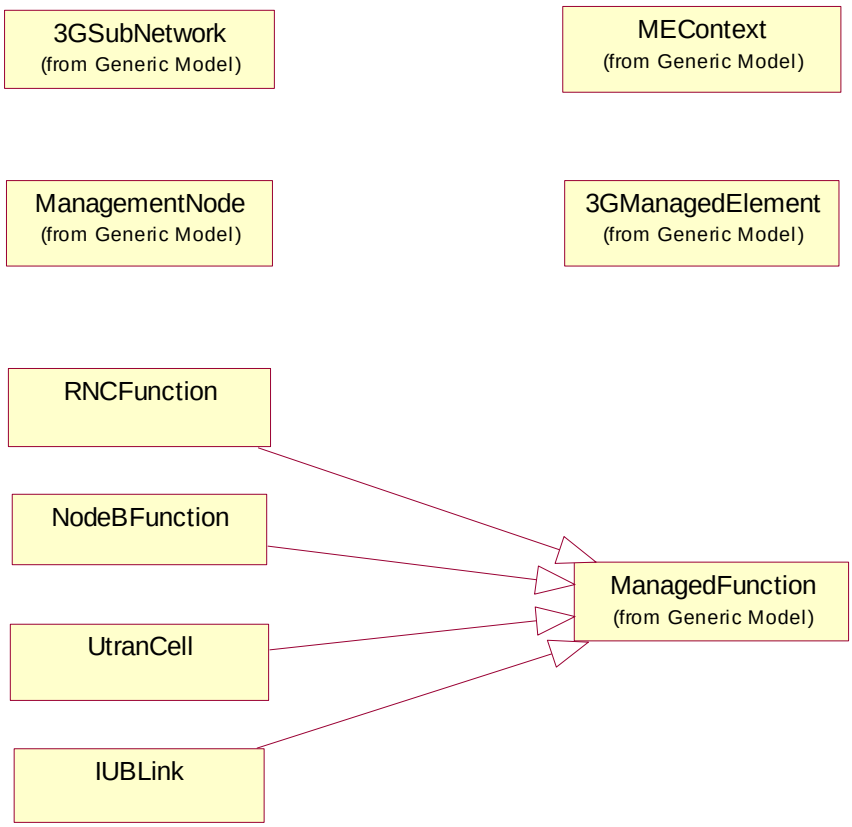


Figure 7: UMTS NRM Inheritance Hierarchy

6.4.1.2 Containment/Naming and Association diagram

Figure 8 shows the containment/naming hierarchy and the associations of the UMTS NRM defined by this IRP.

NOTE: All instantiations of UMTS specific Managed Elements, e.g. MSC, HLR, SGSN etc, all shall use the 3GManagedElement directly – i.e. no inheritance (subclassing) shall be used.

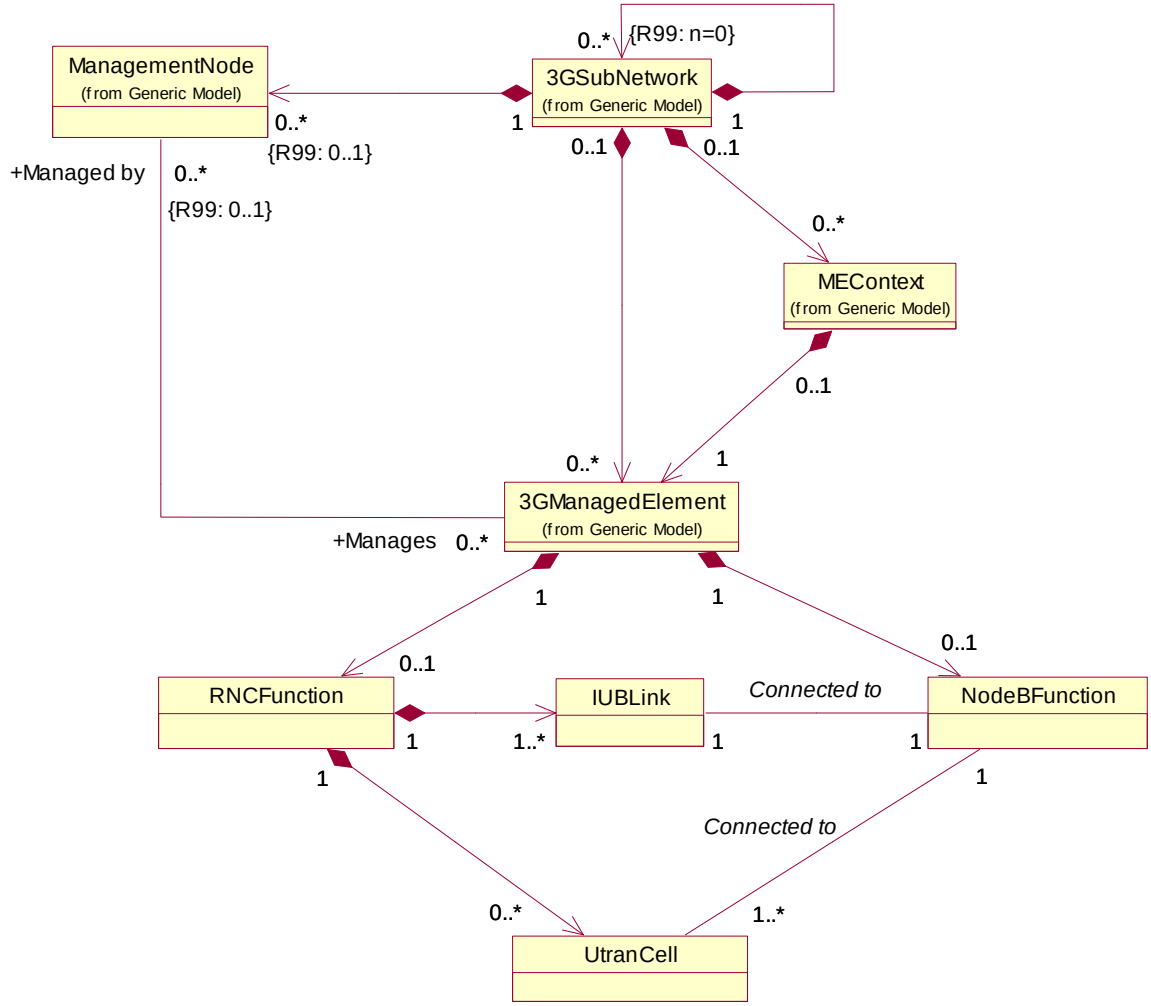


Figure 8: UMTS NRM Containment/Naming and Association diagram

Each Managed Object is identified with a distinguished name (DN) according to 3G TS 32.106-8 [13] that expresses its containment hierarchy. As an example, the DN of a Managed Object representing a cell could have a format like:

```
subNetwork=Sweden, meContext=MEC-Gbg-1, managedElement=RNC-Gbg-1,
rncFunction=RF-1, cell=Gbg-1.
```

6.4.2 UMTS specific Managed Object Class definitions

6.4.2.1 MOC RNCFunction (M)

This managed object class represents RNC functionality..

It inherits from ManagedFunction.

Table 15: Attributes of RNCFunction

Name	Qualifier	Description
rncFunctionId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ-ONLY, M	A user-friendly (and user assigned) name of the associated object. Inherited from ManagedFunction.

6.4.2.2 MOC NodeBFunction (M)

This managed object class represents NodeB functionality.

It inherits from ManagedFunction.

Table 16: Attributes of NodeBFunction

Name	Qualifier	Description
nodeBFunctionId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ-ONLY, M	A user-friendly (and user assigned) name of the associated object. Inherited from ManagedFunction.

6.4.2.3 MOC UtranCell (M)

This managed object class represents a radio cell controlled by the RNC.

It inherits from ManagedFunction.

Table 17: Attributes of UtranCell

Name	Qualifier	Description
utranCellId	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ-ONLY, M	A user-friendly (and user assigned) name of the associated object. Inherited from ManagedFunction.

6.4.2.4 MOC IubLink

The 'Iub link' managed object is the logical link to a NodeB as seen from the RNC.

Table 18: Attributes of IUBLink

Name	Qualifier	Description
iubLinkID	READ-ONLY, M	An attribute whose 'name+value' can be used as an RDN when naming an instance of this object class. This RDN uniquely identifies the object instance within the scope of its containing (parent) object instance.
userLabel	READ-ONLY, M	A user-friendly (and user assigned) name of the associated object. Inherited from ManagedFunction.

6.4.3 Associations

6.4.3.1 Association ManagedBy (M)

The same (bidirectional) association as defined in the generic model (subclause 6.3) is here used to represent relationships between a management system and the UMTS specific managed elements that it manages.

6.4.3.2 Association ConnectedTo

This bidirectional association models the relationship between the IUBLink and NodeB (through the NodeBFunction), as well as the relationship between the UtranCell and NodeB.

Annex A (informative): Supported network configurations

Figure B.1 depicts four typical network configurations, which are supported by the NRM over the Itf-N. However, this does not preclude support for other configurations.

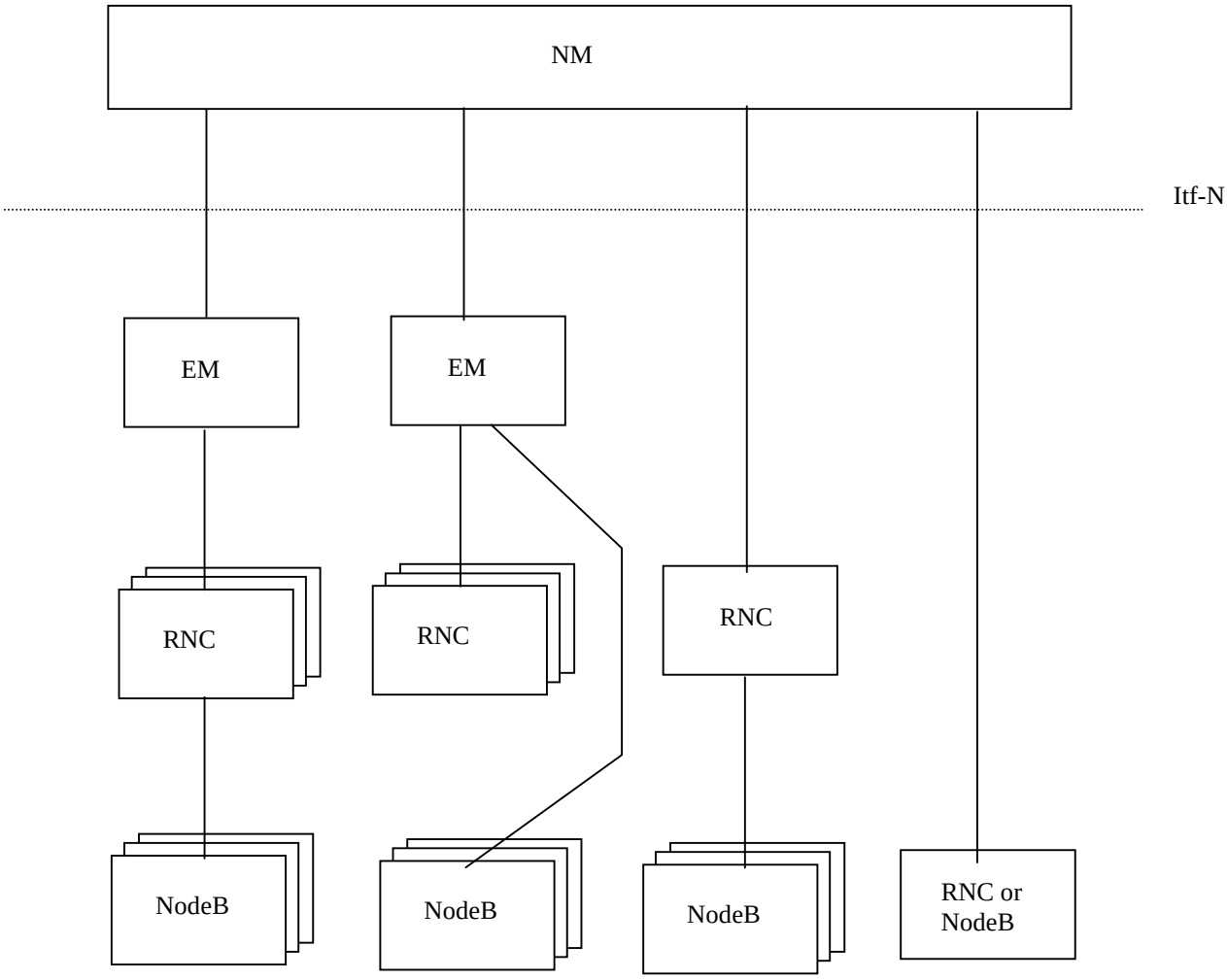


Figure B.1: Typical network configurations supported by the NRM

Table B.1 shows the possible number of instances in R99 for each network configuration (counted from left to right in figure B.1. 9):

Table B.1: Number of instances for each configuration in figure B.1

MOC	Config. 1	Config. 2	Config. 3	Config. 4
3GSubNetwork	1	1	1	0..1
MgmtNode	1	1	0	0
3GManagedElement	1..N	1..N	1..N	1
MEContext	0..M	0..M	0..M	0..1

Annex B (informative): Change history

Change history					
TSG SA#	Version	CR	Tdoc SA	New Version	Subject/Comment
S_09	1.0.0	-	SP-000436		Submitted to SA #9 for Information