Technical Specification Group Services and System Aspects
Meeting #12, Stockholm, Sweden, 18-21 June 2001

TSGS#12(01)0232

Source: **SA5**

Title: **Rel4 CRs to 3G Telecom Management Architecture (32.102)**

Document for: **Approval**

Agenda Item: **7.5.3**

Doc-1st-Level	Doc-2nd-Level	Spec	CR	Rev	Phase	Subject	Cat	Version-Current	Version-New	Workitem
SP-010232	S5-010374	32.102	008		Rel4	**Correction of ITU-T TMN concerns**	D	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010375	32.102	009		Rel4	**Alignment with 3GPP drafting rules regarding headings**	D	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010376	32.102	010		Rel4	**Update of TM architectural aspects**	F	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010377	32.102	011		Rel4	**General clarifications and enhancements**	F	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010378	32.102	012		Rel4	**Alignment with 3GPP drafting rules regarding verbal forms for the expression of provisions**	F	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010379	32.102	013		Rel4	**Update and clarify compliance condition for a UMTS entity**	F	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010395	32.102	014		Rel4	**Delete OSA definition**	D	4.0.0	4.1.0	OAM-AR
SP-010232	S5-010398	32.102	015		Rel4	**Enhancements of the IRP Concept**	F	4.0.0	4.1.0	OAM-AR

3GPP TSG-SA5 (Telecom Management) **S5-010374**
Meeting #20, Brighton, UK, 28 May – June 1 2001

CR-Form-v3

CHANGE REQUEST

⌘	**32.102 CR 008**	⌘ rev	**-**	⌘ Current version:	**4.0.0**	⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title:	⌘	Correction of ITU-T TMN concerns		
Source:	⌘	SA5		
Work item code:	⌘	OAM-AR	***Date:*** ⌘	01/06/2001
Category:	⌘	**D**	***Release:*** ⌘	Rel4
		Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	New versions of ITU-T TMN Recommendations make some statements about ITU-T TMN inappropriate.
Summary of change:	⌘	Statements targeting older versions of ITU-T TMN Recommendations are not fully appropriate anymore and are deleted.
Consequences if not approved:	⌘	3GPP Technical Specifications will express misleading concerns not fully appropriate for ITU-T TMN Recommendations of today.

Clauses affected:	⌘	4.2	
Other specs affected:	⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments:	⌘		

4.2 TMN

TMN (Telecommunications Management Network), as defined in [1], provides:

- an architecture, made of OS (Operations Systems) and NEs (Network Elements), and the interfaces between them (Q, within one Operator Domain and X, between different Operators);
- the methodology to define those interfaces;
- other architectural tools such as LLA (Logical Layered Architecture) that help to further refine and define the Management Architecture of a given management area;
- a number of generic and/or common management functions to be specialised/applied to various and specific TMN interfaces.

The UMTS Management Architecture is largely based on TMN, and will reuse those functions, methods and interfaces already defined (or being defined) that are suitable to the management needs of UMTS. However, the UMTS Management needs to explore the incorporation of other concepts (other management paradigms widely accepted and deployed) ~~since:~~ for the new challenges UMTS faces.

- ~~UMTS incorporates other technologies to which TMN is not applied fully;~~
- ~~UMTS faces new challenges that TMN does not address today.~~

~~It shall be noted, that these concerns are applicable to other telecommunication areas as well as to UMTS, it is expected that the eventual evolution of TMN will cover this ground. Indeed, most of the above concepts are already being taken into account by TMN evolution (protocols and methodologies).~~

CR-Form-v3

CHANGE REQUEST

⌘	**32.102**	**CR**	**009**	⌘ rev	**-**	⌘ Current version:	**4.0.0** ⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Alignment with 3GPP drafting rules regarding headings		
Source: ⌘	SA5		
Work item code: ⌘	OAM-AR	***Date:*** ⌘	01/06/2001
Category: ⌘	**D**	***Release:*** ⌘	Rel4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	32.102 does not fully follow the drafting rules for headings
Summary of change: ⌘	A new heading (7.3.1) is introduced and sub-clause 11.1 heading is removed.
Consequences if not approved: ⌘	Unconsistent 3GPP Technical Specification

Clauses affected: ⌘	7.3 and 11	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

7 TM Architectural aspects

7.3 Interoperability

7.3.1 Introduction

The new requirement on a UMTS TMN will imply a focus change from net element management towards management of information "information management". Network providers make use of different information in several different ways which also may vary from network to network and from time to time. Basic information as alarms is of course essential information for localising faults but may also be the key information to be able to set up a service with a service level agreement.

Numerous of different interfaces can be identified in a UMTS network in the areas of network element management, network management and service management. The most important and complex of these interfaces will be standardised but many interfaces of less importance are unlikely to be fully standardised and will be up to the individual operator and vendor to develop. To adopt mainstream computing technologies, re-use widely used protocols, standards and an open system architecture will be essential to secure interworking between all physical entities in a UMTS.

Low-cost and general access to management systems information will be needed. Obviously this is the critical issue and challenging task in the heterogeneous, distributed and complex network of a UMTS.

11 Implementation aspects

~~11.1 Layering of the OS applications~~

UMTS operators might categorise and organise its operation systems in many different ways as:

- A national fault and performance OS.
- A national charging, billing and accounting OS.
- Regional configuration OS.
- Regional fault, performance and configuration OS.
- etc.

This geographical dependent categorisation may change after time and the growth of the network. A physical architecture based on an open system design and re-usable application components would ease the work to adopt such structural changes. A management system build for a UMTS shall provide the possibility of layering the applications.

3GPP TSG-SA5 (Telecom Management) **S5-010376**
Meeting #20, Brighton, U.K., 26 February – 2 March 2001

CR-Form-v3

CHANGE REQUEST

⌘	**32.102**	**CR**	**010**	⌘ rev	**-**	⌘ Current version:	**4.0.0**	⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Update of TM architectural aspects		
Source: ⌘	SA5		
Work item code: ⌘	OAM-AR	***Date:*** ⌘	01/06/2001
Category: ⌘	**F**	***Release:*** ⌘	Rel4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change: ⌘	Alignment of the domain concept with other 3GPP Technical Specifications and general update of material for Rel4.
Summary of change: ⌘	Update of sections and figures describing the Telecom Management Domains and clarification of the entities to manage. General update of material in clause 7.3
Consequences if not approved: ⌘	Misunderstandings and unclear requirements

Clauses affected: ⌘	7.3	
Other specs affected: ⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications	
Other comments: ⌘		

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. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] ITU-T Recommendation M.3010 (2000): "Principles for a telecommunications management network".

[2] 3GPP TS 32.101: "3G Telecom Management principles and high level requirements".

[3] ITU-T Recommendation X.721: "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".

[4] ITU-T Recommendation X.200 (1994): "Information technology – Open Systems Interconnection – Basic reference model: The basic model".

[5] ITU-T Recommendation X.733: "Information technology - Open Systems Interconnection - Systems Management: Alarm reporting function".

[6] ITU-T Recommendation X.736: "Information technology – Open Systems Interconnection – Security Alarm Reporting Function".

[7] ITU-T Recommendation M.3100-1995: "Generic network information model".

[8] GSM 12.11: Digital cellular telecommunications system (Phase 2); Fault management of the Base Station System (BSS).

[9] TMF GB910. Smart TMN Telecom Operations Map (Release 1.1).

[10]

TMF GB909. Smart TMN Technology Integration Map (Issue 1.1).

[11] ITU-T Recommendation M.3013 (2000): "Considerations for a telecommunications management network".

[12] 3GPP TS 23.002: "Network architecture (Release 4)".

[13] 3GPP TS 23.101: "General UMTS Architecture (Release 4)".

7.3 Interoperability

7.3.1 Introduction

The new requirement on a UMTS TMN will imply a focus change from net element management towards management of information "information management". Network providers make use of different information in several different ways which also may vary from network to network and from time to time. Basic information as alarms is of course essential information for localising faults but may also be the key information to be able to set up a service with a service level agreement.

Numerous of different interfaces can be identified in a UMTS network in the areas of network element management, network management and service management. The most important and complex of these interfaces will be standardised but many interfaces of less importance are unlikely to be fully standardised and will be up to the individual operator and vendor to develop. To adopt mainstream computing technologies, re-use widely used protocols, standards and an open system architecture will be essential to secure interworking between all physical entities in a UMTS.

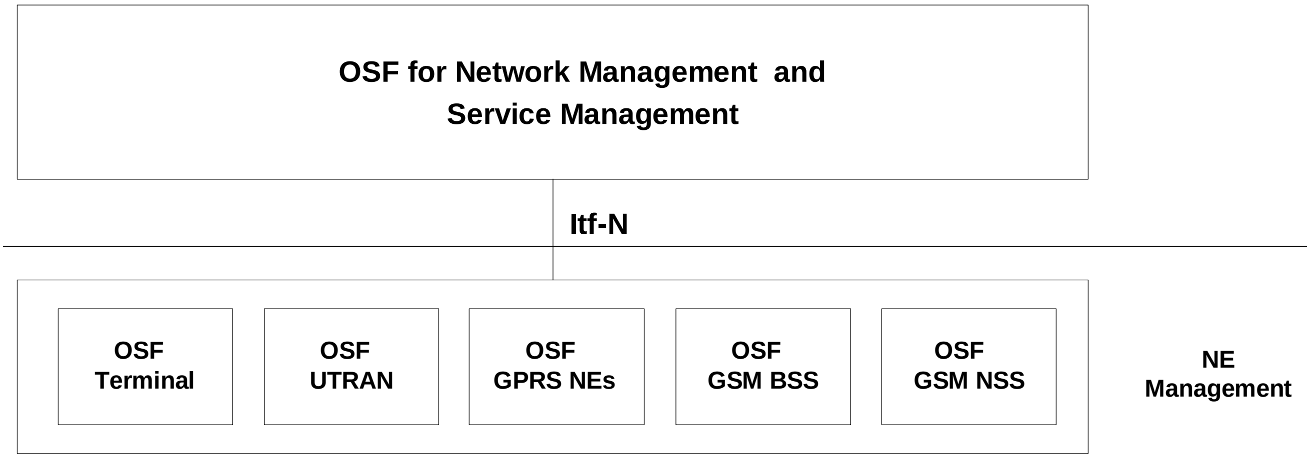
Low-cost and general access to management systems information will be needed. Obviously this is the critical issue and challenging task in the heterogeneous, distributed and complex network of a UMTS.

~~7.3.1~~7.3.2 Interfaces

A UMTS will consist of many different types of components based on different types of technologies. There will be access-, core-, transmission- and ~~intelligent~~ service node networks and many of the UMTS components have already been the targets for Telecom Management standardisation at different levels. Many of these standards will be reused and the management domain of a UMTS will thereby consist of many TMNs. An architectural requirement for UMTS management shall be to support distributed TMNs and TMN-interworking on peer-to-peer basis.

The Telecom Management Architecture can vary greatly in scope and detail, because of scale of operation and that different organisations may take different roles in a UMTS (see clause 5). The architecture of UMTS TMNs shall provide a high degree of flexibility to meet the various topological conditions as the physical distribution and the number of NEs. Flexibility is also required to allow high degree of centralisation of personnel and the administrative practices as well as allowing dispersion to administrative domains (see further clause 10). The 3G Telecom Management architecture shall be such that the NEs will operate in the same way, independently of the OS architecture.

Figure 2 illustrates ~~common NE management domains and interfaces which can be identified in a UMTS.~~the basic domains in UMTS (identified in 3GPP Technical Standards [12],[13]), related management functional areas and introduces Interface-N (Itf-N).



~~Figure 2: Overview of UMTS Telecom Management Domains and Itf-N~~

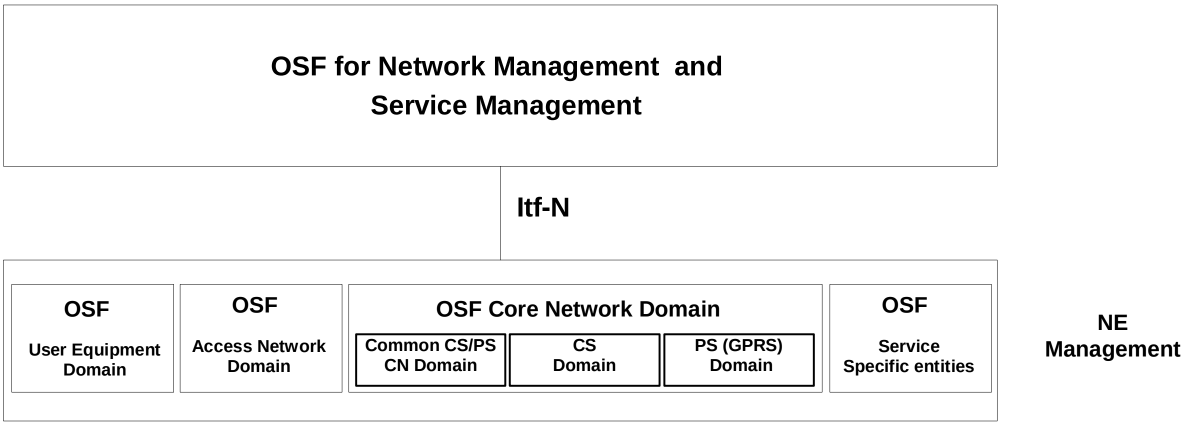


Figure 2: Overview of UMTS Telecom Management Domains and Itf-N

Itf-N between the NE OSFs and NM/SM OSFs (see figure 2).

This interface could be used by the network- and service management systems to transfer management messages, notifications and service management requests via the NE OSF to the Network Elements (NEs).

This interface shall be open and the information models standardised.

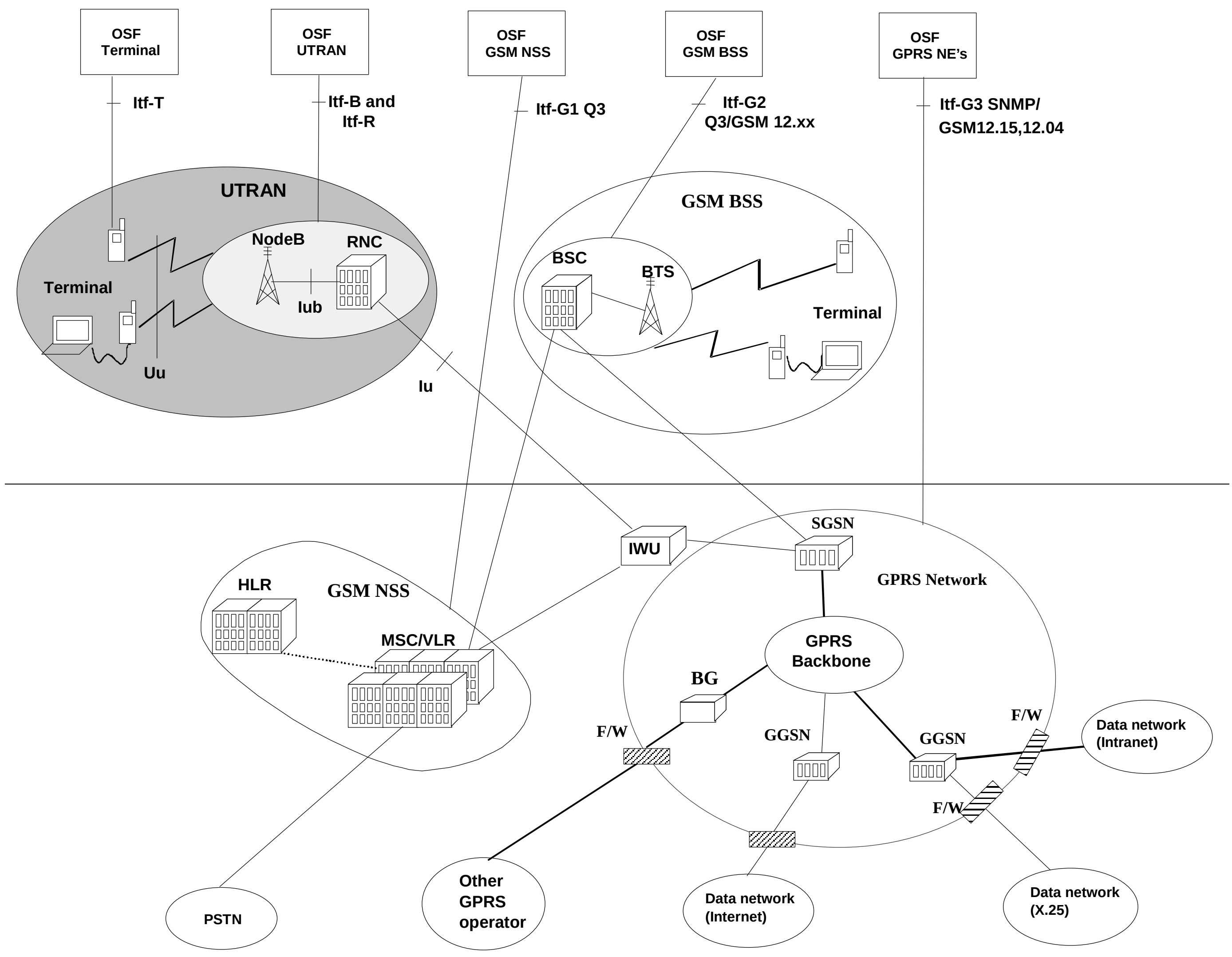


Figure 3: Overview of a UMTS Network, showing management interfaces and management domains

~~All the following interfaces are in illustrated in figure 3:~~

- ~~Itf-T between a terminal and a NE Manager. This interface will in some extent manage the 3G terminal and the USIM of the subscriber. Requirements of this interface are for further study.~~
- ~~Itf-B and Itf-R between UTRAN and a NE Manager.~~
- ~~Itf-G1 between GSM NSS and NE Manager.~~
- ~~Itf-G2 between GSM BSS and NE Manager. This interface is standardised in GSM 12-series specifications.~~
- ~~Itf-G3 between GPRS NEs and a NE Manager. This interface is based on SNMP, GSM 12.15 (charging) and GSM 12.04 (performance management).~~

Telecom management interfaces may be considered from two perspectives:

1. the management information model;
2. the management information exchange.

The management information models will be standardised in other 3GPP documents but the management information exchange will be further described in this architectural standard.

The management task will vary greatly between different network elements in a UMTS. Some NEs are of high complexity e.g. a RNC, while others e.g. a border gateway is of less complexity. Different application protocols can be chosen to best suite the management requirements of the different Network Elements and the technology used.

Application protocols can be categorised out of many capabilities as:

- Functionality;
- Implementation complexity;
- Processor requirements;
- Cost efficiency;
- Market acceptance, availability of "off the shelf commercial systems and software".

For each Telecom Management interface that will be standardised by 3GPP at least one of the accepted protocols will be recommended. Accepted application protocols (e.g. CMIP, SNMP, CORBA IIOP) are defined in 3GPP TS 32.101 [2], Annex A.

7.3.3 Basic entities of a UMTS

To provide the mobile service as it is defined in a UMTS, some specific functions are introduced [12]. These functional entities can be implemented in different physical equipments or gathered. In any case, exchanges of data occur between these entities and from the Telecom Management perspective they can all normaly be treated as network elements of a UMTS. The basic telecom management functional areas as fault management, configuration management, performance management and security management are all applicable to these UMTS entities. As such they are all the targets for UMTS Telecom Management technical standards.

As discussed in clause 5, there will be many possible ways to build a UMTS and thereby many possible architectures of a mobile system. The entities presented in figures 2a,2b,2c,2d should be treated as the fundamental building blocks of any possible implementation of a UMTS.

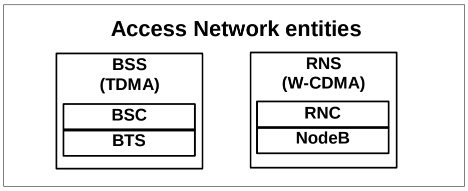


Figure 2a: Basic AN entities

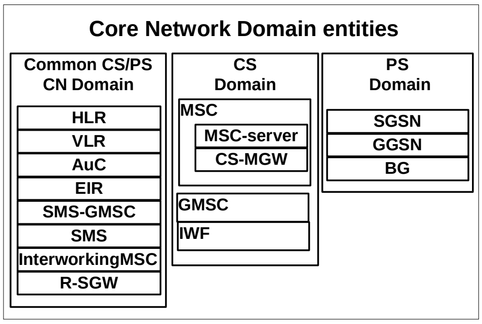


Figure 2b: Basic CN entities

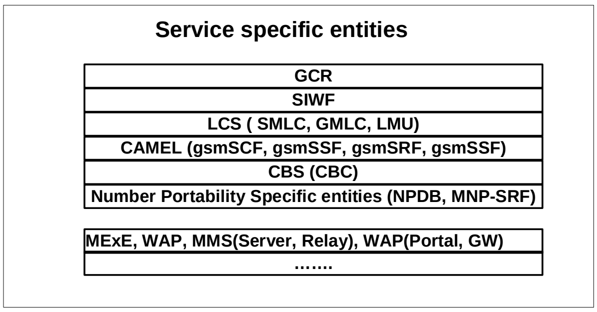


Figure 2c: Examples of Service Specific entities

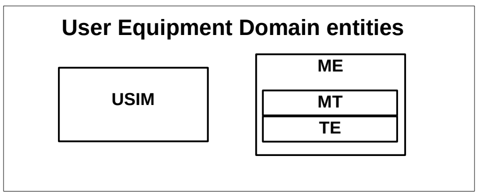


Figure 2d: Basic User Equipment entities

In figure 3 the prime domains for the standardisation effort of 3GPP Telecom Management are shown as shaded.

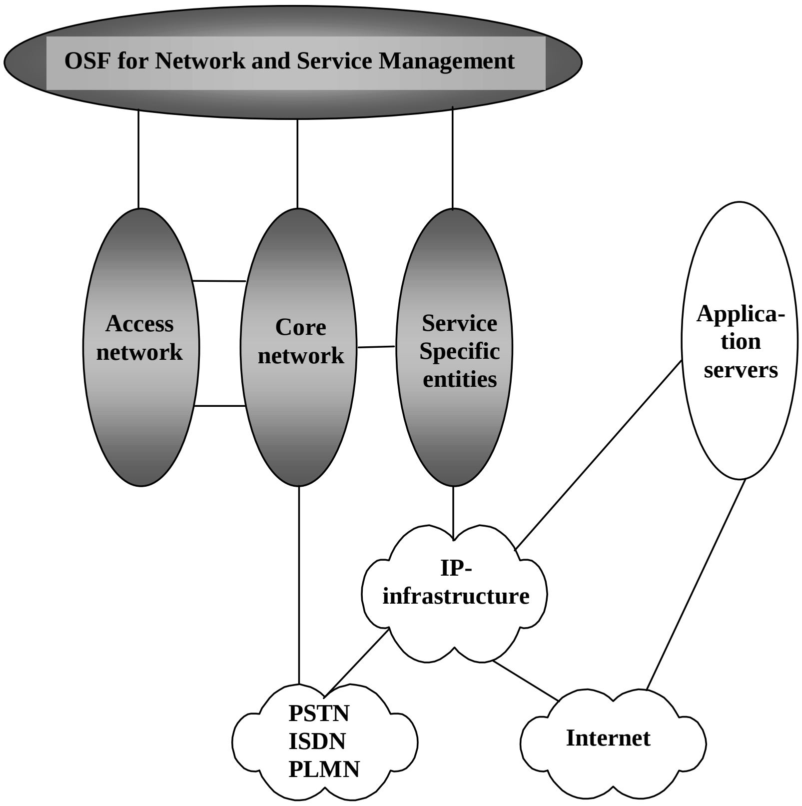


Figure 3 : High level UMTS Network architecture

7.3.42 Open systems approach

Even in the second generation of mobile radio networks the operators has to cope with heterogeneous environments in many different ways. No single vendor is likely to deliver all the management systems needed for a mobile operator.

The many different types of network elements, some with very high management complexity as an exchange and some less complex as a repeater system, are generally supported with unique vendor specific management systems with very low interoperability. Duplicated TMN applications is another obvious reality of this generation of management systems. This will be further discussed under Clause 9 (TMN Applications).

The new UMTS requirements call for open systems that can be supported by the marketplace, rather than being supported by a single (or limited) set of suppliers, due to the unique aspects of the design chosen. Open systems architectures are achieved by having the design focus on commonly used and widely supported interface standards. This should ensure costs and quality that are controlled by the forces of competition in the marketplace.

The open systems approach is a technical and business strategy to:

- Choose commercially supported specifications and standards for selected system interfaces.
- Build systems based on modular hardware and software design.

Selection of commercial specifications and standards in the Open systems approach should be based on:

- Those adopted by industry consensus based standards bodies or de facto standards (those successful in the market place).

- Market research that evaluates the short and long term availability of products.
- Trade-offs of performance.
- Supportability and upgrade potential within defined cost constraint.
- Allowance for continued access to technological innovation supported by many customers and a broad industrial base.

7.3.~~3~~5 Level of openness

The level the interfaces conform to open standards is critical for the overall behaviour. A low level of openness will severely impact on long-term supportability, interoperability, development lead-time, and lifecycle cost and overall performance.

Interfaces are expensive parts in a TMN and interfaces with low level of openness severely impact on development lead-time for the introduction of any system, application component or service. Easy implementation (plug & play) is a requirement for UMTS TMN physical entities and requires a high the level of openness.

7.3.~~4~~6 Closed interfaces

Many second-generation mobile network physical management entities have vendor controlled system/subsystem boundary descriptions that are not disclosed to the public or are unique to this single supplier - closed interfaces.

In a UMTS network, such interfaces will not fulfil the basic requirements and can not be a part of a UMTS TMN.

Closed interfaces can only be used as internal interfaces where no information what so ever has to be shared to other physical management entities.

Annex B (informative): Overview of a UMTS Network

Figure B presents an example of a UMTS network, related management areas and introduces some management interfaces. UMTS Service specific entities are not shown.

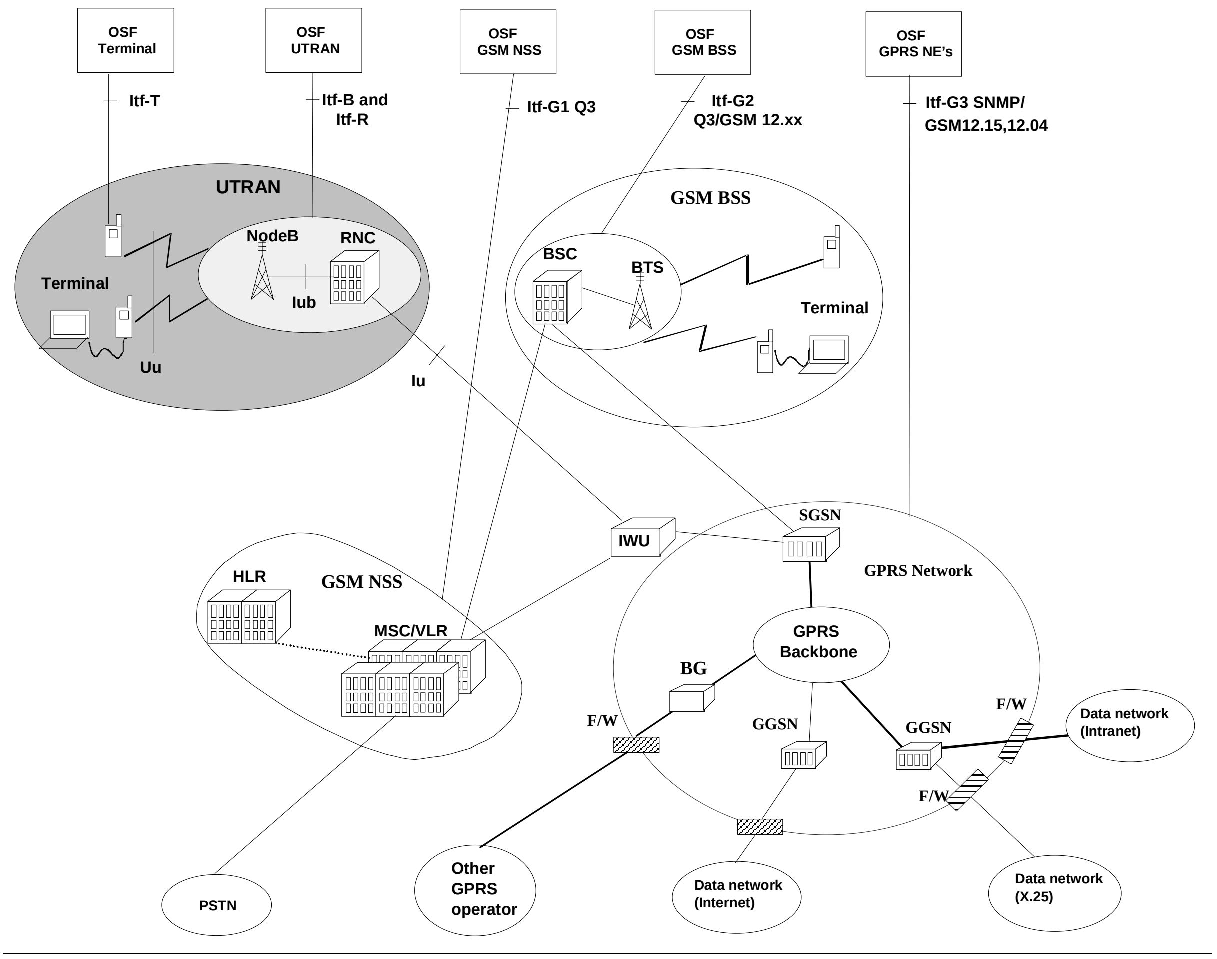


Figure B: Overview of a UMTS Network, showing management interfaces and management areas

All the following interfaces are illustrated in figure B:

- Itf-T between a terminal and a NE Manager. This interface will in some extent manage the 3G terminal and the USIM of the subscriber. Requirements of this interface are for further study.
- Itf-B and Itf-R between UTRAN and a NE Manager.
- Itf-G1 between GSM NSS and NE Manager.
- Itf-G2 between GSM BSS and NE Manager. This interface is standardised in GSM 12-series specifications.
- Itf-G3 between GPRS NEs and a NE Manager. This interface is based on SNMP, GSM 12.15 (charging) and GSM 12.04 (performance management).

Annex CB (informative): Change history

3GPP TSG-SA5 (Telecom Management) **S5-010377**
Meeting #20, Brighton, UK, 28 May – June 1 2001

CR-Form-v3

CHANGE REQUEST

⌘	**32.102**	**CR**	**011**	⌘	rev	**-**	⌘	Current version:	**4.0.0**	⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	General clarifications and enhancements			
Source: ⌘	SA5			
Work item code: ⌘	OAM-AR		***Date:*** ⌘	01/06/2001
Category: ⌘	**F**		***Release:*** ⌘	Rel4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*	

Reason for change: ⌘	Ambiguity about the subject of TS 32.102 and requirements for a UMTS TMN conformant entity.
Summary of change: ⌘	Better formulated scope indicating the target for the document and clearifying requirements for a UMTS TMN conformant entity.
Consequences if not approved: ⌘	The scope can not fully be used as a summary for bibligraphic purposes and some requirements for UMTS TMN Conformance entities are unclear.

Clauses affected: ⌘	1, 12	
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments: ⌘		

1 Scope

The present document identifies identify and standardises the most important and strategic contexts in the physical architecture for the management of UMTS. It serves as a framework to help define a telecom management physical architecture for a planned UMTS and to adopt standards and provide products that are easy to integrate.

The requirements identified in this document are applicable to all further development of UMTS Telecom Management specifications as well as the development of UMTS Management products. This document can be seen as guidance for the development of all other Technical Specification addressing the management of UMTS, except 3GPP TS 32.101 [2].

The present document is applicable to all further Technical Specifications regarding the Telecom Management of UMTS.

12 UMTS TMN Conformance

The goal of TMN conformance (see M.3010) is to increase the probability that different implementations within a TMN will be able to interwork, that TMNs in different service/network provider's administrations and customer's system will be able to interwork as much as agreed on.

TMN conformance are testable conditions.

It is only the requirements on the external behaviour that have to be met by the conformance statements.

To finally guarantee interoperability the purchaser/user must be able to test and verify that any two systems, claiming any type of TMN conformance, interoperate. Interoperability testing must include:

- Testing of the interface protocols
- The shared/exposed information over those interfaces
- The interface functionality of the system

A UMTS TMN conformant entity must support necessary information to support such interoperability testing namely:

- Statements made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities and options have been implemented.
- Detailed information to help determine which capabilities are testable and which are untestable.
- Information needed in order to be able to run the appropriate test.
- The system interface documentation shall list the documents that define the specified UMTS information models with the inclusion of the version number and date.
- Necessary information about vendor supplied extensions of a standardised interface

The interface specification must be documented, publicly available and licensable at reasonable price on a non-discriminatory basis.

Specific conformance guidelines shall be included in the different IRP solution sets. A UMTS TMN conformant entity must support information stated in those conformance guidelines.

3GPP TSG-SA5 (Telecom Management) **S5-010378**
Meeting #20, Brighton, UK, 28 May – June 1 2001

CR-Form-v3

CHANGE REQUEST

⌘	**32.102**	**CR**	**012**	⌘	rev	**-**	⌘	Current version:	**4.0.0** ⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title: ⌘	Alignment with 3GPP drafting rules regarding verbal forms for the expression of provisions			
Source: ⌘	SA5			
Work item code: ⌘	OAM-AR		***Date:*** ⌘	01/06/2001
Category: ⌘	**F**		***Release:*** ⌘	Rel4
	Use one of the following categories: **F** *(essential correction)* **A** *(corresponds to a correction in an earlier release)* **B** *(Addition of feature),* **C** *(Functional modification of feature)* **D** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*	

Reason for change: ⌘	Global change of all occurrences of the word "must" to "shall" has been introduced.
Summary of change: ⌘	Some occurrences of the word "Shall" in version 4.0.0 are changed to align with 3GPP drafting rules
Consequences if not approved: ⌘	Misunderstanding and unclear requirements.

Clauses affected: ⌘			
Other specs affected: ⌘	[ ]	Other core specifications	⌘
	[ ]	Test specifications	
	[ ]	O&M Specifications	
Other comments: ⌘			

5 General view of UMTS Management Physical architectures

Telecom Management Architectures can vary greatly in scope and detail. The architecture for a large service provider, with a lot of existing legacy systems and applications, upon which many services are based, will be of high complexity. In contrast, the architectural needs of a start-up mobile operator providing its services to a small group of value added Service Providers will be much less and will probably focus on more short-term needs.

A mobile network operator has to manage many different types of networks as radio networks, exchanges, transmission networks, area networks, intelligent nodes and substantial amounts of computer hardware/software. This wide variety of network equipment ~~shall~~ will most probably be obtained from a variety of equipment vendors. The nature of a mobile radio network will be heterogeneous and will present a number of operational difficulties for the service provider on enabling effective and efficient network management.

The standardisation work for the management of UMTS has adopted the top-down approach and will from business needs identify functional and informational architectures. The physical architecture will have to meet these requirements and as there are many ways to build a UMTS it will vary greatly from one TMN solution to another. There will be many physical implementations, as different entities will take different roles in a UMTS.

It is obvious that it will not be meaningful or even possible to fully standardise a common telecom management physical architecture for UMTS. This document will identify and standardise the most important and strategic contexts and serve as a framework to help define a physical architecture for a planned UMTS.

7 TM Architectural aspects

7.2 Architectural constraints

Large software systems, such as a network management system, are a capital investment that operators cannot afford to scrap every time its requirements change. Network operators are seeking cost-effective solutions to their short-term needs. All these reality-related issues are vital constraints that ~~shall~~ should be addressed in the definition of the architecture.

The standardisation of UMTS will bring new and different services that will add new demands on network management. Every UMTS organisation will include different functionality depending on the role-played and the equipment used by that UMTS entity. Regulation may force some of the roles that shall be taken. The need to link systems across corporate boundaries will be a consequence of this.

The rapid evolution of new services and technologies will also put requirements on the UMTS physical management architecture to accommodate market and technology trends. To future-proof investments and continuously be able to take advantage of new technologies are important constraints to the physical architecture.

A UMTS TMN ~~shall~~ should also adopt an architecture that will achieve scalability and extensibility of systems and networks so the TMN can grow as the services expand over time. To start with a small TMN and easily be able to expand the TMN after new requirements will be important issues for most UMTS operators.

The telecom management network will be just one part of the overall business of a company. System management, general security issues and development strategies can be the target for company policies. System architectures and technology choices, as well as the availability of off-the-shelf commercial systems and software components that fulfil the requirements established in this specification, may be critical to an operator's implementation of the specified UMTS management architecture.

7.3.1 Interfaces

A UMTS will consist of many different types of components based on different types of technologies. There will be access-, core-, transmission- and intelligent node networks and many of the UMTS components have already been the targets for Telecom Management standardisation at different levels. Many of these standards will be reused and the management domain of a UMTS will thereby consist of many TMNs. ~~An architectural requirement for~~The architecture of UMTS ~~management~~ TMNs ~~shall~~ should ~~be to~~ support distributed TMNs and TMN-interworking on peer-to-peer basis.

The Telecom Management Architecture can vary greatly in scope and detail, because of scale of operation and that different organisations may take different roles in a UMTS (see clause 5). The architecture of UMTS TMNs ~~shall~~ should provide a high degree of flexibility to meet the various topological conditions as the physical distribution and the number of NEs. Flexibility is also required to allow high degree of centralisation of personnel and the administrative practices as well as allowing dispersion to administrative domains (see further clause 10). The 3G Telecom Management architecture ~~shall~~ should be such that the NEs will operate in the same way, independently of the OS architecture.

7.4 Data communication networks

Within a TMN, the necessary physical connection (e.g. circuit-switched or packet-switched) may be offered by communication paths constructed with all kinds of network components, e.g. dedicated lines, packet-switched data network, ISDN, common channel signalling network, public-switched telephone network, local area networks, terminal controllers, etc. In the extreme case the communication path provides for full connectivity, i.e. each attached system can be physically connected to all others.

The TMN should be designed such that it has the capability to interface with several types of communications paths, to ensure that a framework is provided which is flexible enough to allow the most efficient communications:

- between NE and other elements within the TMN;
- between WS and other elements within the TMN;

- between elements within the TMN;
- between TMNs;
- between TMNs and enterprise.

In this case the term efficiency relates to the cost, reliability and maintainability of the data transported.

Two aspects impact costs. The first is the actual cost to transport data across the network between the TMN and the NE. The second aspect is the design of the interface including the selection of the appropriate communications protocol.

Whatever standardised protocol suite at the networking level that is capable of meeting the functional and operational requirements (including the network addressing aspects) of the Logical and Application Protocol levels of a given UMTS management interface, is a valid Networking Protocol for that interface.

A number of requirements ~~shall~~ must be met by the Networking Protocol, as follows:

- Capability to run over ~~any~~ all supported bearers (leased lines, X.25, ATM, Frame Relay,...)
- Support of existing transport protocols and their applications, such as OSI, TCP/IP family, etc.
- Widely available, cheap and reliable.

The Internet Protocol (IP) is a Networking Protocol that ideally supports these requirements. IP also adds flexibility to how management connectivity is achieved when networks are rolled out, by offering various implementation choices. For instance, these may take the form of:

- Dedicated management intranets.
- Separation from or integration into an operator's enterprise network.
- Utilisation, in one way or another, of capacities of the public Internet and its applications or other resources.

7.5 New technologies

Meeting application requirements in the most affordable manner is together with development lead-time important issues identified in early UMTS management standardisation work. But the TMN functional, information and physical architectures ~~shall~~ should also keep pace with the introduction of new technologies, services and evolving network infrastructures. Technology is advancing so rapidly today that this ~~shall~~ should be a fundamental part of the physical architecture – to be able to easily adopt new important technologies.

A UMTS will need to incorporate new successful technologies from the IT-world to which TMN standardisation is not fully applicable. Today distributed computing implementations have matured to a point where the goals of TMN can be realised using commonly available technologies for a reasonable cost.

Widely accepted open standards and new IT-technologies will be indispensable to fulfil the challenging managing requirements of UMTS.

New technologies in the IT business as generic application components together with distributed processing technology are new important drivers upon application design of management systems. The possibility to purchase functional components from the open market are of great importance from many aspects as cost-efficiency and time-to-market.

13.5 Communications considerations

DCN architectures ~~shall~~ should be planned and designed to ensure that their implementation provides appropriate degrees of availability and network delay while minimising cost.

One ~~shall~~ should consider the selection of communications architectures, e.g. star, multipoint, loop, tree, etc..

The communications channels, e.g. dedicated lines, circuit-switched networks and packet networks used in providing the communications paths, also play an important role.

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Meeting #20, Brighton, U.K., 28 May – 1 June 2001

CR-Form-v3

CHANGE REQUEST

⌘	**32.102**	**CR**	**013**	⌘ rev	**-**	⌘ Current version:	**4.0.0**	⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title:	⌘	Update and clarify compliance condition for a UMTS entity		
Source:	⌘	SA5		
Work item code:	⌘	OAM-AR	***Date:*** ⌘	01/06/2001
Category:	⌘	**F**	***Release:*** ⌘	Rel4
		Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Updating and clearifying important compliance conditions for UMTS entities
Summary of change:	⌘	Sharpening of the condition that if an IRP Information Model is standardised and a corresponding Solution Set is specified, than it shall be supported.
Consequences if not approved:	⌘	Unclear compliance conditions

Clauses affected:	⌘	8.2		
Other specs affected:	⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘	
Other comments:	⌘			

8.2 Network elements management architecture

Figure 4 shows two possible options for management interface from the OS upper layers to NE. Option 1, provides access to the NE via element manager, and Option 2, provides a direct access. It is sufficient to provide one or the other.

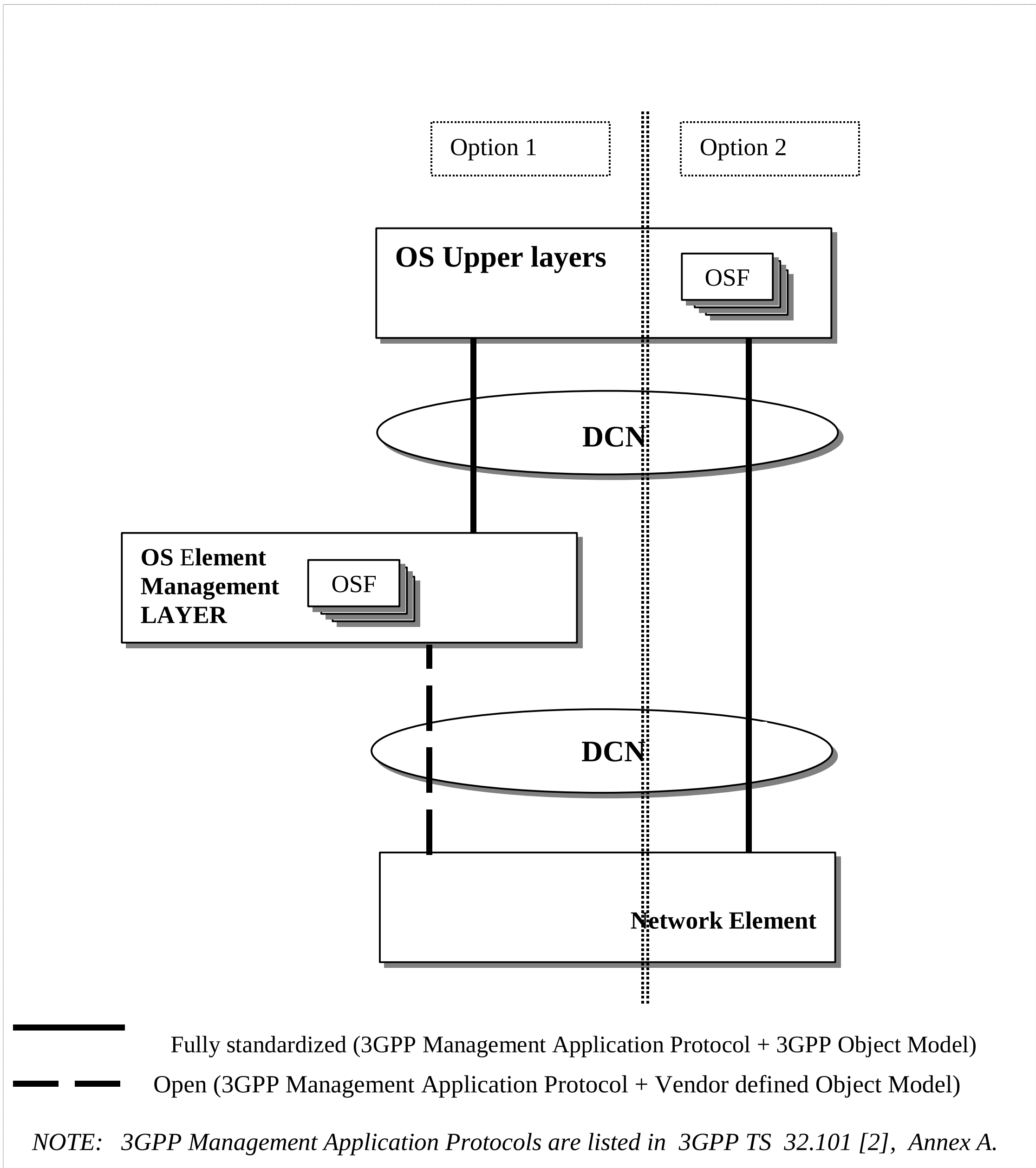

Figure 4: Network Element Management Architecture

For a UMTS entity (Network Element or management system) to be compliant to a given UMTS Management Interface the following conditions shall all be satisfied:

Item	Compliance conditions
1	Implements relevant 3GPP ~~UMTS Management~~IRP Information Model ~~and flows~~ For an interface illustrated by the dashed line in figure 4 the object model is not standardised but it shall be open
2	Application protocol (e.g. CMIP,SNMP,CORBA IIOP) (Defined in TS 32.101 [2], Annex A) If 3GPP has specified one or more IRP Solution Sets corresponding to the IRP Information Model in item 1 then at least one of those IRP Solution Sets shall be supported ~~Implements relevant IRP Solution Sets, if available for that application protocol.~~ (Defined in TS 32.101 [2], Annex C)
3	Valid Network Layer Protocol (see Annex B of TS 32.101 [2])
4	Lower protocol levels required by Item 1,2 and 3

~~Any other entity taking part in a UMTS, as an implementation choice, shall satisfy the following condition:~~

~~Item~~	~~Compliance conditions~~
~~1~~	~~Not standardised but open~~

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CHANGE REQUEST

⌘	**32.102**	**CR**	**014**	⌘ rev	**-**	⌘ Current version:	**4.0.0**	⌘

Proposed change affects: ⌘ (U)SIM [ ] ME/UE [ ] Radio Access Network [X] Core Network [X]

Title:	⌘	Delete OSA definition	
Source:	⌘	SA5	
Work item code:	⌘	OAM-AR	***Date:*** ⌘ 01/06/2001
Category:	⌘	**D**	***Release:*** ⌘ Rel4
		Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.	*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*

Reason for change:	⌘	Unused definition of OSA (Open System Architecture) unclearly reincarnated with other meaning (Open Service Access)
Summary of change:	⌘	The definition of Open Systems Access (OSA) deleted
Consequences if not approved:	⌘	Ambiguity of the definition of OSA

Clauses affected:	⌘	3.1
Other specs affected:	⌘	[ ] Other core specifications ⌘ [ ] Test specifications [ ] O&M Specifications
Other comments:	⌘	

3 Definitions and abbreviations

3.1 Definitions

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

Architecture: The organisational structure of a system or component, their relationships, and the principles and guidelines governing their design and evolution over time.

Closed interfaces: Privately controlled system/subsystem boundary descriptions that are not disclosed to the public or are unique to a single supplier.

De facto standard: A standard that is widely accepted and used but that lacks formal approval by a recognised standards organisation.

Interface standard: A standard that specifies the physical or functional interface characteristics of systems, subsystems, equipment, assemblies, components, items or parts to permit interchangeability, interconnection, interoperability, compatibility, or communications.

Interoperability: The ability of two or more systems or components to exchange data and use information.

Intra-operability: The ability to interchange and use information, functions and services among components within a system.

IRPAgent: The IRPAgent encapsulates a well-defined subset of network (element) functions. It interacts with IRPManagers using an IRP. From the IRPManager's perspective, the IRPAgent behaviour is only visible via the IRP.

IRPManager: The IRPManager models a user of the IRPAgent and it interacts directly with the IRPAgent using the IRP. Since the IRPManager represents an IRPAgent user, they help delimit the IRPAgent and give a clear picture of what the IRPAgent is supposed to do. From the IRPAgent perspective, the IRPManager behaviour is only visible via the IRP.

IRP Information Model: An IRP Information Model consists of an IRP Information Service and a Network Resource Model (see below for definitions of IRP Information Service and Network Resource Model).

IRP Information Service: An IRP Information Service describes the information flow and support objects for a certain functional area, e.g. the alarm information service in the Fault Management area. As an example of support objects, for the Alarm IRP there is the "alarm information" and "alarm list".

IRP Solution Set: An IRP Solution Set is a mapping of the IRP Information Service to one of several technologies (CORBA/IDL, SNMP/SMI, CMIP/GDMO etc.). An IRP Information Service can be mapped to several different IRP Solution Sets. Different technology selections may be done for different IRPs.

Management Infrastructure: The collection of systems (computers and telecommunications) a UMTS Organisation has in order to manage UMTS.

Market Acceptance: Market acceptance means that an item has been accepted in the market as evidenced by annual sales, length of time available for sale, and after-sale support capability.

Modular: Pertaining to the design concept in which interchangeable units are employed to create a functional end product.

Module: An interchangeable item that contains components. In computer programming, a program unit that is discrete and identifiable with respect to compiling, combining with other modules, and loading is called a module.

Network Resource Model (NRM): A protocol independent model describing managed objects representing network resources, e.g. an RNC or NodeB.

Open Specifications: Public specifications that are maintained by an open, public consensus process to accommodate new technologies over time and that are consistent with international standards.

Open Standards: Widely accepted and supported standards set by recognised standards organisation or the commercial market place. These standards support interoperability, portability, and scalability and are equally available to the general public at no cost or with a moderate license fee.

~~**Open Systems Access (OSA):** In order to be able to implement future applications/end user services that are not yet known today, a highly flexible Framework for Services is required. The Open Service Access (OSA) enables applications implementing the services to make use of network functionality. Network functionality offered to applications is defined in terms of a set of Service Capability Features (SCFs). These SCFs provide functionality of network capabilities which is accessible to applications through the standardised OSA interface upon which service developers can rely when designing new services (or enhancements/variants of already existing ones). The aim of OSA is to provide a standardised, extendible and scalable interface that allows for inclusion of new functionality in the network and/or by third party service providers in future releases with a minimum impact on the applications using the OSA interface.~~

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S5A010132

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CHANGE REQUEST

⌘	32.102	CR	015	⌘	rev	-	⌘	Current version:	4.0.0	⌘

*For **HELP** on using this form, see bottom of this page or look at the pop-up text over the ⌘ symbols.*

Proposed change affects: ⌘	(U)SIM		ME/UE		Radio Access Network	X	Core Network	X

Title:	⌘ Enhancements of the IRP Concept			
Source:	⌘ SA5			
Work item code:	⌘ OAM-AR		***Date:*** ⌘	01/06/2001
Category:	⌘ **F**		***Release:*** ⌘	Rel4
	Use one of the following categories: ***F*** *(essential correction)* ***A*** *(corresponds to a correction in an earlier release)* ***B*** *(Addition of feature),* ***C*** *(Functional modification of feature)* ***D*** *(Editorial modification)* Detailed explanations of the above categories can be found in 3GPP TR 21.900.		*Use one of the following releases:* *2 (GSM Phase 2)* *R96 (Release 1996)* *R97 (Release 1997)* *R98 (Release 1998)* *R99 (Release 1999)* *REL-4 (Release 4)* *REL-5 (Release 5)*	

Reason for change: ⌘	In release 1999 the IRP methodology was not precise enough. As a result IRPs contained redundant and sometimes confusing text, and the same IRPs could be interpreted in different ways.
Summary of change: ⌘	Add a more precise definition of the IRP methodology, with the inclusion of Information Objects and pre- and post conditions for operations.
Consequences if not approved: ⌘	The identified ambiguity and weakness of the IRP description will remain.

Clauses affected: ⌘	2, 3.1, 3.2, 10.1, 10.3, 10.4, 10.5 (new), 10.6 (old 10.5), Annex B, C (new), D (new), E (new) and F (old C)	
Other specs affected: ⌘	[ ] Other core specifications [ ] Test specifications [ ] O&M Specifications	⌘
Other comments: ⌘	Editorial Instructions: Note that the old figure 12 (marked with Delete) shall be deleted and replaced by the new figure 12. Note also that the inclusion of the new figure 13 will mean that all subsequent figures have to be given higher numbers.	

2 References

[3] VoidITU-T Recommendation X.721: "Information technology - Open Systems Interconnection - Structure of management information: Definition of management information".

[5] VoidITU-T Recommendation X.733: "Information technology - Open Systems Interconnection - Systems Management: Alarm reporting function".

[6] VoidITU-T Recommendation X.736: “Information technology – Open Systems Interconnection – Security Alarm Reporting Function”.

[7] VoidITU-T Recommendation M.3100-1995: “Generic network information model”.

[8] VoidGSM 12.11: Digital cellular telecommunications system (Phase 2); Fault management of the Base Station System (BSS).

[12] 3GPP TS 32.111: "3G Fault Management".

3.1 Definitions

Information Object : defined in 3GPP TS 32.101 [2].

Information Service: defined in 3GPP TS 32.101 [2].

IRPManager: The IRPManager models a user of the IRPAgent and it interacts directly with the IRPAgent using the IRP. ~~Since the IRPManager represents an IRPAgent user, they help delimit the IRPAgent and give a clear picture of what the IRPAgent is supposed to do.~~ From the IRPAgent perspective, the IRPManager behaviour is only visible via the IRP.

IRP Information Model: defined in 3GPP TS 32.101 [2].~~An IRP Information Model consists of an IRP Information Service and a Network Resource Model (see below for definitions of IRP Information Service and Network Resource Model).~~

IRP Information Service: defined in 3GPP TS 32.101 [2].~~An IRP Information Service describes the information flow and support objects for a certain functional area, e.g. the alarm information service in the Fault Management area. As an example of support objects, for the Alarm IRP there is the "alarm information" and "alarm list".~~

IRP Solution Set: defined in 3GPP TS 32.101 [2].~~An IRP Solution Set is a mapping of the IRP Information Service to one of several technologies (CORBA/IDL, SNMP/SMI, CMIP/GDMO etc.). An IRP Information Service can be mapped to several different IRP Solution Sets. Different technology selections may be done for different IRPs.~~

Managed Object : defined in 3GPP TS 32.101 [2].

Network Resource Model (NRM): defined in 3GPP TS 32.101 [2].~~A protocol independent model describing managed objects representing network resources, e.g. an RNC or NodeB~~.

Solution Set: defined in 3GPP TS 32.101 [2].

Support object : defined in 3GPP TS 32.101 [2].

3.2 Abbreviations

IM	Information Model
IS	Information Service
SS	Solution Set
SNM	Sub-Network Manager

10.1 General

Relating to the OSI functional areas "FCAPS", IRPs are here introduced addressing parts of "FCPS" – Fault, Configuration, Performance, and Security management. Comparing with TMF TOM (Telecom Operations Map) [9], the introduced IRPs address process interfaces at the EML-NML (Element Management Layer – Network Management Layer) boundary. In 3GPP/SA5 context, this can also be applied to the Itf-N between EM-NM and NE-NM.

The three cornerstones of the IRP concept are:

- **Top-down, process-driven modelling approach**
  The purpose of each IRP is automation of one specific task, related to TMF TOM. This allows taking a "one step at a time" approach with a focus on the most important tasks.

- **Protocol-independent modelling**
  Each IRP consists of a protocol-independent model (the IRP information ~~model~~Service) and several protocol-dependent models (IRP solution sets).

- **Standard based protocol dependent modelling**
  Models in different IRP solution sets (CMIP, SNMP, WBEM etc.) will be different as existing standard models of the corresponding protocol environment need to be considered. The means that solution sets largely need to be "hand crafted".

10.3 Network infrastructure IRPs

When providing integrated management solutions for multi-vendor networks, there is a strong requirement that the NEs and the management solutions that go together with them are systems integrateable. It is here proposed that the telecom vendors provide a set of Network Infrastructure IRPs.

It should be noted that these IRPs could be provided by either the NE, or the Element Manager (EM) or Sub-Network Manager (SNM) that goes together with the type of NE. There is actually not a clear distinction any more between NE and element management applications, mainly due to the increased processing capacity of the equipment platforms. Embedded Element Managers providing a web user interface is a common example of that.

These IRPs are introduced to ensure interoperability between Product-Specific Applications (PSA) and the types of generic applications shown in the figure below. These IRPs are considered to cover the most basic needs of task automation.

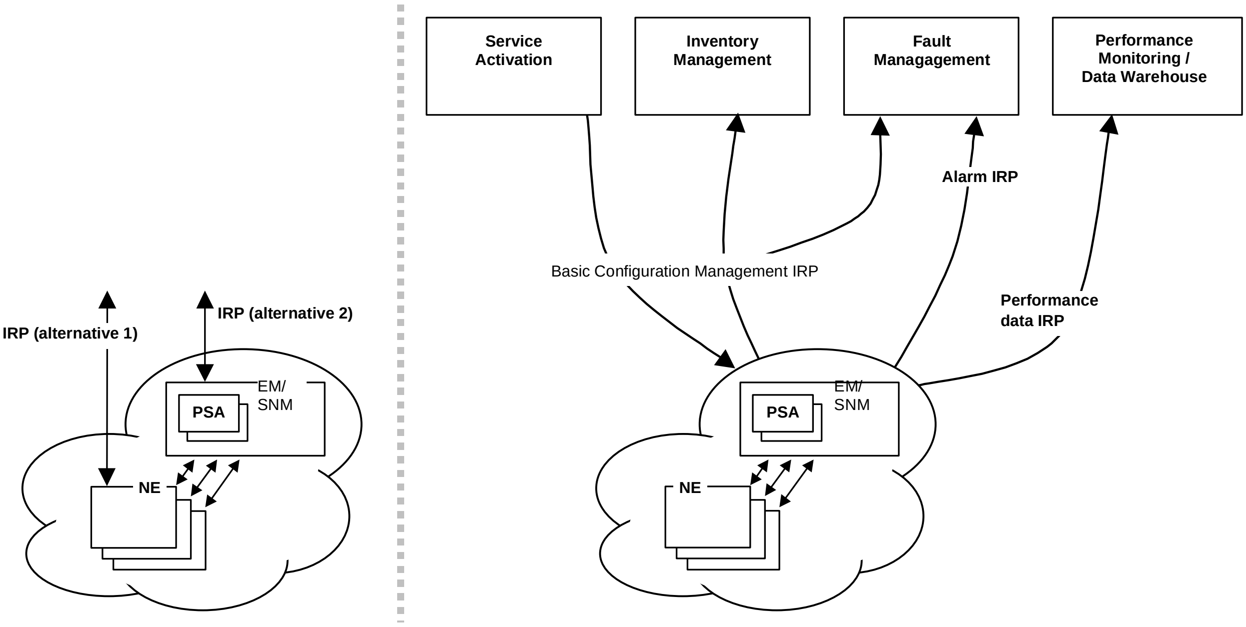


Figure 11: IRPs for application integration

The IRPs presented in the figure are just an example and do not reflect the exact set of IRPs defined by the 3GPP. ~~The following gives examples of some basic IRPs:~~

~~The most basic need of a Fault Management (FM) application is to support alarm surveillance. Product-specific applications need to supply an *Alarm IRP* to forward alarms from all kinds of NEs and equipment to the FM application.~~

~~A *Basic Configuration Management IRP* is needed for management of topology and logical resources in the network (retrieval of the configuration and status of the network elements). It can also be used by inventory management applications, to track individual pieces of equipment and related data, as well as for all types of Configuration Management e.g. Service Activation applications, as a provisioning interface for frequent configuration activities that require automation. This IRP defines an IRP Information Model, covering both an IRP Information Service and a Network Resource Model.~~

~~Performance Monitoring (PM) information is made available through the *Performance Data IRP*.~~

~~It is realised that the Alarm IRP, Performance Data IRP and Basic Configuration Management IRP~~ M~~m~~any IRPs ~~all~~ have similar needs to use notifications. The corresponding service is formalised as a *Notification IRP*. It specifies: firstly, an interface through which subscriptions to different types of notifications can be set up (or cancelled), and secondly, common attributes for all notifications.

Further, applying a common *Name Convention for Managed Objects* is useful for co-operating applications that require identical interpretation of names assigned to network resources under management.

10.4 Defining the IRPs

It is important to ~~avoid dependency on~~accommodate more than one specific technology, as the technologies will change over time. Applications need to be future-proof; One fundamental principle for achieving this is to clearly separate the semantics of information definition ~~models~~ from the protocols definitions (accessing the information) for the external interfaces~~, where the information models are more important than the selection of protocols~~.

~~Thus, the detailed IRP specifications are divided into two main parts, following the directives from TMF's SMART TMN:~~

- ~~*Information models* specified with an implementation neutral modelling language. The Unified Modelling language (UML) has been selected, as it is standardised (by OMG), supported by most object-oriented tools and used in several ongoing standardisation efforts (CIM etc.).~~

- ~~*Solution sets*, i.e. mappings of the information models to one or several protocols (CORBA/IDL, SNMP/SMI, CMIP/GDMO, COM/IDL etc.). Different protocol selections may be done for different IRPs.~~

The framework being used to define IRPs allows the implementation of user requirements for each management capability (e.g. configuration management), by modelling the information related to the resources to be managed and the way that the information may be accessed and manipulated. Such modelling is done in a way that is independent of the technology and distribution used in the implementation of a management system.

An IRP for a management capability is composed of 3 types of documents. The first type of document captures the user requirements. The second type of document, known as « Information Service », specifies the information observable and controlled by management system's client, related to the network resources under management. The IS document also specifies the semantics of the interactions used to carry these information. The third type of document, known as « Solution Set », contains specification of the system in terms of technology choice (e.g. CMIP, CORBA). In this type of specification, the syntax, rather than the semantic are specified. One instance of a Solution Set document is produced per communication technology supported.

The IRP methodology uses the following steps:

a. Capture the management requirements.
b. Specify the semantics of the information to describe the system. Trace back to item (a).
c. Specify the semantics of the interactions between the management system and its clients. Trace back to item (a).
d. Specify the syntaxes of the information and interactions identified in (b) and (c). The specification is technology dependent. Trace back to items (b) and (c)

The set of resources that form an NRM can also be described using the requirement documents and the Information Service (without the part on information access). Both the NRM and IRP Information Service definitions are used to define Solution Sets to develop management capabilities at, for example a CORBA based interface.

As presented above, the Information Service document may contain two parts, the information related to the resources to be managed and the way that the information may be manipulated.

The first part defines the information types within a distributed system. It is in line with the Analysis phase of ITU-T M.3020. From the point of view of the Network Level modelling work it reflects the information aspects (including states and significant transitions) of the managed resources and the management services. It defines information object classes, the relationships between these object types, their attributes and states along with their permitted state transitions. It may also define the allowable state changes of one or more information objects. As recommended in M.3020, UML diagrams (class diagram, state diagram) are used to represent information when appropriate. This rest of the specification is described using an information description specified in natural language with appropriate label keywords (e.g. DEFINITION, ATTRIBUTE, CONSTRAINTS, etc…). A definition of the IS information template is provided in Annex B.

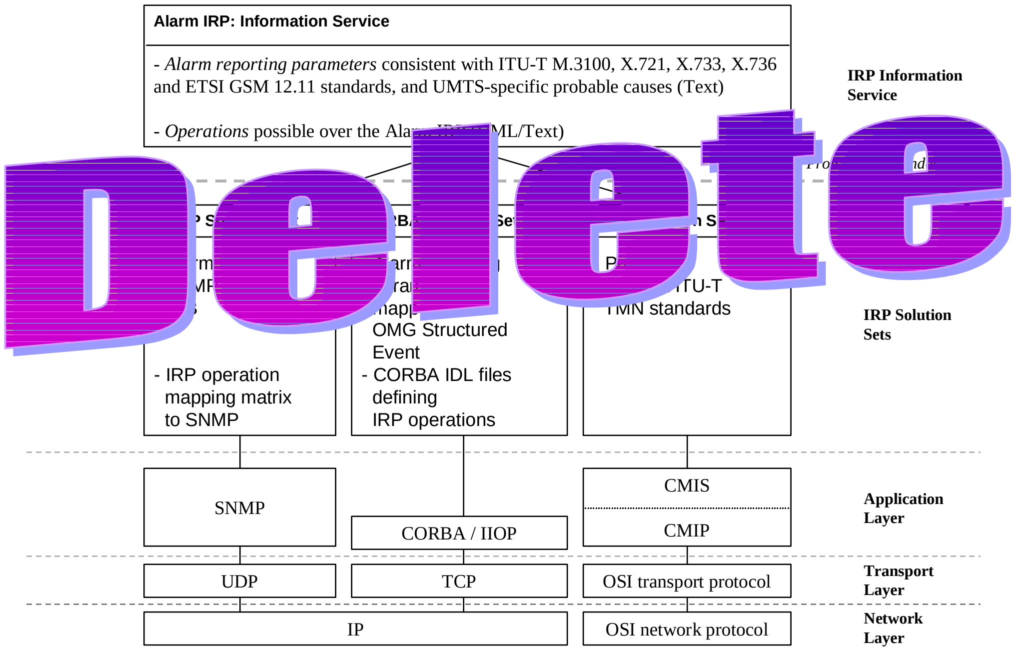
Management service specific information objects may be created by subclassing from the objects in the basic network model, and extending them for that application. In this case, the new management service specific subclass may include other attributes, in addition to those defined in its superclass. Additional relationships and attributes may also be created as needed for that management service. Completely new objects can also be added.

The second part defines interfaces. Each interface contains one or more operations or one or more notifications that are made visible to management service users. An interface encapsulates information exchanged that is atomic in the sense that either all the information exchanged are visible (to management service users) or none. In addition, the specification of the information exchanged is in semantics only. No syntax or encoding can be implied. The operations or notifications are defined with their name, input and output parameters, pre and post conditions, raised exceptions and operation behaviour. These operation and notification specifications refer, through the utilisation of parameter matching, to the information objects. A definition of the IS operations/notifications template is provided in Annex B.

The Solution Set document contains the mapping of the information objects and interactions specified in the IS, into their corresponding syntaxes of a particular chosen technology. The mapping is infrastructure specific and satisfies scenarios where interfaces have been selected, according to mapping choices (driven for example by system performance, development cost, time to market). The mapping is not always one-to-one. General rules valid for all IRP Solution Sets are defined in Annex D. Rules for specific Solution Sets, such as ~~Corba~~CORBA, are defined in an Annex for each of the Solution Set technologies used by 3GPP.

Managed Object Classes as defined in a CMIP or CORBA Solution Set document represents a mapping into GDMO or IDL of Information Object Classes and other additional objects classes that can be introduced to support interfaces defined in the Information Service. Whether instances of Managed Object Classes are directly accessible or not may not be specified by IRP specifications.

Figure 12 shows an example of how an IRP can be structured (the Alarm IRP). Note that figure 12 is only an example of what could be the Alarm IRP, the Alarm IRP specified in [12] can be different.



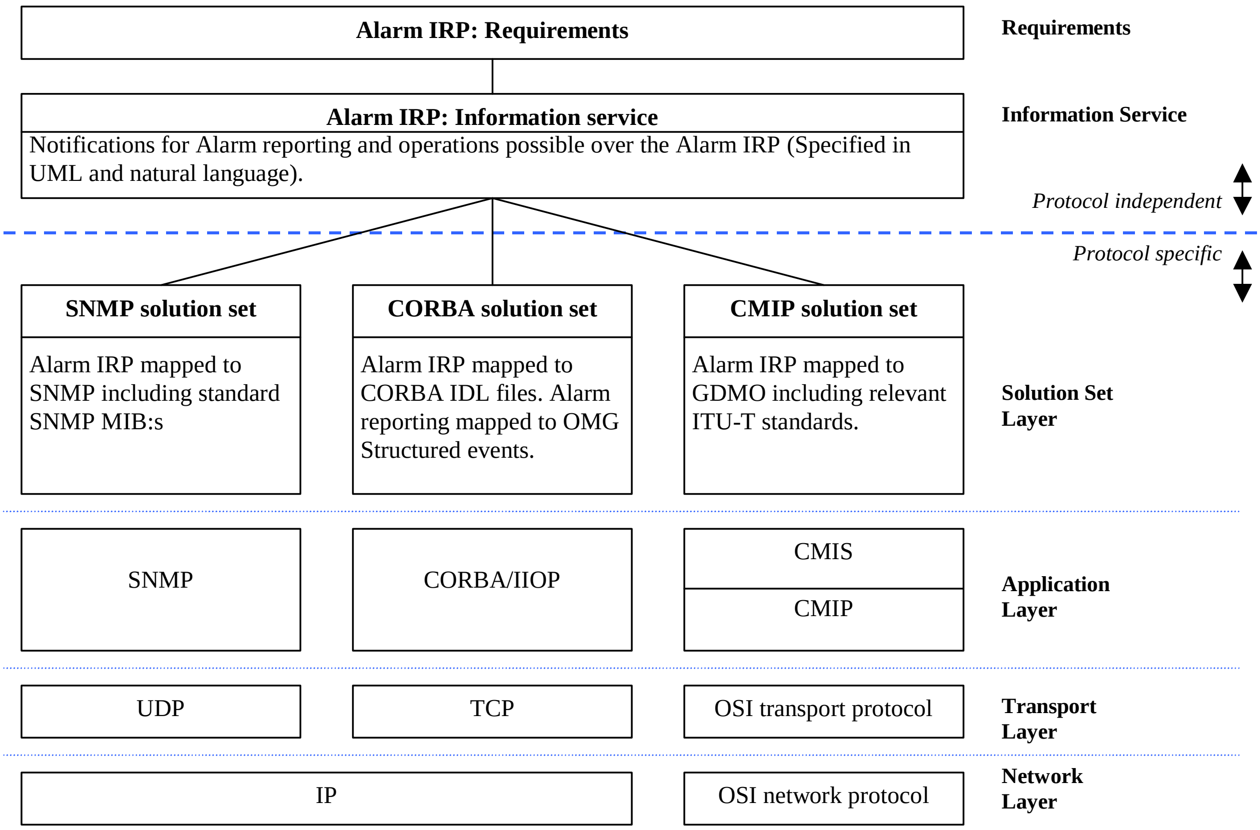


Figure 12: Example of an IRP (Alarm IRP)~~IRP example~~

10.5 Relationships between specifications

This sub-clause presents the target architecture of SA5 Network Resources Models, Information Services and Information Models. This architecture is based on the concepts of level and partition of information. To achieve this, information object classes and interfaces are defined and grouped into packages which can be related to each others through the import relationship.

Level means that the information services are structured in a way that enables reutilization between levels, either through inheritance or through a traditional relationship between classes. Four levels are identified namely:

- A **generic Network Resource Model IS**, also called "Generic NRM", which defines the information object classes and interfaces that are independent of any 1/ protocol (e.g. ~~Corba~~CORBA / IDL, CMIP / GDMO, etc.) and 2/ "sub-network" (e.g. UTRAN, GERAN, CN). This Network Resource Model contains definitions of the largest subset of information object classes that are common to all the Network Resources Models to be defined in SA5. This Network Resources Model is part of Level 1. For this Information Service, a number of solution sets may be provided;

- A number of **domain-specific Network Resource Model ISs**. Up to now, three Network Resource Models of this type have been identified: the CN Model, the UTRAN Model and the GERAN Model. They are part of Level 2. These Network Resource Models are specified in corresponding packages and import information object classes from the Generic Network Resources Model defined in Level 1. For each of these Information Services, a number of solution sets may be provided;

- A number of **function-specific ISs**. Such information services as the BasicCmIRP IS, the NotificationIRP IS and the AlarmIRP IS are part of this level. They are part of Level 3. These Information Services are specified in corresponding packages and import information object classes and interfaces defined in Level 2. For each of these Information Services, a number of solution sets may be provided;

- A number of (protocol-independent) **Information Models**. Up to now, none of them have been defined. They will be part of Level 4. These Information Models are specified in corresponding packages and import information object classes and interfaces defined both in Level 2 and in Level 3. An example of such Information Model is a "UTRAN Alarm IM" (see figure 13). For each of these Information Models, a number of solution sets may be provided;

These levels provide a means for separation of concerns and reutilization.

NRM and IRP ISs shall be kept as simple as possible. To achieve this, information object classes and interfaces shall be grouped into packages. The grouping shall be based on semantics, i.e. information object classes and interfaces which participate to the definition of a given IRP or NRM should be gathered into a dedicated package.

Reutilization of information specification contained in an NRM or IRP IS previously specified shall be possible through the *import* relationship. The import relationship is a means for reutilization : once a piece of information (i.e. an information object class, an attribute, a relationship or an interface) defined in an NRM or IRP IS is imported in another NRM or IRP IS, it is added to the name space of the importing NRM or IRP IS. Then, the whole information available in a NRM or IRP IS is made up of the information which is owned by the NRM or IRP IS itself (i.e. defined in this document) plus the information which is imported from other NRM(s) or IRP IS(s). This imported information can then be utilised in the importing NRM or IRP IS, for instance, through:

- inheritance (e.g. any information object class defined at Levels 2 to 4 inherits from the information object class Top defined in the generic NRM at Level 1), either directly or indirectly;

- relationship (e.g. any information object class defined at Levels 2 to 4 may have a containment relationship with the information object class IRPAgent defined in the generic NRM at Level 1).

An illustration of this architecture is provided in the figure below; it uses the UML diagrammatic conventions.

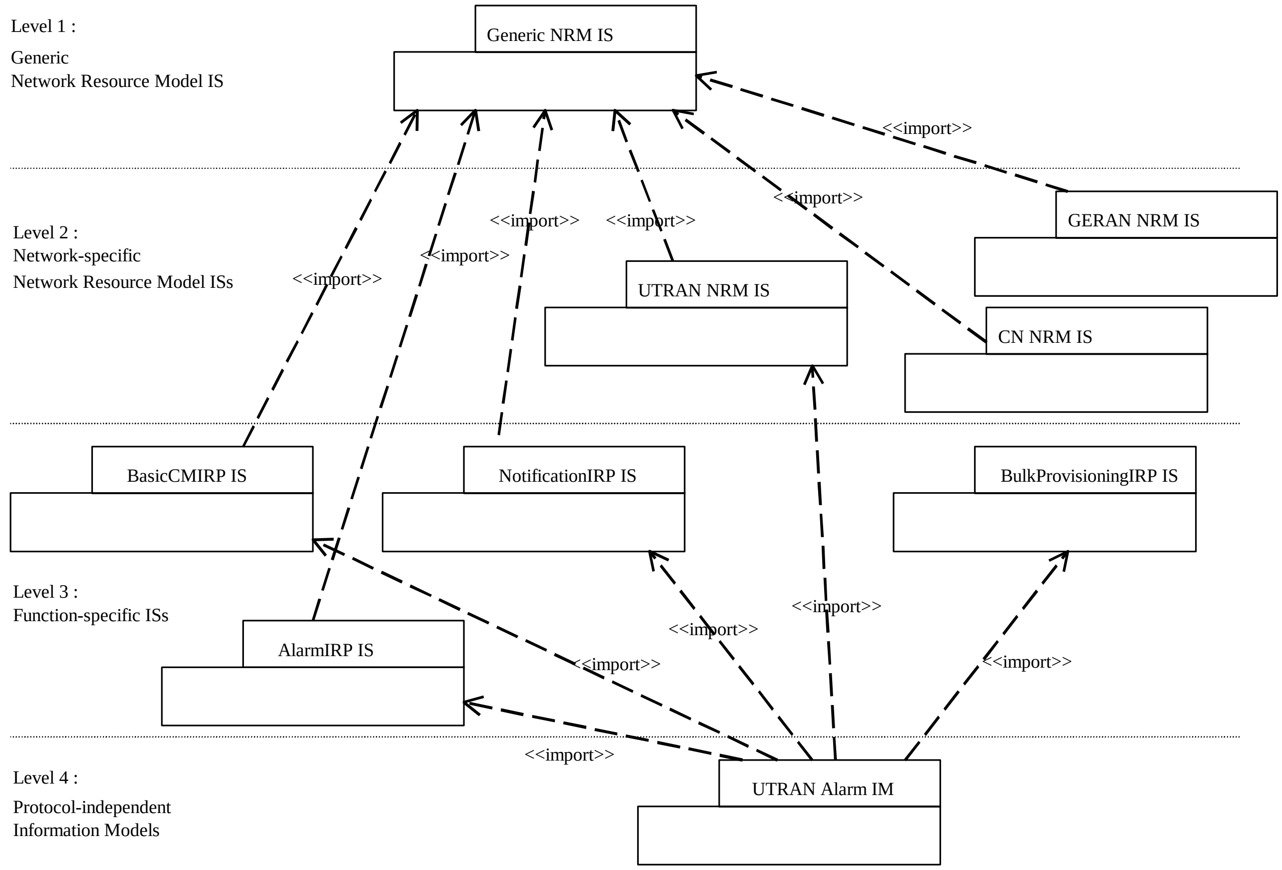


Figure 13: Specification architecture (not complete)

In order not to mix up the concept of “information object class” and “interface” with other concepts such as “managed object class” and “manager / agent interface”, the former are labelled according to the UML notation capability (cf. stereotype). “Information object class” is defined as a stereotype of “Class” in the UML meta-model. As a consequence, information object classes defined in Information Models are labelled <<InformationObjectClass>>. Similarly, interfaces are labelled <<Interface>>. In Annex C you can find an example of the inheritance between some ISs.

The following piece of information regarding the Semantics of the relationship "import" can be imported from other standard documents:

1. An information object class. The definition of the IOC, the attributes and the roles that the IOC plays in some relationships are imported. The import clause shall specify the TS number from which the IOC is imported and the name of the IOC;
2. An attribute. Two cases can happen :
   - 2.1. An attribute definition. In this case, the attribute definition is imported. The import clause shall specify the TS number from which the attribute is imported and the name of the attribute;
   - 2.2. An attribute reference within an IOC definition. In this case, the attribute definition is imported together with its qualifier within the specified IOC. The import clause shall specify the TS number from which the attribute is imported, the name of the IOC and the name of the attribute;
3. A relationship. The definition of the relationship is imported. The import clause shall specify the TS number from which the relationship is imported and the name of the relationship;
4. An interface. The definition of the interface and all its operations or notifications are imported. The import clause shall specify the TS number from which the interface is imported and the name of the interface;
5. An operation or a notification. The definition of the operation / notification is imported. The import clause shall specify the TS number from which the operation / notification is imported, the name of the interface in which the operation / notification is defined and the name of the operation / notification;

A piece of information must always be imported from the TS where it is initially defined. It cannot be imported from any other

10.56 Mandatory, Optional and Conditional qualifiers

…

Table 1: Definitions of Mandatory, Optional and Conditional Used in Information Service Documents

	Mandatory (M)	Conditional (C)	Optional (O)
Operation and Notification	Each Operation and Notification shall be mapped to its equivalents in all SSs. Mapped equivalent shall be M.	Each Operation and Notification shall be mapped to its equivalents in at least one SS. Mapped equivalent can be M or O.	Each Operation and Notification shall be mapped to its equivalents in all SSs. Mapped equivalent shall be O.
Input and output parameter	Each parameter shall be mapped to one or more information elements of all SSs. Mapped information elements shall be M.	Each parameter shall be mapped to its equivalent in at least one SS. Mapped equivalent can be M or O.	Each parameter shall be mapped to its equivalent in all SSs. Mapped equivalent shall be O.
Information relationship	Each relationship shall be supported in all SS's.	Each relationship shall be supported in at least one SS.	Each relationship shall be supported in all SS's.
Information attribute	Each attribute shall be supported in all SS's.	Each attribute shall be supported in at least one SS.	Each attribute shall be supported in all SS's.

Table 2 defines the meaning of the two terms Mandatory and Optional when they are used to qualify the operations, parameters of operations, notifications and parameters of notifications in Solution Sets.the relations between operations, notifications and parameters equivalents specified in Solutions Sets and their impact on IRPAgent implementation. The terms are used in Solution Set documents.

Table 2: Definitions of Mandatory and Optional Used in Solution Set Documents

Mapped SS Equivalent	Mandatory	Optional
Mapped notificationy equivalent	IRPAgent shall generate it. IRPManager should be prepared to receive and process it.	IRPAgent may or may not generate it. IRPManager should be prepared to receive it but can ignore it.
Mapped operation equivalent	IRPAgent shall support it.have an implementation. IRPManager may use (e.g., invoke) it.	IRPAgent may or may not support this operation. If the IRPAgent does not support this operation, the IRPAgent shall reject the operation invocation with a reason indicating that the IRPAgent does not support this operation. The rejection, together with a reason, shall be returned to the IRPManager.IRPAgent may have an implementation. IRPManager may use (e.g., invoke) it and should be prepared that IRPAgent may not have an implementation.
input parameter of the mapped operation equivalent	IRPAgent shall accept and behave according to its value. IRPManager should use it with a legal value.	IRPAgent may or may not support this input parameter. If the IRPAgent does not support this input parameter and if it carries meaning (i.e., it does not carry no-information semantics), the IRPAgent shall reject the invocation with a reason (that it does not support the parameter). The rejection, together with the reason, shall be returned to the IRPManager. If the optional parameter is present the IRPAgent may reject the invocation or the IRPAgent may accept the invocation but ignore the parameter. IRPManager may use it but should be prepared that IRPAgent may reject or ignore it.
Input parameter of mapped notify equivalent AND output parameter of mapped operation equivalent	IRPAgent shall generate it with a legal value. IRPManager should be prepared to receive it but can ignore it.	IRPAgent may generate it. If IRPAgent generates it, it shall use a legal value. IRPManager should be prepared to receive it but can ignore it.

Annex B (informative): Information Service template

This annex contains the template to be used for the Information Services documents produced within the 3GPP SA TSG5. This template is based on the latest 3GPP template which must be used for any 3GPP Technical Specification.

The introductory clauses of the 3GPP template (from clause 1 to clause 3) are unchanged.

This template is numbered starting with “X” which, in general should correspond to 4 which is the beginning of the main text document. However, if there is a need for a specific IS to introduce additional clauses in the body X may correspond to a number higher than 4. For an NRM only clause X shall be used.

The conclusive clauses/annexes of the 3GPP template are unchanged.

X Information Object Classes

-- ‘X’ represents a number

X.1 Information entities imported and local labels

-- this clause identifies a list of information entities (e.g. information object class, information relationship, information attribute) that have been defined in other specifications and that are imported in this specification. This includes information entities from other specifications imported for inheritance purpose. Each element of this list is a pair (label reference, local label).The label reference contains the name of the specification where it is defined, the type of the information entity and its name. The local label of imported information entities can then be used throughout the specification instead of the label reference.

-- this information is provided in a table. An example of such a table is given herebelow :

Label reference	**Local label**
32.106-5 [10], information object class, Top	Top

X.2 Class diagram

X.2.1 Attributes and relationships

-- this first diagram represents all information object classes defined in this IS with all their relationships and all their attributes. This diagram shall contain relationship names, role name and role cardinality. This shall be a UML compliant class diagram.

-- Characteristics (attributes, relationships) of imported information object classes need not to be repeated in the diagram. Names of information elements (class, attribute) defined in the IS and which scope is local to this IS must be prefixed by a 3 characters prefix uniquely identifying the IS. Information object classes should be defined using the stereotype <<InformationObjectClass>>. On the class diagram, each attribute in an information object class shall be qualified as “protected” by the addition of a symbol “#” before each attribute.

X.2.2 Inheritance

-- this second diagram represents the inheritance hierarchy of all information object classes defined in this IS. This diagram does not need to contain the complete inheritance hierarchy but shall at least contain the parent information object classes of all information object classes defined in this specification. By default, an information object class inherits from the information object class "top". This shall be a UML compliant class diagram.

-- Characteristics (attributes, relationships) of imported information object classes need not to be repeated in the diagram. Information object classes should be defined using the stereotype <<InformationObjectClass>>.

-- Note : some inheritance relationships presented in X.2.2 can be repeated in X.2.1 to enhance readability.

X.3 Information object classes definition

-- each information object class is defined using the following structure :

X.3.a InformationObjectClassName

-- InformationObjectClassName is the name of the information object class

-- 'a' represents a number, starting at 1 and increasing by 1 with each new definition of an information object class

X.3.a.1 Definition

-- The <definition> sub-clause is written in natural language. The <definition> sub-clause refers to the information object class itself. The characteristics related to the relationships that the object class can have with other object classes can't be found in the definition. The reader has to refer to relationships definition to find such kind of information. Information related to inheritance shall be precised here.

X.3.a.2 Attributes

- The <attributes> sub-clause presents the list of attributes, which are the manageable properties of the object class . Each element is a pair (attributeName, supportQualifier).The supportQualifier indicates whether the attribute is Mandatory, Optional or Conditional (M, O, C).

-- this information is provided in a table. An example of such a table is given herebelow :

Attribute name	Support Qualifier
ntfSubscriptionId	M

- Note : this sub-clause does not need to be present when there is no attribute to define.

X.3.a.3 Attribute constraints

-- The <attribute constraints> sub-clause presents constraints between attributes that are always held to be true.). Those properties are always held to be true during the lifetime of the attributes and in particular don't *need to be repeated in pre or post conditions of operations or notifications.*

- Note : this sub-clause does not need to be present when there is no attribute constraints to define.

X.3.a.4 Relationships

-- The <relationship> sub-clause presents the list of relationships in which this class in involved. Each element is a relationshipName.

- Note : this sub-clause is optional and may be avoided since all relationships are represented in the class diagram in clause.X.2.1.

X.3.a.5 State diagram

-- The <state diagram> sub-clause contains state diagrams. A state diagram of an information object class defines permitted states of this information object class and the transitions between those states. A state is expressed in terms of individual attribute values or a combination of attribute values or involvement in relationships of the information object class being defined. This shall be a UML compliant state diagram.

X.4 Information relationships definition

-- each information relationship is defined using the following structure :

X.4.a InformationRelationshipName (supportQualifier)

-- InformationRelationshipName is the name of the information relationship followed by a qualifier indicating whether the relationship is Mandatory, Optional or Conditional (M, O, C)

-- 'a' represents a number, starting at 1 and increasing by 1 with each new definition of an information relationship

X.4.a.1 Definition

-- The <definition> sub-clause is written in natural language.

X.4.a.2 Roles

-- The <roles> sub-clause identifies the roles played in the relationship by object classes.. Each element is a pair (roleName, roleDefinition)

-- this information is provided in a table. An example of such a table is given herebelow :

Name	**Definition**
isSubscribedBy	This role represents the one who has subscribed

X.4.a.3 Constraints

-- The <constraints> sub-clause contains the list of properties specifying the semantic invariants that must be preserved on the relationship. Each element is a pair (propertyName, propertyDefinition). Those properties are always held to be true during the lifetime of the relationship and don't need to be repeated in pre or post conditions of operations or notifications.

-- this information is provided in a table. An example of such a table is given herebelow :

Name	Definition
inv_notificationCategoriesAllDistinct	"the notification categories contained in the ntfNotificationCategorySet attribute of ntfSubscription playing the role hasSubscription are all distinct from each other"

X.5 Information attributes definition

-- each information attribute is defined using the following structure :

X.5.1 Definition and legal values

-- This sub-clause contains for each attribute being defined its name, its definition written in natural language and a list of legal values supported by the attribute.

-- In the case where the legal values can be enumerated, each element is a pair (legalValueName, legalValueDefinition), unless a legalValueDefinition applies to several values in which case the definition is provided only once. When the legal values cannot be enumerated, the list of legal values is defined by a single definition.

-- this information is provided in a table. An example of such a table is given herebelow :

Attribute Name	Definition	Legal Values
ntfSubscriptionId	It identifies uniquely a subscription	N/A
ntfSusbcriptionState	It indicates the activation state of a subscription	"suspended" : the subscription is suspended "notSuspended" : the subscription is active

X.5.2 Constraints

-- The <constraints> sub-clause indicates whether there are any constraints affecting attributes. Each constraint is defined by a pair (propertyName, propertyDefinition). PropertyDefinitions are expressed in natural language.

-- An example is given herebelow :

Name	Definition
inv_TimerConstraints	"ntfTimeTickTimer is lower than or equal to ntfTimeTick"

X.6 Particular information configurations

-- some configurations of information are special or complex enough to justify the usage of a state diagram to clarify them. A state diagram in this clause defines permitted states of the system and the transitions between those states. A state is expressed in terms of a combination of attribute values constraints or involvement in relationships of one or more information object classes.

Y Interface Definition

-- 'Y' represents a number, immediately following 'X'

Y.1 Class diagram representing interfaces

-- each interface is defined in the diagram. This shall be a UML compliant class diagram.

-- Interfaces are defined using a stereotype <<Interface>>. Each interface contains a set of either operations or notifications which are mandatory or either a single operation or a single notification which is optional. The support of an interface by an information object class is represented by a relationship between the 2 entities with a cardinality (1..1) if all the operations or notifications contained in the interface are mandatory, and (0..1) if the operation or notification contained in the interface is optional. On the class diagram, each operation and notification in an interface shall be qualified as "public" by the addition of a symbol "+" before each operation and notification.

Y.2 Generic rules

-- the following rules are relevant for all IS. They shall simply be copied as part of the template.

- rule 1 : each operation with at least one input parameter supports a pre-condition valid_input_parameter which indicates that all input parameters shall be valid with regards to their information type. Additionally, each such operation supports an exception operation_failed_invalid_input_parameter which is raised when pre-condition valid_input_parameter is false. The exception has the same entry and exit state.

- rule 2 : Each operation with at least one optional input parameter supports a set of pre-conditions supported_optional_input_parameter_xxx where "xxx" is the name of the optional input parameter and the pre-condition indicates that the operation supports the named optional input parameter. Additionally, each such operation supports an exception operation_failed_unsupported_optional_input_parameter_xxx which is raised when (a) the pre-condition supported_optional_input_parameter_xxx is false and (b) the named optional input parameter is carrying information. The exception has the same entry and exit state.

- rule 3 : each operation shall support a generic exception operation_failed_internal_problem which is raised when an internal problem occurs and that the operation cannot be completed. The exception has the same entry and exit state.

Y.b InterfaceName Interface

-- InterfaceName is the name of the interface

-- 'b' represents a number, starting at 3 and increasing by 1 with each new definition of an interface

-- Each interface is defined by its name and by a sequence of operations or notifications as defined herebelow.

-- each operation is defined using the following structure :

Y.b.a Operation OperationName (supportQualifier)

-- OperationName is the name of the operation followed by a qualifier indicating whether the operation is Mandatory, Optional or Conditional (M, O, C)

-- 'a' represents a number, starting at 1 and increasing by 1 with each new definition of an operation

Y.b.a.1 Definition

-- The <definition> sub-clause is written in natural language.

Y.b.a.2 Input parameters

-- list of input parameters of the operation. Each element is a tuple (inputParameterName, supportQualifier, InformationType, inputParameterComment)

-- this information is provided in a table. An example of such a table is given herebelow :

Parameter Name	Qualifier	Information type	Comment
managerReference	M	ntfSubscriber.ntfManagerReference	It specifies the reference of IRPManager to which notifications shall be sent.

Y.b.a.3 Output parameters

-- list of output parameters of the operation. Each element is a tuple (outputParameterName, supportQualifier, MatchingInformation, outputParameterComment)

-- this information is provided in a table. An example of such a table is given herebelow :

Parameter Name	Qualifier	Matching Information	Comment
versionNumberSet	M	notificationIRP.irpversion	It indicates one or more SS version numbers supported by the notificationIRP.

Y.b.a.4 Pre-condition

-- a pre-condition is a collection of assertions joined by AND, OR, and NOT logical operators. The pre-condition must be held to be true before the operation is invoked .. An example is given herebelow :

notificationCategoriesNotAllSubscribed OR notificationCategoriesParameterAbsentAndNotAllSubscribed

-- Each assertion is defined by a pair (propertyName, propertyDefinition). All assertions constituting the pre-condition are provided in a table. An example of such a table is given herebelow :

Assertion Name	**Definition**
notificationCategoriesNotAllSubscribed	"at least one notificationCategory identified in the notificationCategories input parameter is supported by IRPAgent and is not a member of the ntfNotificationCategorySet attribute of an ntfSubscription which is involved in a subscription relationship with the ntfSubscriber identified by the managerReference input parameter".
notificationCategoriesParameterAbsentAndNotAllSubscribed	" notificationCategories input parameter is absent and at least one notificationCategory supported by IRPAgent is not a member of the ntfNotificationCategorySet attribute of an ntfSsubscription which is involved in a subscription relationship with the ntfSubscriber identified by the managerReference input parameter"

Y.b.a.5 Post-condition

-- a post-condition is a collection of assertions joined by AND, OR, and NOT logical operators. The post-condition must be held to be true after the completion of the operation. When nothing is said in a post-condition regarding an information entity, the assumption is that this information entity has not changed compared to what is stated in the pre-condition. An example is given herebelow :

subscriptionDeleted OR allSubscriptionDeleted

-- Each assertion is defined by a pair (propertyName, propertyDefinition). All assertions constituting the post-condition are provided in a table. An example of such a table is given herebelow :

Assertion Name	**Definition**
subscriptionDeleted	"the ntfSubscription identified by subscriptionId input parameter is no more involved in a subscription relationship with the ntfSubscriber identified by the managerReference input parameter and has been deleted. If this ntfSubscriber has no more ntfSubscription, it is deleted as well."
allSubscriptionDeleted	"in the case subscriptionId input parameter was absent, the ntfSubscriber identified by the managerReference input parameter is no more involved in any subscription relationship and is deleted, the corresponding ntfSubscription have been deleted as well."

Y.b.a.6 Exceptions

-- list of exceptions that can be raised by the operation. Each element is a tuple (exceptionName, condition, ReturnedInformation, exitState))

Y.b.a.6.c exceptionName

-- exceptionName is the name of an exception

-- 'c' represents a number, starting at 1 and increasing by 1 with each new definition of an exception

-- this information is provided in a table. An example of such a table is given herebelow :

Exception Name	Definition
Ope_failed_existing_subscription	**Condition:** (notificationCategoriesNotAllSubscribed OR notificationCategoriesParameterAbsentAndNotAllSubscribed) not verified **Returned information:** output parameter status is set to OperationFailedExistingSubscription **Exit state:** Entry State

-- each notification is defined using the following structure :

Y.b.a Notification NotificationName (supportQualifier)

-- NotificationName is the name of the notification followed by a qualifier indicating whether the notification is Mandatory, Optional or Conditional (M, O, C).

-- 'a' represents a number, starting at 1 and increasing by 1 with each new definition of a notification

Y.b.a.1 Definition

-- The <definition> sub-clause is written in natural language.

Y.b.a.2 Input parameters

-- list of input parameters of the notification. Each element is a tuple (inputParameterName, supportQualifier and filteringQualifier, matchingInformation, inputParameterComment)

-- the filteringQualifier indicates whether the parameter of the notification can be filtered or not. Values are Yes (Y) or No (N). The matchingInformation refers to information in the state "toState".

-- this information is provided in a table. The column "Qualifiers" contains the two qualifiers supportQualifier and filteringQualifier separated by a comma. An example of such a table is given herebelow :

Parameter Name	Qualifiers	Matching Information	Comment
managerReference	M,Y	ntfSubscriber.ntfManagerReference	It specifies the reference of IRPManager to which notifications shall be sent.

Y.b.a.3 Triggering event

-- the triggering event for the notification to be sent is the transition from the information state defined by the 'from state' sub-clause to the information state defined by the 'to state' sub-clause.

Y.b.a.3.1 From state

-- this sub-clause is a collection of assertions joined by AND, OR, and NOT logical operators. An example is given herebelow :

alarmMatched AND alarmInformationNotCleared

-- Each assertion is defined by a pair (propertyName, propertyDefinition). All assertions constituting the state “from state” are provided in a table. An example of such a table is given herebelow :

Assertion Name	**Definition**
`alarmMatched`	The newly generated network alarm matches with one AlarmInformation (same values for eventType, probableCause, specificProblem attributes) in AlarmList.
`alarmInformationNotCleared`	The perceivedSeverity attribute of the matched AlarmInformation is not cleared

Y.b.a.3.2 To state

-- this sub-clause is a collection of assertions joined by AND, OR and NOT logical operators. When nothing is said in a to-state regarding an information entity, the assumption is that this information entity has not changed compared to what is stated in the from state. An example is given herebelow :

resetAcknowledgementInformation AND perceivedSeverityUpdated

-- Each assertion is defined by a pair (propertyName, propertyDefinition). All assertions constituting the state “to state” are provided in a table. An example of such a table is given herebelow :

Assertion Name	**Definition**
`resetAcknowledgementInformation`	The matched AlarmInformation identified in `inv_alarmMatched` in pre-condition has been updated according to the following rule : ackTime, ackUserId and ackSystemId are updated to contain no information; ackState is updated to “unacknowledged”;
`perceivedSeverityUpdated`	The perceivedSeverity attribute of matched AlarmInformation identified in `inv_alarmMatched` in pre-condition has been updated.

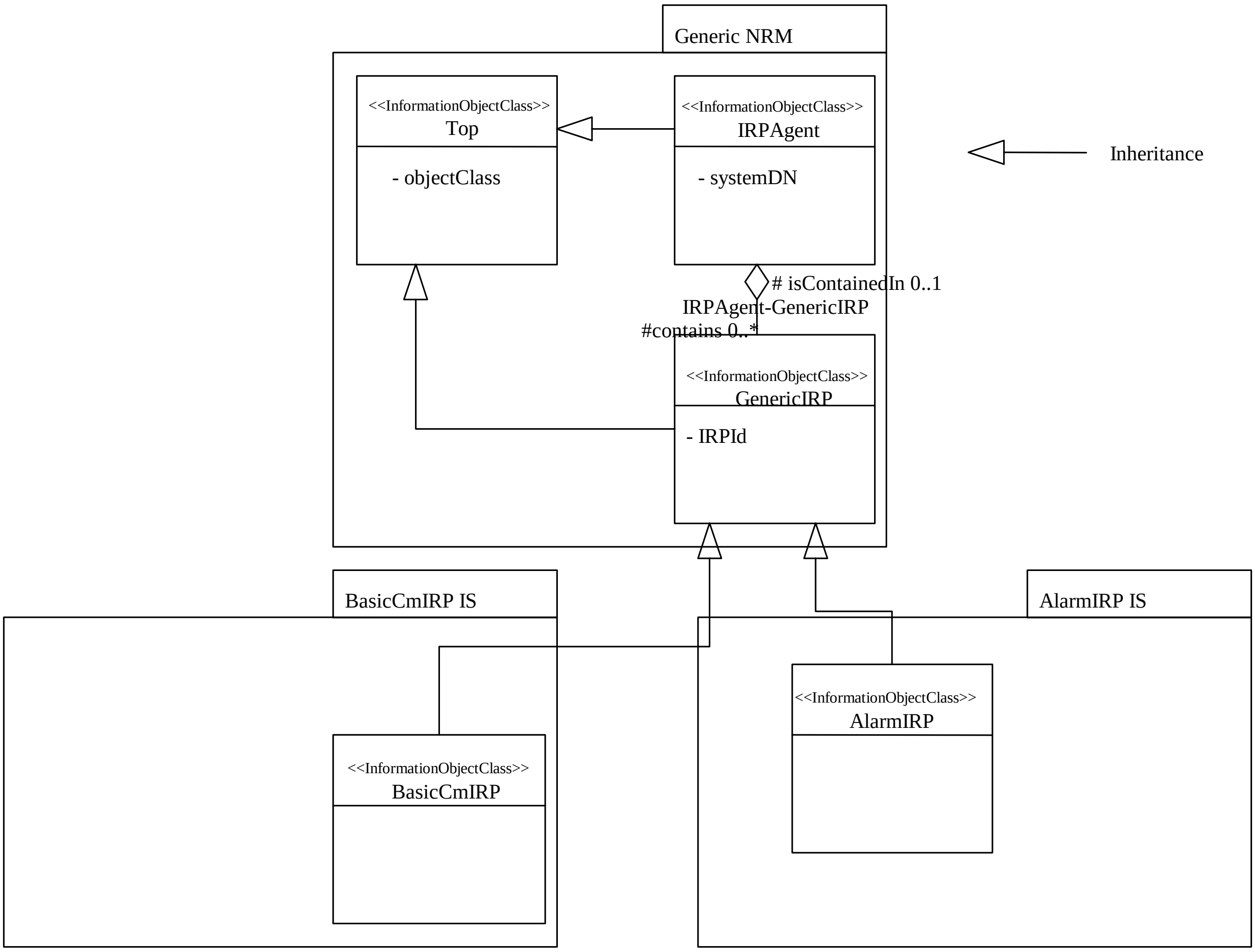
Z Scenario

-- ‘Z’ represents a number, immediately following ‘Y’

-- list of sequence diagrams each describing a possible scenario. This shall be a UML compliant sequence diagram. This is an optional clause.

Annex C (informative): Example of inheritance between ISs

The figure below illustrates the architecture defined in clause 10.5 with a simplified example. Note that this figure is for illustration only.



Example of possible packages together with information object classes and their inter-relationships

The following aspects are illustrated in the above figure:

1. Information object classes that are common to all Network Resources Models / some Information Services are captured in the GenericNRM package : Top, IRPAgent, GenericIRP, together with their attributes and relationships;
2. The information object class BasicCmIRP is defined in the BasicCmIRP IS package. As illustrated in the previous figure, this package imports the GenericNRM package;
3. The information object class AlarmIRP is defined in the AlarmIRP IS package. As illustrated in the previous figure, this package imports the GenericNRM package;
4. As a consequence, every information object class can inherit from the class Top, either directly or indirectly;
5. The IRPAgent class is defined in the GenericNRM;

6. A GenericIRP information object class is defined in the Generic NRM. It represents an abstraction of all the IRPs such as, e.g., BasicCmIRP or AlarmIRP. A containment relationship between IRPAgent and GenericIRP is defined;

7. Both the information object classes BasicCmIRP and AlarmIRP (defined in different Information Services) inherit from GenericIRP. As a first consequence, they inherit the attributes IRPId and IRPVersion (from GenericIRP) and objectClass (from Top). As a second consequence, both BasicCmIRP and AlarmIRP are contained in IRPAgent.

Annex D (informative): General rules for Solution Sets

D.1 Introduction

The intent of this annex is twofold. The first intent is for 3GPP internal use to document how a 3GPP Solution set is produced and what it shall contain. The second intent with the annex is to give the reader of an IS or a Solution set a better understanding on how to interpret the IS or Solution Set document.

It can be noted that it is expected that this annex is to be extended in later version of this document.

D.2 Solution set versioning

For further study.

Annex E (normative): Rules for CorbaCORBA Solution Sets

E.1 Introduction

The intent of this annex is threefold. The first intent is for 3GPP internal use to document how a 3GPP CorbaCORBA Solution set is produced and how it is structured. The second intent with the annex is to give the reader or implementor of a CorbaCORBA Solution set a better understanding on how to interpret the CorbaCORBA Solution set document. The last and maybe most important intent is to put requirement on an implementor of a CorbaCORBA Solution set.

It can be noted that it is expected that this annex is to be extended in later versions of this document.

E.2 Rules for specification of CorbaCORBA Solution sets

E.2.1 Introduction

This clause identifies rules for specification of CorbaCORBA Solution sets. This clause is mainly for 3GPP internal use. It is only for information for the implementor of a CorbaCORBA Solution Set.

E.2.2 Pragma prefix

All IDL-code shall define the pragma prefix using the following statement:

#pragma prefix "3gppsa5.org"

E.3 Implementation aspects of CorbaCORBA Solution sets

E.3.1 Introduction

This clause identifies rules for the implementation of CorbaCORBA Solution sets. This clause is normative for the implementor of a CorbaCORBA Solution Set.

E3.2 IRPAgent behaviour on incoming optional method

The IRPAgent, claiming compliance to a particular SS version of a particular IRP such as the Alarm IRP, shall implement all mandatory and all optional methods. Each method implementation shall have a signature specifying all mandatory and all optional parameters.

- If the IRPAgent does not support a particular optional method, it shall throw the `OperationNotSupported` exception when the IRPManager invokes that method.
- If the IRPAgent have not implemented a particular method (because it is compiled with an IDL version that does not define the method), the CORBA ORB of the IRPAgent shall throw a system exception if the IRPManager invokes that method.

In all the above cases when an exception is thrown, the IRPAgent shall restore its state before the method invocation.

E.3.3 IRPAgent Behaviour on incoming optional parameter of operation

An IRPAgent must implement all optional parameters, as well as mandatory parameters, in all methods.

If the IRPAgent supports the implemented method but does not support its (one or more) optional input parameters, upon method invocation, the IRPAgent shall check if those parameters carry "no information" or absence semantics (defined later in sub-clause "Encoding rule for absence semantics"). If the check is negative, the IRPAgent shall throw the `ParameterNotSupported` exception with a string carrying the name of the unsupported optional parameter.

E.3.4 IRPAgent Behaviour on outgoing attributes of Notification

CORBA SS uses OMG defined structured event to carry notification. The structured event is partitioned into header and body.

The absence semantics of attribute in the header is realised by a string of zero length.

The body consists of one or more name-value pair attributes. The absence semantics of these attributes is realised by their absence.

For optional sub-attributes of an attribute carried by the name-value pair, their absence semantics is realised by the encoding rule of "absence semantics". See sub-clause E.3.5, "Encoding rule of absence semantics".

E.3.5 Encoding rule of absence semantics

The absence semantics for parameter is type dependent. For a string type, the absence semantics is a `string` of zero length. For an `integer` type, it is the highest possible positive number. For a boxed `valueType` (supported by CORBA 2.3), it is the null value.

Annex FDB (informative): Change history

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