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3GPP TSG-SA5 (Telecom Management) **S5-042138**
Meeting #37, Malaga, SPAIN, 23-27 Feb 2004

Presentation of Technical Specification to TSG SA

Presentation to:	**TSG SA Meeting #23**
Document for presentation:	**TS 32.150, Version 2.0.0** **Integration Reference Point (IRP) Concept and Definitions**
Presented for:	**Approval**

Abstract of document:

This TS Release 6 specification provides the overall concept for all Integration Reference Point (IRP) specifications produced by 3GPP.
Relevant IRP overview and high-level definitions are already provided in 32.101 and 32.102.
It introduces the overall concept for all Integration Reference Point (IRP) specifications.

Work done against the WID contained in SP-020754 (Work Item ID: OAM-NIM).

Purpose of these Specifications:

This TS is intended for Release 6 and is part of a TS-family consisting of:

Numbe	Title
32.150	**Telecommunication management; Integration Reference Point (IRP) Concept and definitions**
32.151	Telecommunication management; Integration Reference Point (IRP) Information Service (IS) template
32.152	Telecommunication management; Integration Reference Point (IRP) Information Service (IS) Unified Modelling Language (UML) repertoire

Changes since last presentation to TSG-SA#22:
Minor Editorial updates.

Outstanding Issues:
None.

Contentious Issues:
None.

3GPP TS 32.150 V2.0.0 (2004-03)

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Contents

Foreword

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

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document provides the overall concept for all Integration Reference Point (IRP) specifications produced by 3GPP. Relevant IRP overview and high-level definitions are already provided in 3GPP TS 32.101 [1] and 3GPP TS 32.102 [2].

The present document is a member of a TS-family consisting of:

3GPP TS 32.150: "Telecommunication management; Integration Reference Point (IRP) Concept and definitions".

3GPP TS 32.151: "Telecommunication management; Integration Reference Point (IRP) Information Service (IS) template".

3GPP TS 32.152: "Telecommunication management; Integration Reference Point (IRP) Information Service (IS) Unified Modelling Language (UML) repertoire".

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] 3GPP TS 32.101: "Telecommunication management; Principles and high level requirements".

[2] 3GPP TS 32.102: "Telecommunication management; Architecture".

[3] 3GPP TS 32.151: "Telecommunication management; Integration Reference Point (IRP) Information Service (IS) template".

[4] 3GPP TS 32.152: "Telecommunication management; Integration Reference Point (IRP) Information Service (IS) Unified Modelling Language (UML) repertoire".

[5] ITU-T Recommendation M.3020: "TMN Interface Specification Methodology".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TS 32.101 [1], 3GPP TS 32.102 [2], 3GPP TS 32.151 [3] and the following apply:

IRPAgent: See 3GPP TS 32.102 [2].

IRPManager: See 3GPP TS 32.102 [2].

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TS 32.101 [1], 3GPP TS 32.102 [2], 3GPP TS 32.151 [3] and the following apply:

CMIP	Common Management Information Protocol
CORBA	Common Object Request Broker Architecture
EM	Element Manager
GDMO	Guidelines for the Definition of Managed Objects
GUI	Graphical User Interface
IDL	Interface Definition Language
IOC	Information Object Class
IRP	Integration Reference Point
IS	Information Service
NE	Network Element
NM	Network Manager
OMG	Object Management Group
ORB	Object Request Broker
PSA	Product Specific Application
SMP	System Management Processes
SNM	Sub-Network Manager
SS	Solution Set
TMF	TeleManagement Forum
TOM	Telecom Operations Map
UML	Unified Modelling Language

4 Integration Reference Points (IRPs)

4.1 Introduction

For the purpose of management interface development 3GPP has developed an interface concept known as Integration Reference Point (IRP) to promote the wider adoption of standardized management interfaces in telecommunication networks. The IRP concept and associated methodology employs protocol and technology neutral modelling methods as well as protocol specific solution sets to achieve its goals.

4.1.2 General

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.

- **Technology-independent modelling:** To create from the requirements an interface technology independent model. This is specified in the IRP Information Service.

- **Standards-based technology-dependent modelling:** To create one or more interface technology dependent models from the technology independent model. This is specified in the IRP Solution Set(s).

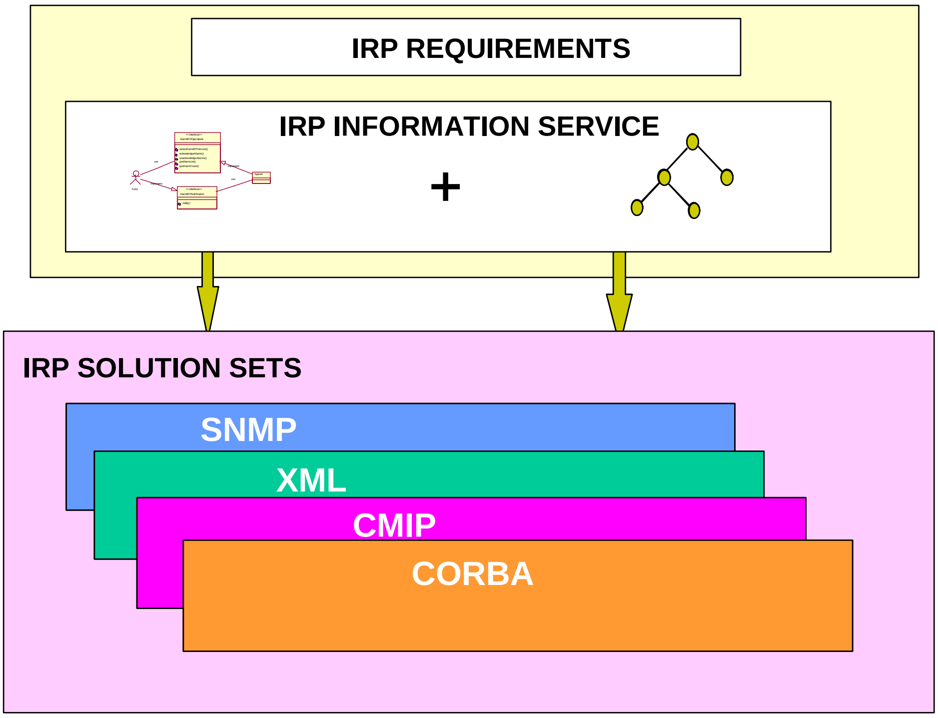

Figure 4.1: IRP components (with example Solution Sets)

4.1.2 IRP Specifications Approach

As highlighted in the previous subclause, IRP interfaces are specified using a 3-level approach: Requirements, IS-level specifications and SS-level.

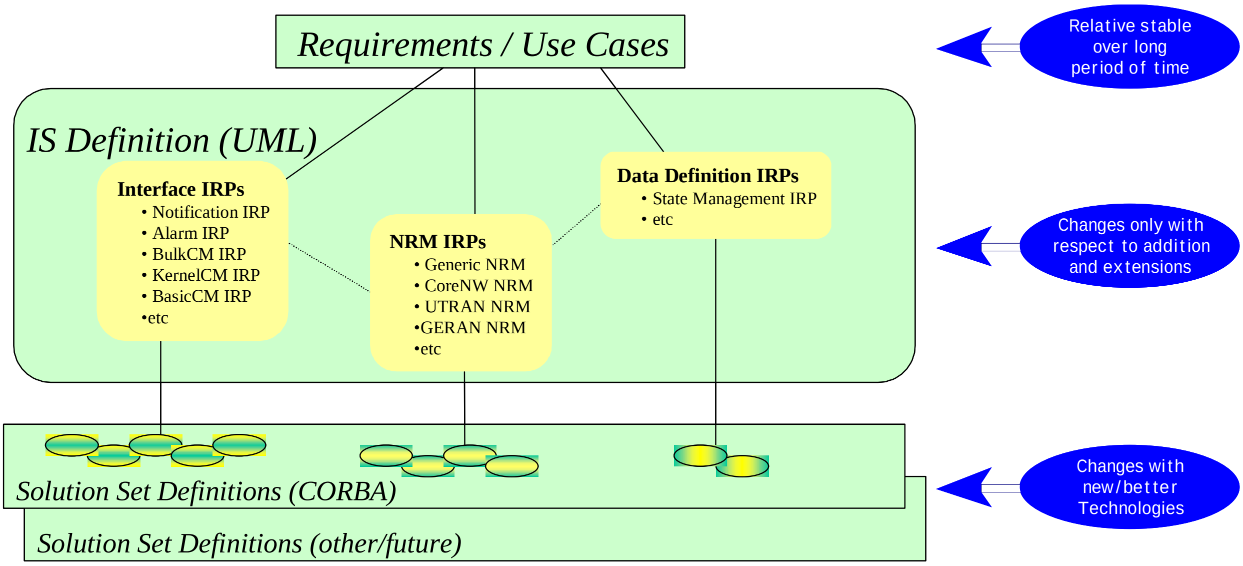

Figure 4.2: The IRP 3-Level Specifications Approach

Level 1:

The "Requirements-level" intends to provide conceptual and use cases definitions for a specific management interface aspect as well as defining subsequent requirements for this IRP.

Level 2:

The "IS-level" provides the technology independent specification of an IRP. From an IS-level perspective there are three types of IRP IS specifications:

- Interface IRPs - providing the definitions for IRP operations and notifications in a network agnostic manner.
- NRM IRPs - providing the definitions for the Network Resources to be managed through the Itf-N (commonly named "Network Resources IRPs").
- Data Definition IRPs - providing data definitions applicable to specific management aspects to be managed via reusing available Interface IRPs and being applied to NRM IRPs as applicable.

Level 3:

The "SS-level" finally provides the mapping of IS definitions into one or more technology-specific Solution Sets. This concept provides support for multiple interface technologies as applicable on a vendor and/or network type basis and also enables accommodation of future interface technologies - without the need to redefine requirements and IS-level definitions.

4.2 Integration levels

Virtually all types of telecom/datacom networks comprise many different technologies purchased from several different vendors. This implies that the corresponding management solution need to be built by integrating product-specific applications from different vendors with a number of generic applications that each provide some aspect of multi-vendor and/or multi-technology support. A complete management solution is thus composed of several independent applications.

The following levels of integration are defined:

- **Screen Integration:** Each application provides its own specific Graphical User Interface (GUI) that need to be accessible from a single, unified screen (a common desktop). A seamless integration between the various GUIs is then required. Screen Integration is not specified in the present document.
- **Application Integration:** Applications need to interwork, on a machine-machine basis, in order to automate various end-to-end processes of a communication provider.

4.2.1 Application integration

Interfaces related to application integration can be divided in the following three categories:

1) **High-level generic interfaces:** between generic applications on the network and service management layers. The same approach and concepts apply for these as the next category.

2) **High-level (technology-independent to the extent possible) interfaces:** between product-specific and generic applications are needed in order to automate and streamline frequently occurring tasks applicable to several types of network elements. A top-down approach shall be taken when defining these interfaces, where the main input is:

   a) business processes of a communication provider; and

   b) the types of generic applications that are used to implement the process support.

   The interfaces need to be stable, open and (preferably) standardized. These IRPs are discussed below under the heading Network Infrastructure IRPs.

3) **Detailed (product-specific) interfaces:** between product-specific applications and the corresponding network elements are of course also needed. These interfaces are defined using the traditional bottom-up approach, where the actual network infrastructure is modelled. This is the traditional TMN approach to element management. The management information in these interfaces is not further discussed in the present document, as it is internal to a specific development organization and does not need to be open. In fact, by publishing the management information in these interfaces, too much of the internal design may be revealed and it may become impossible to later enhance the systems that are using the interfaces. The management services (operations and notifications) and protocol shall however be open and standardized as long as they are independent of the NRM describing the managed NEs/NRs.

4.3 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 integratable.

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 Network and System Management Processes (SMP) of the Network Manager (NM) (3GPP TS 32.101 [1]) shown in figure 4.3. These IRPs are considered to cover the most basic needs of task automation.

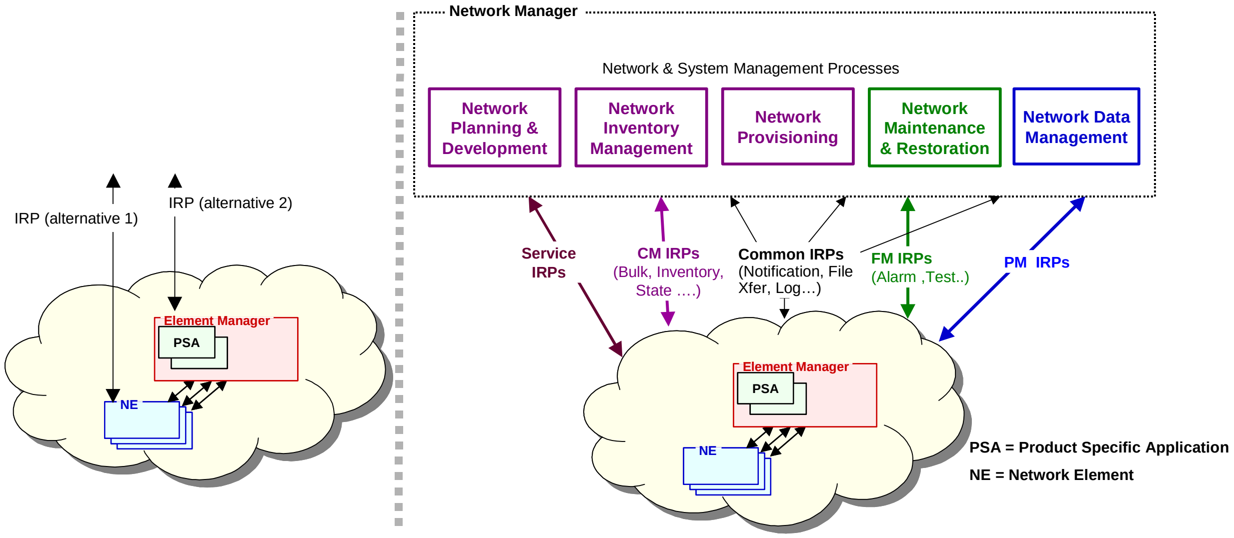

Figure 4.3: IRPs for application integration

The IRPs presented in figure 4.3 are just an example and do not reflect the exact set of IRPs defined by 3GPP.

Taking one of the Common IRPs as an example, the Network and System Management Processes have similar need to receive notifications from various PSAs. The corresponding service is formalized 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.

4.4 Defining the IRPs

It is important to 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 from the protocols definitions (accessing the information) for the external interfaces.

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 three levels of specifications.

Level 1:

The first level of IRP specification captures the **requirements**.

Level 2:

The second level of IRP specifications known as "**IRP Information Service"**, specifies the **information** observable and controlled by management system's client, related to the network resources under management, in a technology-independent way. It also specifies the semantics of the interactions used to carry applicable information.

Level 3:

The third level of IRP specification, known as **IRP Solution Set**, contains specification of the system in terms of interface technology choice (e.g. CMIP/GDMO, CORBA/IDL). In this type of specification, the syntax, rather than the semantics, is specified. At least one instance of a Solution Set is produced per interface 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).

As described above, the Information Service (IS) specification may contain two parts, the information related to the resources to be managed and the way that the information may be manipulated.

Part 1:

The first part defines the information types within a distributed system. It is in line with the Analysis phase of ITU-T Recommendation M.3020 [5]. 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 ITU-T Recommendation M.3020 [5], 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 C.

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.

Part 2:

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 utilization of parameter matching, to the information objects. A definition of the IS operations / notifications template is provided in annex C.

The Solution Set (SS) contains the mapping of the information objects and interactions (if applicable) specified in the IS-level specification, into their corresponding syntaxes of a particular chosen technology. The mapping is interface technology 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 SSs are defined in annex A. Rules for specific SSs, such as CORBA, are defined in an Annex to the present document as well as within each of the SS technologies used by 3GPP (as applicable).

Managed Object Classes as defined in a CMIP or CORBA Solution Set specifications represent 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 4.4 shows an example of how an IRP can be structured (the Alarm IRP).

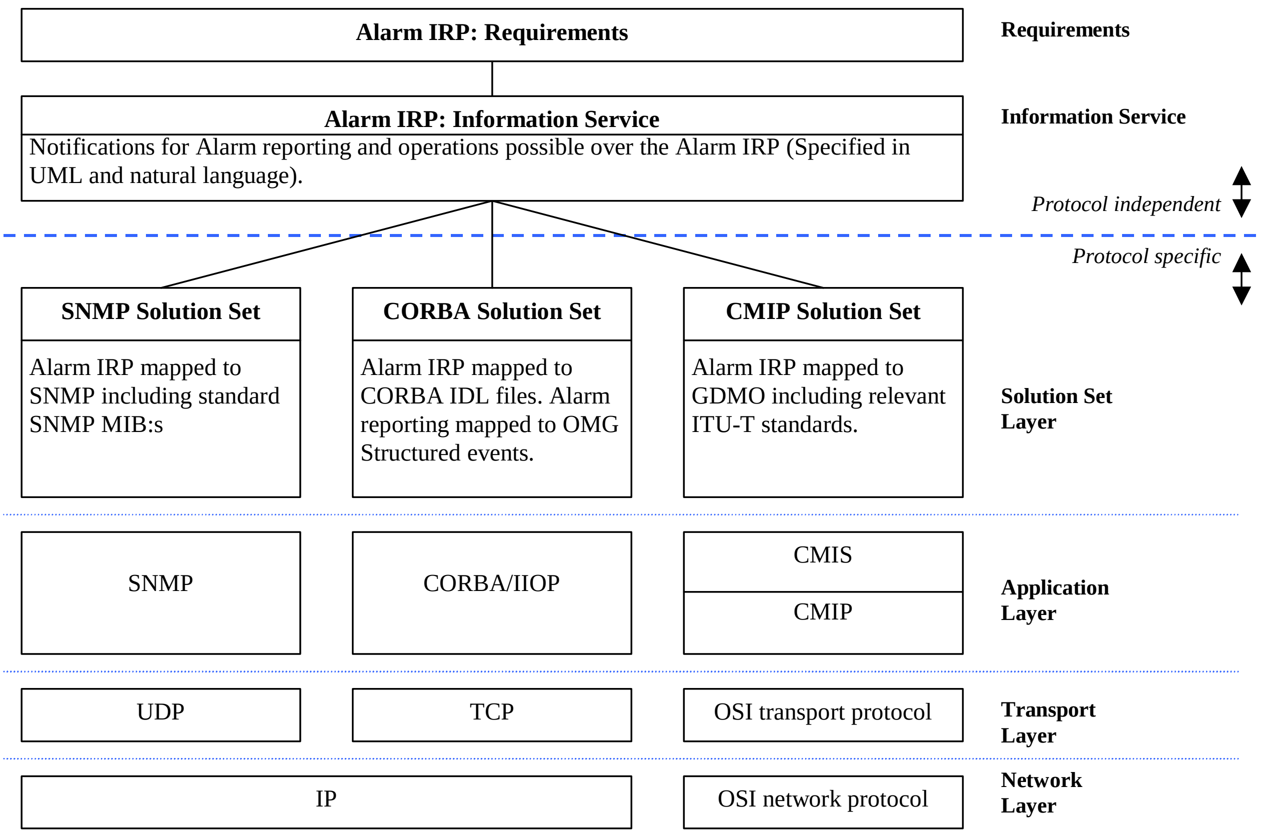

Figure 4.4: Example of an IRP (Alarm IRP)

4.5 Relationships among IS-level specifications

This subclause presents the target architecture of the SA5 IRP Information Models. This architecture is based on the concepts of level and partition of information. To achieve this, Information Object Classes (IOCs) and interfaces are defined and grouped into packages that can be related to each other through the *import* relationship.

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

1) A **Generic Network Resource Model**, also called "Generic NRM", which defines the information object classes that are independent of any:

    1. protocol (e.g. CORBA / IDL, CMIP / GDMO, etc.); and

    2. "domain specific 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.

2) A number of **Domain-specific Network Resource Models**. Examples of these are: 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.

3) A number of **function-specific ISs**. Such information services as the Basic CM IRP IS, the Notification IRP IS and the Alarm IRP IS are part of this level. They are part of Level 3. These Information Services are specified in corresponding packages and may import information object classes and interfaces defined in Level 1 and 2. For each of these Information Services, a number of solution sets may be provided.

4) A number of (interface technology-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 may import information object classes and interfaces defined both in Level 1, 2 and 3. An example of such Information Model could be a "UTRAN Alarm IM" (see figure 4.5). For each of these Information Models, a number of solution sets may be provided.

These levels provide a means for separation of concerns and re-utilization.

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 that participate in the definition of a given IRP should be gathered into a dedicated package. See further example(s) on this in annex C.

Re-utilization of information specification contained in an IS previously specified shall be possible through the *import* relationship. The import relationship is a means for re-utilization: once a piece of information (i.e. an information object class, an attribute, a relationship or an interface) defined in an IS is imported in another IS, it is added to the name space of the importing IS. Then, the whole information available in a IS is made up of the information which is owned by the IS itself (i.e. defined in the present document) plus the information which is imported from other IS(s). This imported information can then be utilized in the importing 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 figure 4.5; it uses the UML diagrammatic conventions.

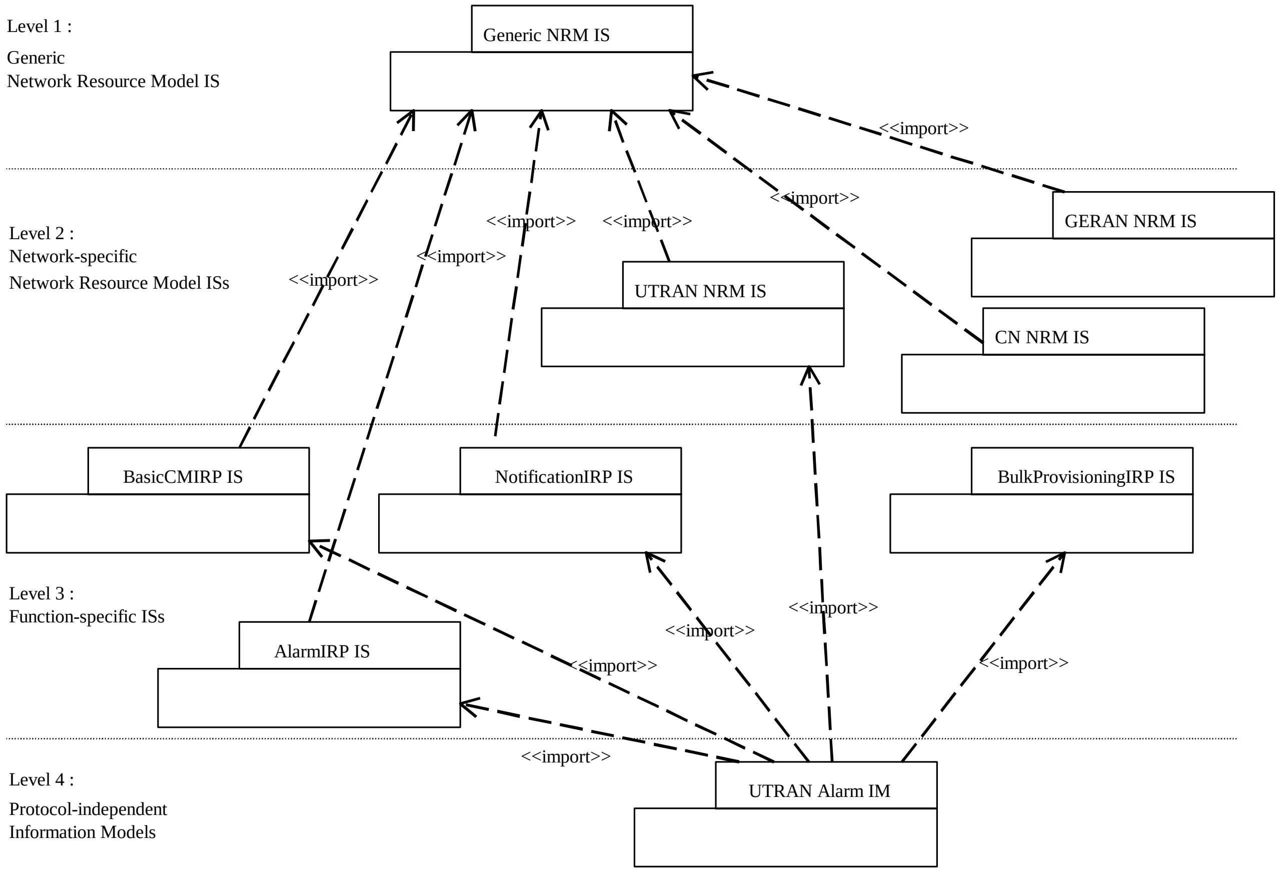

Figure 4.5: Specification architecture (not complete)

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 are valid:

   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 definitions 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.

4.6 Mandatory, Optional and Conditional qualifiers

This subclause defines a number of terms used to qualify the relationship between the "Information Service", the "Solution Sets" and their impact on the IRP implementations. The qualifiers defined in this clause are used to qualify IRPAgent behaviour only. This is considered sufficient for the specification of the IRPs.

Table 4.1 defines the meaning of the three terms Mandatory, Conditional and Optional when they are used to qualify the relations between operations, notifications and parameters specified in "Information Service" documents and their equivalents in Solution Set (SS) specifications.

Table 4.1: Definitions of Mandatory, Optional and Conditional Used in Information Service specifications

	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 4.2 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.

Table 4.2: Definitions of Mandatory and Optional Used in Solution Set Documents

Mapped SS Equivalent	Mandatory	Optional
Mapped notification equivalent	IRPAgent shall generate it.	IRPAgent may or may not generate it.
Mapped operation equivalent	IRPAgent shall support 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.
input parameter of the mapped operation equivalent	IRPAgent shall accept and behave according to its 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.
Input parameter of mapped notify equivalent AND output parameter of mapped operation equivalent	IRPAgent shall generate it.	IRPAgent may generate it.

Annex A (informative): General rules for Solution Sets

A.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 Information Service (IS) or a Solution Set (SS) a better understanding on how to interpret the IS or SS specifications.

A.2 Solution Set (SS) versioning

For further study.

A.3 Referenced Information Service (IS) specification

A sentence shall be included in the clause "Scope" of all Solution Set specifications. The sentence shall read as follows:

"This Solution Set specification is related to Z".

where Z is the 3GPP Information Service (IS) specification number including the version, such as "TS 32.111-2 V4.1.X" for the case of Alarm Integration Reference Point (IRP): Information Service.

NOTE: that "X", rather than the actual digit, is actually used in the sentence. This is because the value of X is not relevant for the reference purpose since different values of X identify different 3GPP published specifications that reflect only minor editorial changes.

Annex B (normative): Rules for CORBA Solution Sets

B.1 Introduction

The intent of this annex is threefold.

1) The first intent is for 3GPP internal use to document how a 3GPP CORBA SS is produced and how it is structured.

2) The second intent with the annex is to give the reader or implementer of a CORBA SS a better understanding on how to interpret the CORBA SS specification.

3) The third and maybe most important intent is to put requirement on an implementer of a CORBA SS.

It is expected that this annex is to be extended in later versions of the present document.

B.2 Rules for specification of CORBA Solution Sets

B.2.1 Introduction

This subclause identifies rules for specification of CORBA SSs. This subclause is mainly for 3GPP-internal use. It is only for information for the implementer of a CORBA SS.

B.2.2 Pragma prefix

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

#pragma prefix "3gppsa5.org"

B.3 Implementation aspects of CORBA Solution Sets

B.3.1 Introduction

This subclause identifies rules for the implementation of CORBA SSs. This subclause is normative for the implementer of a CORBA SS.

B.3.2 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.

B.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 subclause B.3.5). If the check is negative, the IRPAgent shall throw the `ParameterNotSupported` exception with a string carrying the name of the unsupported optional parameter.

B.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 realized by a string of zero length.

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

For optional sub-attributes of an attribute carried by the name-value pair, their absence semantics is realized by the encoding rule of "absence semantics". See subclause B.3.5.

B.3.5 Encoding rule of absence semantics

The operation parameters are mapped to method parameters of CORBA SS. The absence semantics for an operation (input and output) parameter is method parameter type dependent.

- For a string type, if the parameter is specified as a string type, the absence semantics is a string of zero length. If the parameter is specified as a union structure (preferred), the absence semantics is conveyed via a FALSE Boolean value switch.
- For an integer type, if the parameter is specified as a signed, unsigned, long, etc type, the absence semantics is the highest possible positive number. If the parameter is specified as a union structure (preferred), the absence semantics is conveyed via a FALSE Boolean value switch.
- For a boxed valueType (supported by CORBA 2.3), it is the null value.

The notification parameters are mapped to attributes of the CORBA Structured Events. The absence semantics for a notification parameter is attribute position (within the Structured Event) dependent.

- For the fixed header of the Structured Event header, the absence semantics is realized by a string of zero length.
- For the filterable body fields of the Structured Event body, the absence semantics is realized by the absence of the corresponding attribute.

B.4 IDL file name rule

CORBA IDL uses "#include "X"" statement where X is a name of a file containing IDL statements. In the CORBA Solution Set, IDL statements are specified.

The rule defined here specifies:

a) the IDL statements that shall belong to one file; and

b) the name of the file.

Rule:

In the annex where IDL statements are defined, use a special marker to indicate that a set of IDL statements shall be contained in one file. The name of the file shall be the name of the first IDL module of that set (of IDL statements). Multiple markers can be used.

Annex C (informative): Example of inheritance between ISs

Figure C.1 illustrates the architecture defined in clause 4.6 with a simplified example. This figure is for illustration only.

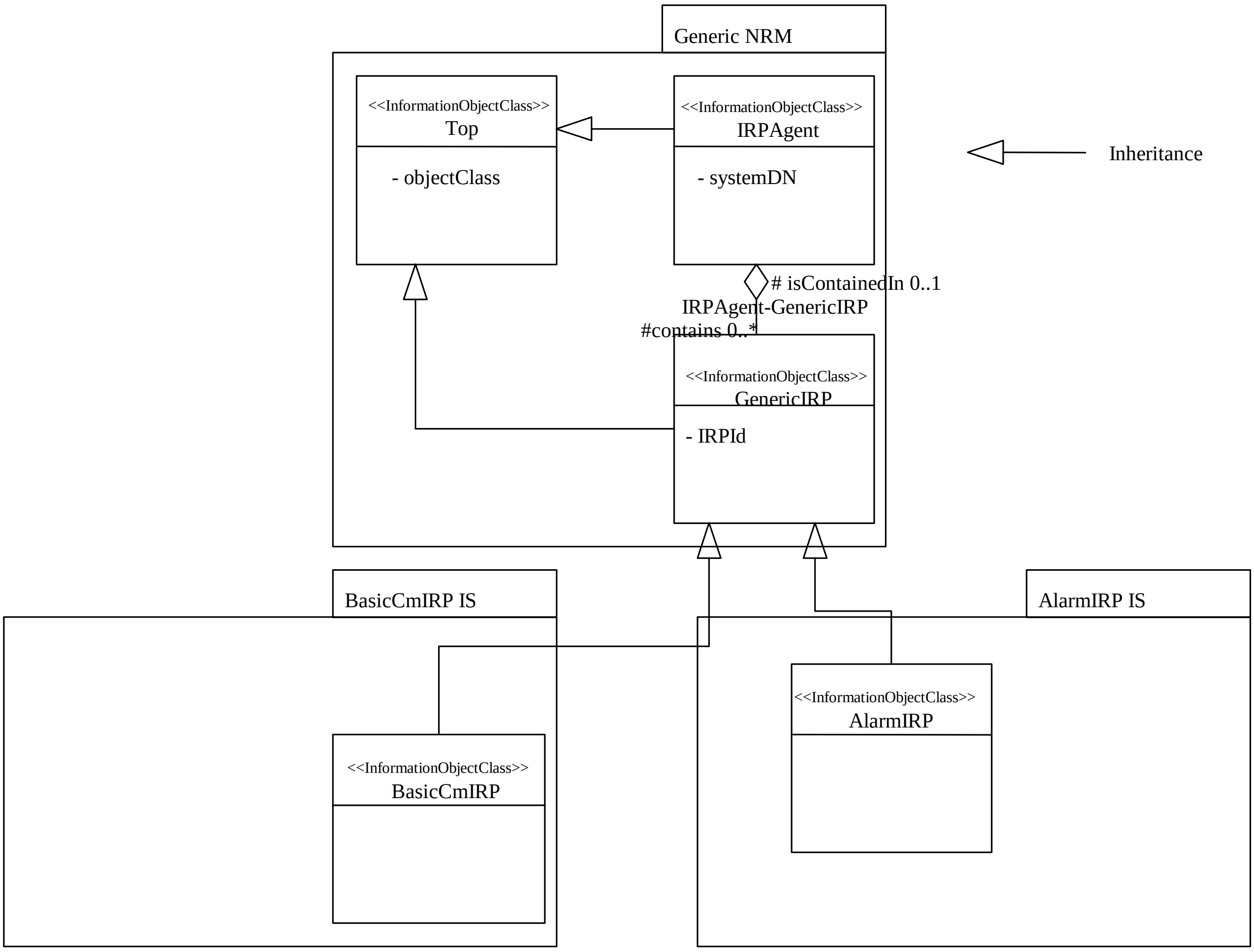

Figure C.1: Example of possible packages together with Information Object Classes (IOCs) and their inter-relationships

The following aspects are illustrated in figure C.1:

1) IOCs 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 IOC BasicCmIRP is defined in the BasicCmIRP IS package. As illustrated in the previous figure, this package imports the GenericNRM package.

3) The IOC 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 IOC can inherit from the class Top, either directly or indirectly.

5) The IRPAgent class is defined in the GenericNRM.

6) A GenericIRP IOC 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 IOCs BasicCmIRP and AlarmIRP (defined in different ISs) 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): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
Dec 2003	S_22	SP-030613	--	--	Submitted to TSG SA#22 for Information	1.0.0	
Mar 2004	S_23	SP-040113	--	--	Submitted to TSG SA#23 for Approval	2.0.0	