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**Digital cellular telecommunications system (Phase 2+) (GSM);  
Universal Mobile Telecommunications System (UMTS);  
LTE;  
Telecommunication management;  
Integration Reference Point (IRP) overview and usage guide  
(3GPP TS 32.103 version 16.3.0 Release 16)**



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# Introduction

This specification provides the IRP Overview for 3GPP specifications, addressing Interface IRPs, NRM IRPs, Measurement / Trace /SON specifications, as well as their relationships with each other.

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# 1 Scope

The present document gives an overview about 3GPP's management capabilities and related functionality. This document is intended to be a guide into the world of 3GPP management specifications, enabling also non-subject matter experts to gain an understanding about 3GPP's management solutions.

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- [150] 3GPP TS 28.653: "Telecommunication management; Universal Terrestrial Radio Access Network (UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [151] 3GPP TS 28.654: "Telecommunication management; GSM/EDGE Radio Access Network (GERAN) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [152] 3GPP TS 28.655: "Telecommunication management; GSM/EDGE Radio Access Network (GERAN) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [153] 3GPP TS 28.656: "Telecommunication management; GSM/EDGE Radio Access Network (GERAN) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [154] 3GPP TS 28.657: "Telecommunication management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".

- [155] 3GPP TS 28.658: "Telecommunication management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [156] 3GPP TS 28.659: "Telecommunication management; Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [157] 3GPP TS 28.661: "Telecommunication management; Generic Radio Access Network (RAN) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [158] 3GPP TS 28.662: "Telecommunication management; Generic Radio Access Network (RAN) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [159] 3GPP TS 28.663: "Telecommunication management; Generic Radio Access Network (RAN) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [160] 3GPP TS 28.671: "Telecommunication management; Home Node B (HNB) Subsystem (HNS) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [161] 3GPP TS 28.672: "Telecommunication management; Home Node B (HNB) Subsystem (HNS) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [162] 3GPP TS 28.673: "Telecommunication management; Home Node B (HNB) Subsystem (HNS) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [163] 3GPP TS 28.674: "Telecommunication management; Home enhanced Node B (HeNB) Subsystem (HeNS) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [164] 3GPP TS 28.675: "Telecommunication management; Home enhanced Node B (HeNB) Subsystem (HeNS) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [165] 3GPP TS 28.676: "Telecommunication management; Home enhanced Node B (HeNB) Subsystem (HeNS) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [166] 3GPP TS 28.701: "Telecommunication management; Core Network (CN) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [167] 3GPP TS 28.702: "Telecommunication management; Core Network (CN) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [168] 3GPP TS 28.703: "Telecommunication management; Core Network (CN) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [169] 3GPP TS 28.704: "Telecommunication management; IP Multimedia Subsystem (IMS) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [170] 3GPP TS 28.705: "Telecommunication management; IP Multimedia Subsystem (IMS) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [171] 3GPP TS 28.706: "Telecommunication management; IP Multimedia Subsystem (IMS) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [172] 3GPP TS 28.707: "Telecommunication management; Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [173] 3GPP TS 28.708: "Telecommunication management; Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [174] 3GPP TS 28.709: "Telecommunication management; Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [175] 3GPP TS 28.731: "Telecommunication management; Transport Network (TN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".

- [176] 3GPP TS 28.732: "Telecommunication management; Transport Network (TN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [177] 3GPP TS 28.733: "Telecommunication management; Transport Network (TN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [178] 3GPP TS 28.734: "Telecommunication management; Signalling Transport Network (STN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [179] 3GPP TS 28.735: "Telecommunication management; Signalling Transport Network (STN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [180] 3GPP TS 28.736: "Telecommunication management; Signalling Transport Network (STN) interface Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [181] 3GPP TS 28.751: "Telecommunication management; Subscription Management (SuM) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [182] 3GPP TS 28.752: "Telecommunication management; Subscription Management (SuM) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [183] 3GPP TS 28.753: "Telecommunication management; Subscription Management (SuM) Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [184] 3GPP TS 28.611: "Telecommunication management; Evolved Packet Core (EPC) and non-3GPP access interworking system Network Resource Model (NRM) Integration Reference Point (IRP); Requirements".
- [185] 3GPP TS 28.612: "Telecommunication management; Evolved Packet Core (EPC) and non-3GPP access interworking system Network Resource Model (NRM) Integration Reference Point (IRP); Information Service (IS)".
- [186] 3GPP TS 28.616: "Telecommunication management; Evolved Packet Core (EPC) and non-3GPP access interworking system Network Resource Model (NRM) Integration Reference Point (IRP); Solution Set (SS) definitions".
- [187] 3GPP TS 23.402: "Architecture enhancements for non-3GPP accesses".
- [188] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".
- [189] 3GPP TS 28.500: "Telecommunication management; Management concept, architecture and requirements for mobile networks that include virtualized network functions".
- [190] 3GPP TS 28.510: "Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Requirements".
- [191] 3GPP TS 28.511: "Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Procedures".
- [192] 3GPP TS 28.512: "Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Stage 2".
- [193] 3GPP TS 28.513: "Telecommunication management; Configuration Management (CM) for mobile networks that include virtualized network functions; Stage 3".
- [194] 3GPP TS 28.515: "Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Requirements".
- [195] 3GPP TS 28.516: "Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Procedures".
- [196] 3GPP TS 28.517: "Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Stage 2".

- [197] 3GPP TS 28.518: "Telecommunication management; Fault Management (FM) for mobile networks that include virtualized network functions; Stage 3".
- [198] 3GPP TS 28.520: "Telecommunication management; Performance Management (PM) for mobile networks that include virtualized network functions; Requirements".
- [199] 3GPP TS 28.521: "Telecommunication management; Performance Management (PM) for mobile networks that include virtualized network functions; Procedures".
- [200] 3GPP TS 28.522: "Telecommunication management; Performance Management (PM) for mobile networks that include virtualized network functions; Stage 2".
- [201] 3GPP TS 28.523: "Telecommunication management; Performance Management (PM) for mobile networks that include virtualized network functions; Stage 3".
- [202] 3GPP TS 28.525: "Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Requirements".
- [203] 3GPP TS 28.526: "Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Procedures".
- [204] 3GPP TS 28.527: "Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Stage 2".
- [205] 3GPP TS 28.528: "Telecommunication management; Life Cycle Management (LCM) for mobile networks that include virtualized network functions; Stage 3".
- [206] 3GPP TS 32.581: "Telecommunication management; Home Node B (HNB) Operations, Administration, Maintenance and Provisioning (OAM&P); Concepts and requirements for Type 1 interface HNB to HNB Management System (HMS)".
- [207] 3GPP TS 32.582: "Telecommunication management; Home Node B (HNB) Operations, Administration, Maintenance and Provisioning (OAM&P); Information model for Type 1 interface HNB to HNB Management System (HMS)".

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## 3 Definitions and abbreviations

### 3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1], TS 32.150 [2], TS 32.101 [3] and the following apply

**Data Definition IRP:** 3GPP publishes IRP specifications relating to commonly used data definitions that can be imported for use by Interface IRP and/or NRM IRP. This term represents all such specifications. An example of a Data Definition IRP is the State Management IRP (28.624 [4], 28.625 [5], 28.626 [6], etc).

**Integration Reference Point (IRP):** An architectural concept that is described by a set of specifications for definition of a certain aspect of a management interface, comprising a **Requirements** specification, an **Information Service** specification, and one or more **Solution Set** specifications.

**Interface IRP:** 3GPP publishes a number of IRP specifications each of which is related to a set of operations and notifications for a specific telecom management domain such as alarm management, configuration management, etc. Interface IRPs also contain definitions of Support IOCs. This term represents all such specifications. An example of an Interface IRP is the Basic CM IRP (the set of TSs 32.601 [7], 32.602 [8], 32.603 [9], etc.).

**IRP Agent:** Encapsulates a well-defined subset of network (element) functions. It interacts with IRPManagers using one or more IRPs. From the IRPManager's perspective, the IRP Agent behaviour is only visible via the IRP(s).

**Information Service (IS):** an IRP Information Service describes the information related to the entities (either network resources or support objects) to be managed and the way that the information may be managed for a certain functional



area (e.g. the Alarm IRP Information Service in the fault management area). Information Services are defined for all IRPs.

**IRPManager:** Models a user of IRPAgent(s) and it interacts directly with the IRPAgent(s) using IRP(s). Since the IRPManager represents an IRPAgent user, it gives a clear picture of what the IRPAgent is supposed to do. From the IRPAgent perspective, the IRPManager behaviour is only visible via the IRP.

**Network Resource Model (NRM):** An Information Service describing Information Object Classes representing the manageable aspects of network resources, e.g. an RNC or NodeB.

**NRM IRP:** 3GPP publishes a number of IRP specifications each of which is related to a particular NRM (Network Resource Model) as defined in 3GPP TS 32.101 [3]. NRM IRPs do not define any operations or notifications. This term represents all such specifications. Note: In some NRM IRP titles, for historic reasons, they are named "...network resources IRP"). An example of an NRM IRP is the Generic NRM IRP (28.621 [10], 28.622 [11], 28.623 [12], etc.).

**Solution Set (SS):** contains a mapping of the IRP Information Service (IS) defined entities (that are technology-agnostic) to technology specific termed entities. It does not contain specification of the entities' semantics. The semantics can be found in the corresponding IS. It is noted that one IS can be mapped to one or several SSs..

## 3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

|      |                                     |
|------|-------------------------------------|
| AN   | Access Network                      |
| CN   | Core Network                        |
| FMC  | Fixed Mobile Convergence            |
| FNIM | Federated Network Information Model |
| IF   | Interface                           |
| IRP  | Integration Reference Point         |
| IS   | Information Service                 |
| NFV  | Network Function Virtualization     |
| NRM  | Network Resource Model              |
| PM   | Performance Management              |
| SS   | Solution Set                        |
| UIM  | Umbrella Information Model          |
| WLAN | Wireless Local Area Network         |

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## 4 IRP Framework

### 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 model-driven development, protocol and technology neutral modelling methods as well as protocol specific solution sets to achieve its goals.

IRP Framework and Methodology related 3GPP specifications:

- 32.150 [2]: Integration Reference Point (IRP) Concept and definitions
- 32.153 [15]: IRP technology specific templates, rules and guidelines
- 32.154 [16]: Backward and Forward Compatibility Concept and definitions
- 32.155 [17]: Requirements template
- 32.156 [18]: Fixed Mobile Convergence (FMC) Model repertoire
- 32.157 [19]: IRP Information Service (IS) template

## 4.2 IRP Framework Highlights

### 4.2.1 IRP Concept

IRP specifications are specified using a 3-level approach: Requirements, IS-level and SS-level.

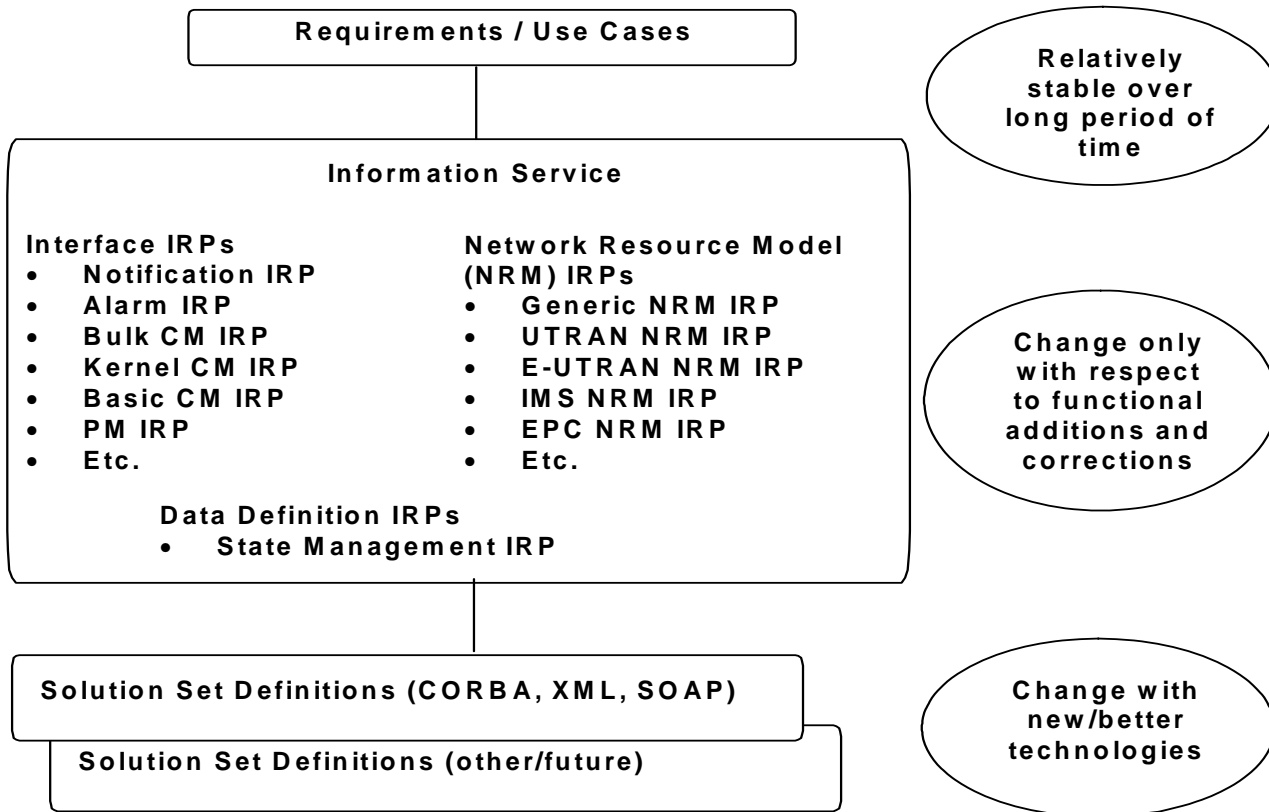


Figure 4.2-1: The IRP 3-level specifications approach combined with the three IRP categories

**Requirements-level:**

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.

**IS-level:**

The "IS-level" provides the technology independent specification of an IRP.

**SS-level:**

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.

## 4.2.2 Relationships between IRPs

There are three categories of IRP specifications:

- Interface IRPs
- NRM IRPs
- Data Definition IRPs

Each category is partitioned into Requirements, IS-level and SS-level specifications.

Relationships between various kinds of IRPs:

- Some Interface IRPs and NRM IRPs are used together. Such Interface IRPs operate on entities modelled by NRM IRPs. For example, operations defined in Basic CM IRP are used together with E- UTRAN NRM IRP to support E-UTRAN configuration management function.
- Interface IRPs are network/radio technology independent and can operate on entities modelled by NRM IRPs of different network technologies. For example, operations defined in Basic CM IRP are used together with E-UTRAN NRM IRP or UTRAN NRM IRP to support E- UTRAN or UTRAN configuration management functions.
- Interface IRPs are Converged Management ready (e.g. support management of fixed and/or mobile) and can operate on modelled mobile and/or fixed network entities.
- A Data Definition IRP provides common data definitions, referenced by specifications of Interface IRPs and NRM IRPs.

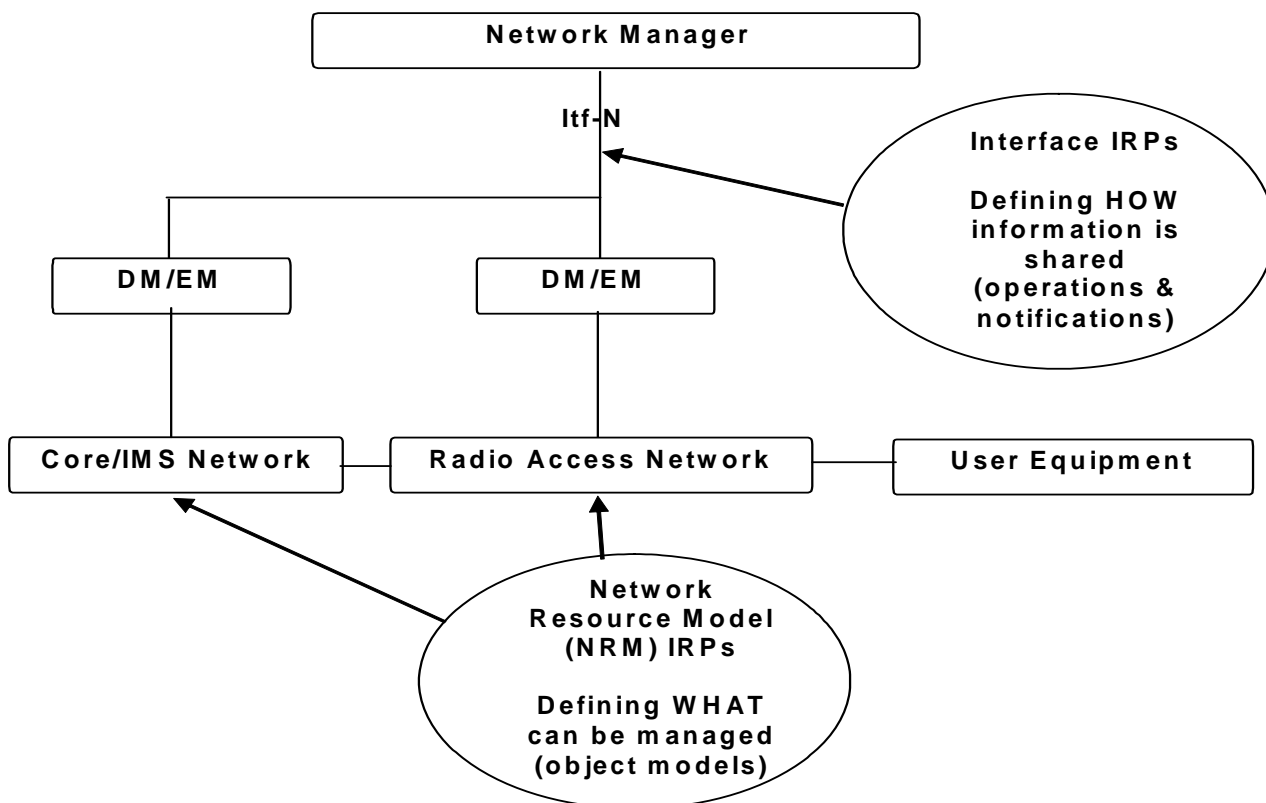


Figure 4.2-2: Relationship Interface IRP vs NRM IRP

### 4.2.3 IRP Development Principles

**NRM IRP Extensibility** - Enabling Technology, Organizational & Vendor-specific NRM extensions via

- Rule-based NRM Extensions (e.g. Sub-classing)
- vsDataContainer

**Interface IRP Flexibility** - Enabling: wide applicability, phased introduction capabilities & broad industry adoption (not just for wireless) via

- Flexible use of qualifiers "mandatory", "optional", "conditional" for operation, notifications and/or parameters
- NRM/Technology-neutrality & avoiding competing procedures

### 4.2.4 IRP Specification Structure

32-series IRPs follow a uniform specification structure:

- xx1: xyz IRP Requirements
- xx2: xyz IRP IS
- xx3: xyz IRP CORBA SS (merged into xx6 after R9)
- xx4: xyz IRP CMIP SS (retired after R6)
- xx5: xyz IRP XML Definitions (applicable for NRM's & notification emitting IRPs - merged into xx6 after R9)
- xx6: xyz IRP SS (since Rel-10, containing all technology specific Solution Set definitions)

*xx7: xyz IRP SOAP SS (merged into xx6 after R9)*

28-series IRPs (supporting FMC) consisting of 3-specification sets, structured as follows:

- 28.3xx: Interface IRP specifications.
- 28.611-28.616 EPC and non-3GPP access interworking system NRM IRP
- 28.620-28.649: Common/Generic NRM IRPs.
- 28.650-28.699: Access Network related NRM IRPs.
- 28.700-28.729: CN-related NRM IRPs.
- 28.730-28.749: Transport-related NRM IRPs.
- 28.750-28.769: Service-related NRM IRPs.
- 28.770-28.799: *reserved for future topic NRM IRPs.*

## 4.2.5 Void

## 4.3 IRP related High-level Requirements & Architecture Specifications

The IRP Framework has been developed in response to management requirements documented in the following specifications:

- 32.101 [3]: Principles and high level requirements
- 32.102 [20]: Architecture
- 32.107 [21]: Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM)
- 32.111-1 [22]: 3G fault management requirements
- 32.140 [23], SuM requirements
- 32.141 [24]: SuM architecture
- 32.300 [25]: Name convention for Managed Objects
- 32.401 [26]: PM Concept and requirements
- 32.500 [27]: SON Concepts and requirements
- 32.511 [28]: ANR management Concepts and requirements
- 32.521 [29]: Self-optimization Concepts and requirements
- 32.541 [30]: Self-healing Concepts and requirements
- 32.551 [31]: Energy Saving Management (ESM) Concepts and requirements
- 32.600 [32]: CM Concept and high-level requirements

## 4.4 Converged Management and IRPs

As outlined in previous sections, 3GPP Interface IRPs are network-technology-independent, and therefore can be utilized for the management of various network technologies.

To further ease converged management (the common management of multiple network technologies) and to address the need for OPEX reduction, 3GPP together with other industry organizations (i.e. NGMN and TM Forum) developed jointly the following specifications:

- Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM) (published in 3GPP as TS 32.107 [21])
  - Defining conceptually the federated network information model and the relationships between participating models (see also section 5.5 of TS 32.101 [3]).
- FMC FNIM Umbrella Information Model (UIM) (published in 3GPP as TS 28.620 [34])
  - Providing abstract definitions of information objects applicable across Domain/Technology-specific Concrete Models.
- Fixed Mobile Convergence (FMC) Model repertoire (published in 3GPP as TS 32.156 [18])
  - Defining meta definitions for models supporting converged management.
- Fixed Mobile Convergence (FMC) 3GPP / TM Forum Concrete Model Relationships and Use Cases
  - Proposing the specific structure of model and realisation of that structure across 3GPP and TM Forum by taking advantage of current TM Forum transport-oriented model work (SID, MTNM/MTOSI) as well as current 3GPP SA5 mobile-oriented model work (NRM IRPs etc.).

Based on above, 3GPP has applied definitions provided by these specifications by creating the 28-series variants of the 3GPP NRM IRPs to support converged management.

## 5 Interface IRPs

### 5.1 Interface IRP Overview

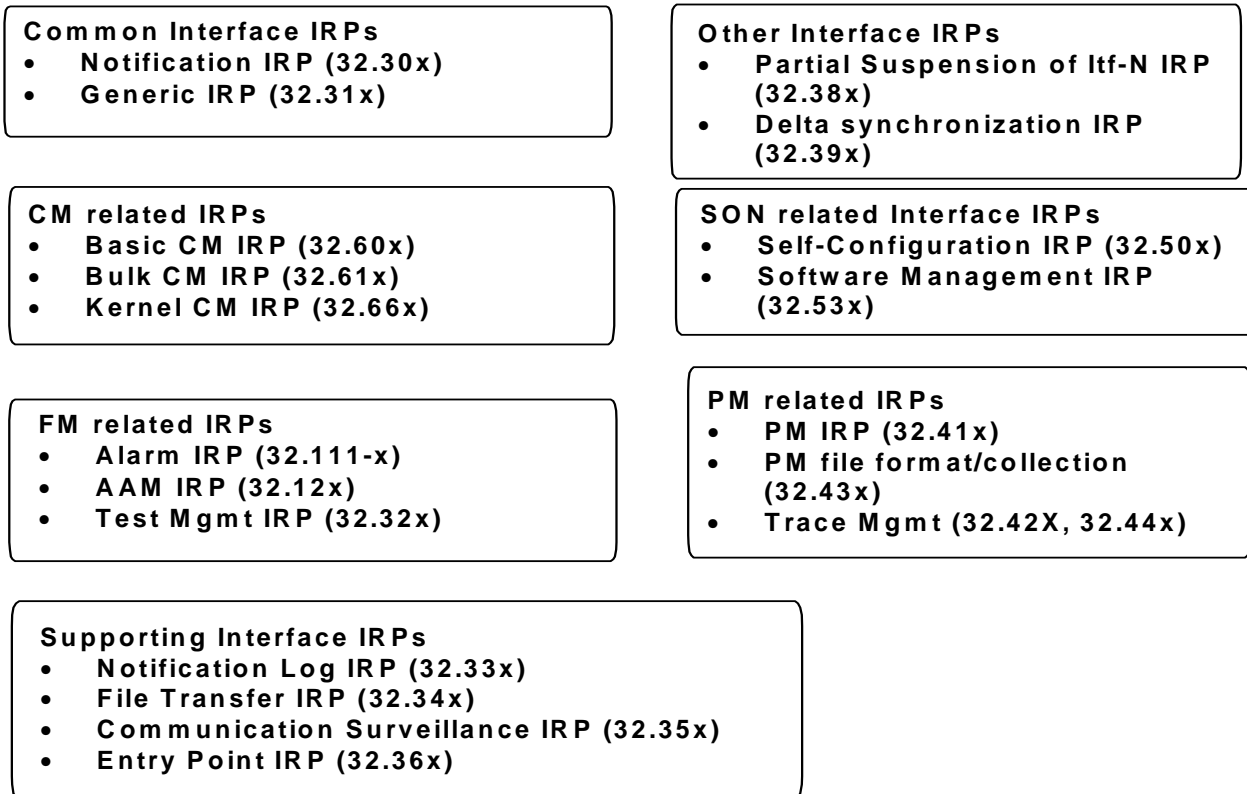


Figure 5.1-1: 3GPP Interface IRPs

### 5.2 Generic/Common Interface IRPs

#### Notification IRP – 32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70]

The purpose of the Notification IRP is to define an interface through which an IRPManager can subscribe to an IRPAgent for receiving notifications, manage these subscriptions, and optionally set filters.

#### Generic IRP – 32.311 [71], 32.312 [72], 32.316 [73]

This IRP defines common services supported by all IRPs such as AlarmIRP. With this common service supported by all IRPs, an IRPManager can retrieve the profile of operations and notifications supported by a given IRP name contained by an IRPAgent. An IRPManager can also retrieve the IRPVersions supported by a given IRP.



## 5.3 FM related interface IRPs

### **Alarm IRP – 32.111-1 [22], 32.111-2 [63], 32.111-6 [64]**

The Alarm (IRP) addresses the alarm surveillance aspects of Fault Management (FM), applied to Itf-N. It defines alarm semantics & syntax as well as alarm management related operations and notifications.

### **Advanced Alarm Management IRP – 32.121 [65], 32.122 [66], 32.126 [67]**

The purpose of Advanced Alarm Management (AAM) IRP is to define an interface through which an IRPManager can categorize alarm notifications. It defines, for the purpose of categorizing alarm notifications, the information observable and controlled by management system's client and it also specifies the semantics of the interactions used to carry this information.

### **Test management IRP – 32.321 [74], 32.322 [75], 32.326 [76]**

The purpose of the Test management IRP is to define an interface through which an IRPManager can manage and monitor tests in NE's, as well as methods to receive test results.

## 5.4 CM related interface IRPs

### **Basic CM IRP – 32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]**

Using this IRP, an IRPAgent can communicate basic Configuration Management related information to one or several IRPManagers. The function of this Basic CM IRP Information Service is to define an interface for the retrieval and modification of Configuration Management Information.

### **Bulk CM IRP – 32.611 [125], 32.612 [126], 32.616 [127]**

Using the Bulk CM IRP an IRPAgent can communicate CM related information to one or several IRPManagers using bulk data transfer methods.

- BulkCM SimpleUpload, enabling upload of resource information by the IRPManager without explicit session control
- BulkCM Controlled Upload, enabling a session controlled upload of resource information by the IRPManager
- BulkCM Controlled Upload & Provisioning, enabling a session controlled upload and provisioning of resource information by the IRPManager

### **Kernel CM IRP – 32.661 [134], 32.662 [135], 32.666 [136]**

The function of this Kernel CM IRP Information Service is to define an interface that provides essential CM notification services. While it is not expected that the Kernel CM IRP alone will provide adequate CM capabilities, the Kernel CM IRP is expected to provide the common supporting CM notifications required for other CM IRPs such as the Basic CM IRP or the Bulk CM IRP, each of which require the Kernel CM IRP.

## 5.5 PM file format/collection & Trace related Interface IRPs

### Performance Management IRP – 32.410 [100], 32.411 [101], 32.412 [102], 32.416 [103]

The Performance Management IRP defines an interface through which an IRPManager can manage measurement jobs as well threshold values.

### Performance Measurement collection – 32.432 [107], 32.435 [108], 32.406 [109]

The Performance Measurement collection specifications describe the general semantics of performance measurement result and collection. They define the report file format, report file conventions and the file transfer procedure.

### Trace Management IRP – 32.441 [38], 32.442 [110], 32.446 [111]

The Trace Management IRP is defines an interface through which an IRPManager can activate and manage equipment and subscriber trace jobs.

## 5.6 Special-purpose related Interface IRPs

### Notification Log IRP – 32.331 [77], 32.332 [78], 32.336 [79]

The purpose of the Notification Log IRP is to define an interface through which an IRPManager can manage a Notification Log, as well as methods for retrieval of logged notifications.

### File Transfer IRP – 32.341 [80], 32.342 [81], 32.346 [82]

The purpose of the File Transfer IRP is to define a generic tools set supporting the management of file transfers between IRPManager and IRPAgent. Curently the following management data types are supported by this IRP:

- performance data files
- configuration & inventory files
- test result files
- call trace files
- notification log files
- charging files

### Communication Surveillance IRP – 32.351 [83], 32.352 [84], 32.356 [85]

The purpose of the Communication Surveillance IRP is to provide an IRPManager with the capability to monitor the health of the communications link towards an IRPAgent.

### Entry Point IRP – 32.361 [86], 32.362 [87], 32.366 [88]

The purpose of the Entry Point IRP is to provide an IRPManager with discovery and entry point capabilities towards an IRPAgent and its supported IRPs.

### Partial Suspension of Itf-N IRP – 32.381 [89], 32.382 [90], 32.386 [91]

The purpose of Partial Suspension of Itf-N IRP is to define an interface through which an IRPManager can suspend the forwarding of notifications via Itf-N which were generated in parts of the managed systems.

### Delta synchronization IRP – 32.391 [92], 32.392 [93], 32.396 [94]

The purpose of Delta Synchronization IRP is to define an interface through which an IRPManager can request only those data that have changed (i.e. changed, were created or deleted) from a synchronization point onwards.

## 5.7 SON related Interface IRPs

### **Self-Configuration IRP – 32.500 [27], 32.501 [36], 32.502 [117], 32.506 [118]**

The Self-Configuration provides methods to allow automatic configuration of eNBs, which are brought newly into a network.

### **Software Management IRP – 32.531 [121], 32.532 [122], 32.536 [123]**

The Software Management IRP provides an IRPManager with capabilities to automate software management via Itf-N.

## 6 NRM IRPs

### 6.1 NRM IRP Overview

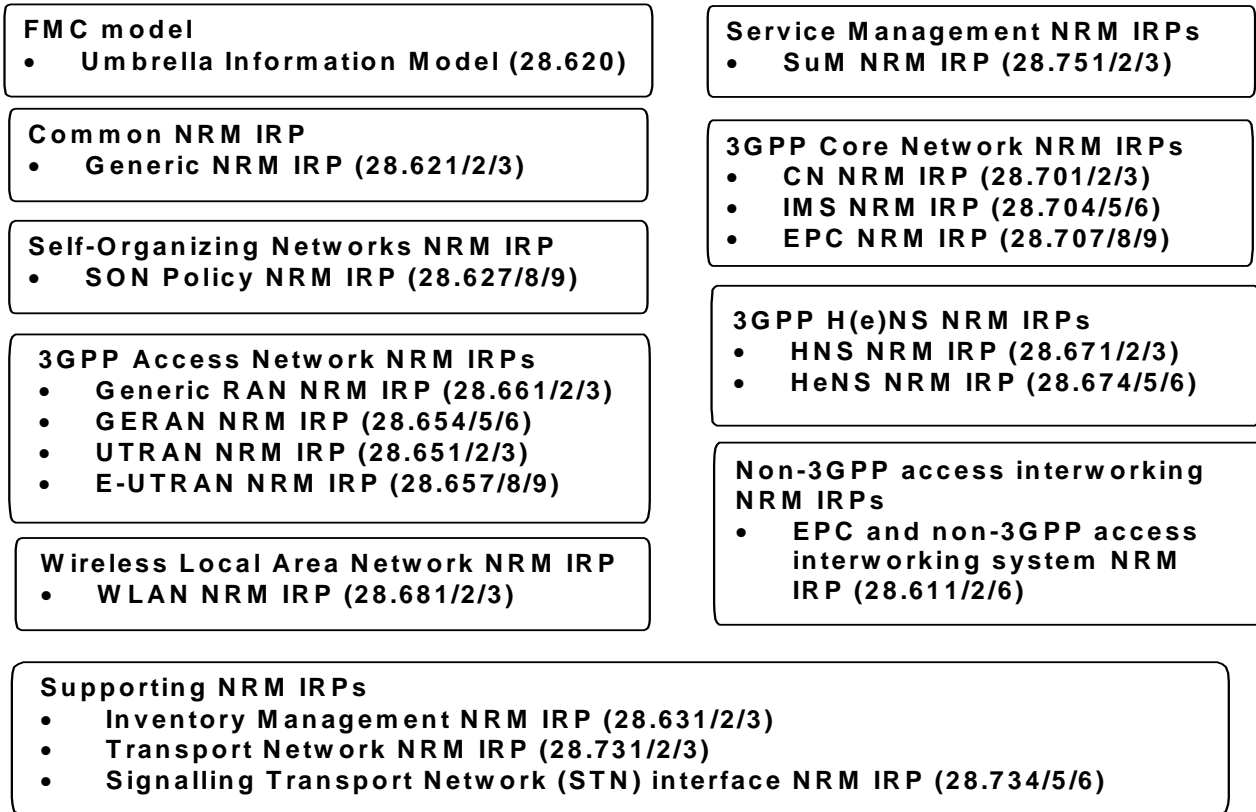


Figure 6.1-1: 3GPP NRM IRPs

### 6.2 FMC Models and Common NRM IRPs

#### FMC FNIM Umbrella Information Model (UIM) – 28.620 [34]

The Umbrella Information Model (UIM) provides abstract definitions of information objects applicable across Domain/Technology-specific Concrete Models to enable end-to-end consistency of such definitions. These definitions are used by the Generic NRM IRP (28.621 [10], 28.622 [11], 28.623 [12]) to enable 3GPP NRM IRPs to be part of the industry-wide Federated Network Information Model (FNIM).

#### Generic NRM IRP – 28.621 [10], 28.622 [11], 28.623 [12]

The Generic NRM IRP provides the generic network resources information that can be communicated between an IRP Agent and one or several IRP Managers for network management purposes. To enable converged management, the Generic NRM IRP as defined in 28.621 [10], 28.622 [11], 28.623 [12] uses the common definitions specified in the FMC FNIM Umbrella Information Model (UIM).

## 6.3 Access Network (AN) related NRM IRPs

### **UTRAN NRM IRP – 28.651 [148], 28.652 [149], 28.653 [150]**

The UTRAN NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning UTRAN specific network resource, by reusing relevant parts of the Generic NRM IRP.

### **GERAN NRM IRP – 28.654 [151], 28.655 [152], 28.656 [153]**

The GERAN NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning GERAN specific network resource, by reusing relevant parts of the Generic NRM IRP.

### **E-UTRAN NRM IRP – 28.657 [154], 28.658 [155], 28.659 [156]**

The E-UTRAN NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning E-UTRAN specific network resource, by reusing relevant parts of the Generic NRM IRP.

### **Generic RAN NRM IRP – 28.661 [157], 28.662 [158], 28.663 [159]**

The Generic RAN NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning common RAN network resource (applicable to GERAN, UTRAN and E\_UTRAN), by reusing relevant parts of the Generic NRM IRP.

## 6.4 Core Network (CN)/IMS related NRM IRPs

### **CN NRM IRP – 28.701 [166], 28.702 [167], 28.703 [168]**

The CN NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning core network specific resource, by reusing relevant parts of the Generic NRM IRP in.

### **IMS NRM IRP – 28.704 [169], 28.705 [170], 28.706 [171]**

The IMS NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning IP Multimedia Subsystem specific network resource, by reusing relevant parts of the Generic NRM IRP.

### **Evolved Packet Core (EPC) NRM IRP – 28.707 [172], 28.708 [173], 28.709 [174]**

The EPC NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Evolved Packet Core specific network resource, by reusing relevant parts of the Generic NRM IRP.

## 6.5 H(e)NB related NRM IRPs

### **HNS NRM IRP – 28.671 [160], 28.672 [161], 28.673 [162]**

The HNS NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Home NodeB Subsystem specific network resource, by reusing relevant parts of the Generic NRM IRP.

### **HeNS NRM IRP – 28.674 [163], 28.675 [164], 28.676 [165]**

The HeNS NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Home enhanced NodeB Subsystem specific network resource, by reusing relevant parts of the Generic NRM IRP.

## 6.6 Service management related NRM IRPs and UDC specifications

### **SuM NRM IRP – 28.751 [181], 28.752 [182], 28.753 [183]**

Subscription Management is a feature that permits Service Providers, Value Added Service Providers and Mobile Operators to provision services for a specific subscriber. The SuM NRM IRP defines the Subscription Management specific network resource information between an IRP Agent and one or several IRP Managers.

### **UDC – 32.181 [141], 32.182 [142]**

User Data Convergence (UDC) presents a layered architecture where user data is accessible at a logically unique repository called User Data Repository (UDR). The UDC CBIM defines a Common Baseline Information Model for UDC, which denotes an abstract, formal representation of entity types that are common to many applications using the UDR.

## 6.7 Special-purpose related NRM IRPs

### **Inventory Management NRM IRP – 28.631 [145], 28.632 [146], 28.633 [147]**

Inventory Management (IM) provides the operator with the ability to assure correct and effective operation of the telecom network as it evolves. IM actions have the objective to monitor the actual configuration on the Network Elements (NEs) and Network Resources (NRs). The Inventory Management NRM IRP defines the inventory specific network resource information between an IRPAgent and one or several IRPManagers.

### **SON Policy NRM IRP – 28.627[35], 28.628 [143], 28.629 [144]**

The SON Policy NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Self-Organizing Networks Policies. Currently the following SON use cases are supported by this NRM IRP:

- SON Self-Optimization Management (requirements determined by TS 32.521 [29], 28.627 [35])
- SON Self-Healing Management (requirements determined by TS 32.541 [30])
- Energy Saving Management (requirements determined by TS 32.551 [31])

### **Transport Network NRM IRP – 28.731 [175], 28.732 [176], 28.733 [177]**

The Transport Network NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Transport resources, by reusing relevant parts of the Generic NRM IRP.

### **Signalling Transport NW IF NRM IRP – 28.734 [178], 28.735 [179], 28.736 [180]**

The Signalling Transport NW IF NRM IRP defines an IRP through which an IRPAgent can communicate Configuration Management information to one or several IRPManagers concerning Signalling Transport resources, by reusing relevant parts of the Generic NRM IRP.

## 6.8 EPC interworking with non-3GPP access NRM IRPs

### **Evolved Packet Core (EPC) and non-3GPP access interworking system Network Resource Model (NRM) IRP – 28.611 [184], 28.612 [185], 28.616 [186]**

This IRP describes the Network Resource Model (NRM) for the EPC and WLAN interworking system according to the structure defined in 3GPP TS 23.402 [8] (e.g. ePDG, 3GPP AAA, etc.).

## 7 Measurement & Trace Definitions

### 7.1 Performance Measurements

#### 7.1.1 Overview and relationships to IRP Framework

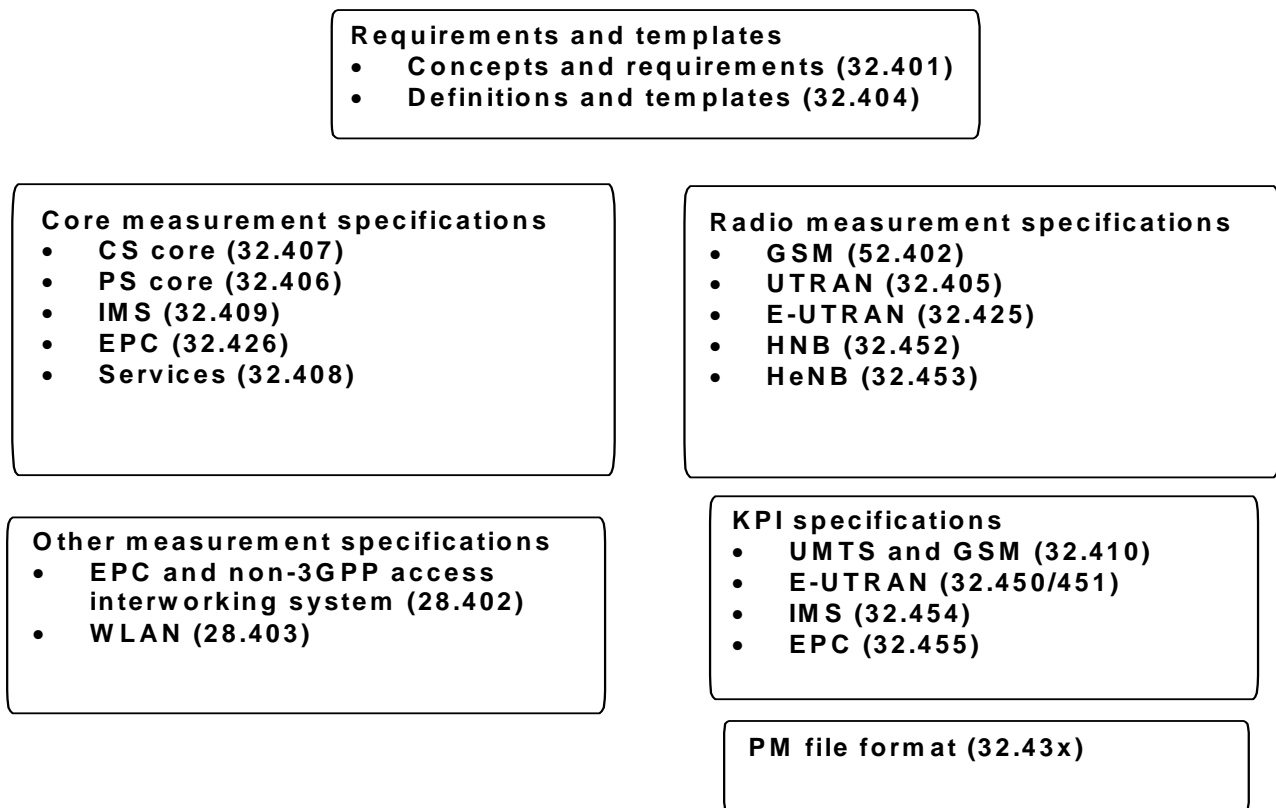


Figure 7.1.1-1: PM-related Specifications



## 7.1.2 Performance Measurement Specifications

### PS core Performance Measurements – 32.406 [96]

The purpose of this specification is to define performance measurements specific to Core Network Packet Switched Domain in a UMTS network or combined UMTS/GSM network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### CS core Performance Measurements – 32.407 [97]

The purpose of this specification is to define performance measurements specific to Core Network Circuit Switched Domain in a UMTS network or combined UMTS/GSM network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### Services Performance Measurements – 32.408 [98]

The purpose of this specification is to define performance measurements specific to teleservices(categorized by Multimedia Messaging Service, Short Message Service, Multimedia Calls, Voice Call and Intelligent Services) in a UMTS network or combined UMTS/GSM network, . The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### IMS Performance Measurements – 32.409 [99]

The purpose of this specification is to define performance measurements specific to an IMS (IP Multimedia Subsystem) network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### EPC Performance Measurements – 32.426 [106]

The purpose of this specification is to define performance measurements specific to an EPC network or combined EPC/UMTS/GSM network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### GSM Performance Measurements – 52.402 [140]

The purpose of this specification is to define performance measurements specific to a GSM system. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### UTRAN Performance Measurements – 32.405 [95]

The purpose of this specification is to define performance measurements specific to a UTRAN in UMTS network or combined UMTS/GSM network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### E-UTRAN Performance Measurements – 32.425 [105]

The purpose of this specification is to define performance measurements specific to an E-UTRAN network. The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### HNB Performance Measurements – 32.452 [113]

The purpose of this specification is to define performance measurements specific to Home NodeB Subsystem(consists of HNB and HNB-GW). The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### HeNB Performance Measurements – 32.453 [114]

The purpose of this specification is to define performance measurements specific to Home enhanced NodeB Subsystem(consists of HeNB and optionally HeNB-GW). The standardized measurements result in comparability of measurement data produced in a multi-vendor network.

### UMTS & GSM KPIs – 32.410 [100]

The purpose of this specification is to define Key Performance Indicators (KPIs) for GSM and UMTS. KPI definitions include high level KPIs that are a) common across GSM and UMTS networks; and b) **specific** to network techniques such as GSM and UMTS networks.

**E-UTRAN KPIs – 32.451 [112]**

This specification defines requirements (business level requirements, specification level requirements and use case descriptions) related to KPIs for E-UTRAN.

**IMS KPIs – 32.454 [115]**

This specification defines KPIs for the IP Multimedia Subsystem (IMS).

**EPC KPIs – 32.455 [116]**

This specification defines KPIs for the Evolved Packet Core (EPC).network.

**PM File Format – 32.432 [107], 32.435 [108], 32.406 [109]**

This set of specifications describe the general semantics of performance measurement result and collection. It defines the report file format, report file conventions, and the file transfer procedure. **Performance measurements for Evolved Packet Core (EPC) and non-3GPP access interworking system – 28.402 [61]**

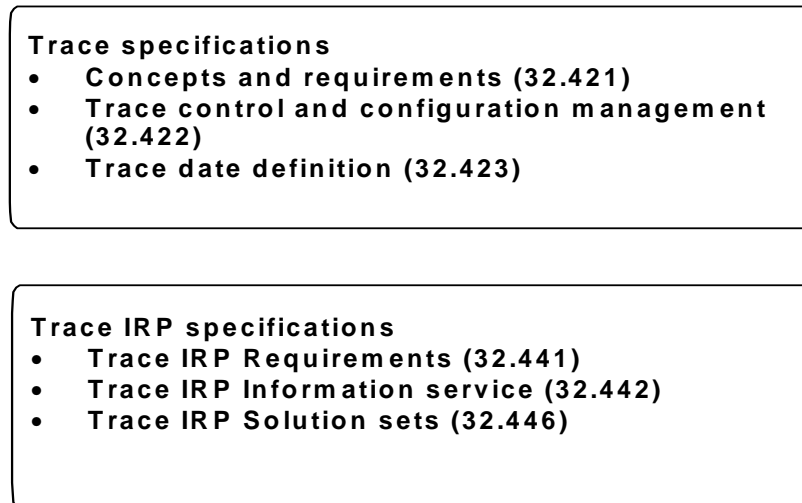
This specification describes the measurements for EPC and non-3GPP access network interworking and is valid for all measurement types provided by an implementation of EPC and non-3GPP access Interworking System. Measurements related to "external" technologies (such as ATM or IP) as described by "external" standards bodies (e.g. ITU-T or IETF) are only be referenced within this specification, wherever there is a need identified for the existence of such a reference.

**Performance measurements for Wireless Local Area Network (WLAN) – 28.403 [62]**

This specification describes the measurements for WLAN and is valid for all measurement types provided by an implementation of a WLAN. Measurements related to "external" technologies (such as WLAN or IP) as described by "external" standards bodies (e.g. IEEE or IETF) are only referenced within the present document, wherever there is a need identified for the existence of such a reference.

## 7.2 Trace Specifications

### 7.2.1 Overview and relationships to IRP Framework



**Figure 7.2.1-2: Trace-related Specifications**

## 7.2.2 Trace Specifications

### **Trace Concepts and Requirements – 32.421 [37]**

The present document describes the requirements for the management of Trace and the reporting of Trace data (including FDD mode and TDD mode) across UMTS networks or EPS networks as it refers to subscriber tracing (tracing of IMSI or Public User Identity) and equipment tracing (tracing of IMEI or IMEISV). Trace also includes the ability to trace all active calls in a cell or multiple cells (Cell Traffic Trace). The present document also includes the description of Service Level Tracing (tracing of a specific service). It defines the administration of Trace Session activation/deactivation by the Element Manager (EM), the network or User Equipment (UE) itself via signalling, the generation of Trace results in the Network Elements (NEs) and UE and the transfer of these results to one or more Operations Systems, i.e. EM(s) and/or Network Manager(s) (NM(s)).

### **Trace Control & Configuration – 32.422 [57]**

This specification describes the mechanisms used for the control and configuration of the Trace functionality at the EMs, NEs and UEs. It covers the triggering events for starting/stopping of subscriber/UE activity traced over 3GPP standardized signalling interfaces, the types of trace mechanisms, configuration of a trace, level of detail available in the trace data, the generation of Trace results in the Network Elements (NEs) and User Equipment (UE) and the transfer of these results to one or more EM(s) and/or Network Manager(s) (NM(s)).

### **Trace Data Definitions – 32.423 [104]**

This specification describes Trace data definition and management. It covers the trace records content, their format and transfer.

### **Trace IRP – 32.441 1 [38], 32.442 [110], 32.446 [111]**

The Trace IRP supports the operations that are required for the Subscriber and Equipment trace, the Cell Traffic Trace, Minimization of Drive Tests (MDT) functionalities across UMTS networks or EPS networks and Radio Link Failure (RLF) reporting functionalities across EPS networks. GSM Trace is outside of the scope of this specification.

## 7.3 QoE measurements

### 7.3.1 Overview and relationships to management services

- QoE measurement collection; specifications
- Concepts, use cases and requirements **(28.404)**
  - Control and configuration **(28.405)**
  - Information definition and transport **(28.406)**

**Figure 7.3.1-1: QoE related Specifications**

### 7.3.2 QoE specifications

#### **QoE measurement collection – Concepts, use cases and requirements – TS 28.404 [58]**

One main motivation of mobile network evolution is to improve the user experience why the evaluation of the user experience at the UE side is vital to network operators, especially when the operators provide some real-time services which require for example high data rate and low latency like streaming services (typically video services), where even intermittent quality degradation is very annoying. Many of these streaming services are a significant part of the commercial traffic growth rate, therefore the focus is on the end users' experience.

Quality of Experience (QoE) information collection provides detailed information at call level on a number of UEs.

The capability to log information within a UE, and in particular the QoE of an end user service, initiated by an operator, provides the operator with QoE information. The collected information (specified in 3GPP TS 26.247 [188]) cannot be deduced from performance measurements in the mobile network.

The QoE information is information collected by the end user application in the UE.

The collected QoE information is collected by the management system for analysis and/or KPI calculations.

#### **QoE measurement collection – Control and Configuration – TS 28.405 [59]**

TS 28.405 [59] addresses the mechanisms used for the function Quality of Experience (QoE) measurement collection in UMTS and LTE. The measurements that are collected are DASH and MTSI measurements.

The function includes collecting QoE information from UEs frequenting a specified area or an individual UE for a specified end user service/end user service type. The document describes the activation and deactivation of a network request session, UE request session and recording session and also the reporting of recorded information.

**QoE measurement collection – Information definition and transport – TS 28.406 [60]**

TS 28.406 [60] describes Quality of Experience (QoE) measurement collection record content definition and management. It covers the Quality of Experience (QoE) measurement data content, their format and transfer across UMTS networks and LTE networks.

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## 8 Relationships between IRPs

Relationships between Interface IRPs:

- All Interface IRPs utilizing the functionality of the Generic IRP
- All notification emitting Interface IRPs utilizing the functionality of the Notification IRP

Relationships between NRM IRPs:

- For FMC-enabled NRM IRP, the Generic NRM IRP is utilizing functionality of the FMC FNIM Umbrella Information Model (UIM)
- All NRM IRPs utilizing the functionality of the Generic NRM IRP
- All function-specific NRM IRPs (e.g. Core NRM IRP) utilizing the functionality of the Inventory NRM IRP

## 9 SON functions

In order to reduce the operating expenses (OPEX) associated with the management of increasing number of nodes from more than one vendor the concept of the Self-Organizing Network (SON) was introduced. Automation of some network planning, configuration and optimisation processes via the use of SON functions can help the network operator to reduce OPEX by reducing manual involvement in such tasks.

SON functions are Radio Access Technology (RAT) dependent. Generally, SON functions are applicable to E-UTRAN network, and can be applied to UTRAN network on a case by case basis. The following specifications have identified the use cases and requirements in context of SON for standardization:

- Self-establishment of an eNodeB: Related requirements are defined in TS 32.501 [36];
- Automatic Neighbour Relation Management: Related requirements are defined in TS 32.511 [28];
- Self-Optimisation Management: Related requirements are defined in TS 32.521 [29] or TS 28.627 [35];
- Self-Healing Management: Related requirements are defined in TS 32.541 [30];
- Energy Saving Management: Related requirements are defined in TS 32.551 [31];
- Minimization of Drive Tests: Related requirements are defined in TS 32.421 [37] and TS 32.441 [38].

Each SON use case can involve multiple IRPs when corresponding management scenarios are applied. As to IRP solution fulfilment, Self-Optimization Management, Self-Healing Management and Energy Saving Management share the common information model of SON policy NRM (TS 32.522 [119]), while each one also has RAT-dependent information model in E-UTRAN NRM (TS 32.761 [137], 32.762 [138], 32.766 [139] / 28.657 [154], 28.658 [155], 28.659 [156]) or UTRAN NRM (TS 32.641 [131], 32.642 [132], 32.646 [133], 28.651 [148], 28.652 [149], 28.653 [150]). The IRP relationships of SON functions and measurement definitions are addressed case by case as follows,

### Self-establishment of an eNodeB

Interface IRPs:

- SC IRP (32.500 [27], 32.501 [36], 32.502 [117], 32.506 [118])
- Software Management IRP (32.531 [121], 32.532 [122], 32.536 [123])
- Generic IRP (32.311 [71], 32.312 [72], 32.316 [73])
- Alarm IRP (32.111-1 [22], 32.111-2 [63], 32.111-6 [64])
- Test Management IRP (32.321 [74], 32.322 [75], 32.326 [76])
- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])
- Notification IRP (32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70])
- File Transfer IRP (for ARCF data download) (32.341 [80], 32.342 [81], 32.346 [82])

NRM IRPs:

- Umbrella Information Model (28.620 [34])
- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.621 [10], 28.622 [11], 28.623 [12])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.658 [155], 28.659 [156])

### Automatic Neighbour Relation Management

Interface IRP:

- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- Alarm IRP (32.111-1 [22], 32.111-2 [63], 32.111-6 [64])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])
- Notification IRP (32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70])

#### NRM IRP:

- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.620 [34], 28.621 [10], 28.622 [11], 28.623 [12])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.656 [153], 28.659 [156])
- UTRAN NRM IRP (32.641 [131], 32.642 [132], 32.646 [133])

### Self-Optimisation Management

#### Interface IRP:

- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- Alarm IRP (32.111-1 [22], 32.111-2 [63], 32.111-6 [64])
- PM IRP (32.410 [100], 32.411 [101], 32.412 [102], 32.416 [103])
- File Transfer IRP (for PM data upload) (32.341 [80], 32.342 [81], 32.346 [82])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])
- Notification IRP (32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70])

#### NRM IRP:

- SON Policy NRM IRP (32.521 [29], 32.522 [119], 32.526 [120] or 28.627 [35], 28.628 [143], 28.629 [144])
- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.620 [34], 28.621 [10], 28.622 [11], 28.623 [12])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.656 [153], 28.659 [156])

#### Measurement Definitions:

- E-UTRAN Performance Measurements (32.425 [105])

### Self-Healing Management

#### Interface IRP:

- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- Alarm IRP (32.111-1 [22], 32.111-2 [63], 32.111-6 [64])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])
- Notification IRP (32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70])

#### NRM IRP:

- SON Policy NRM IRP (32.521 [29], 32.522 [119], 32.526 [120] or 28.627 [35], 28.628 [143], 28.629 [144])



- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.620 [34], 28.621 [10], 28.622 [11], 28.623 [12])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.656 [153], 28.659 [156])

### Energy Saving Management

#### Interface IRP:

- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- PM IRP (32.410 [100], 32.411 [101], 32.412 [102], 32.416 [103])
- File Transfer IRP (for PM data upload) (32.341 [80], 32.342 [81], 32.346 [82])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])
- Notification IRP (32.300 [25], 32.301 [68], 32.302 [69], 32.306 [70])

#### NRM IRP:

- SON Policy NRM IRP (32.521 [29], 32.522 [119], 32.526 [120] or 28.627 [35], 28.628 [143], 28.629 [144])
- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.620 [34], 28.621 [10], 28.622 [11], 28.623 [12])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.656 [153], 28.659 [156])
- UTRAN NRM IRP (32.641 [131], 32.642 [132], 32.646 [133])

#### Measurement Definitions:

- E-UTRAN Performance Measurements (32.425 [105])
- UTRAN Performance Measurements (32.405 [95])

### Minimization of Drive Tests

#### Interface IRP:

- Trace Management IRP (32.441 [38], 32.442 [110], 32.446 [111])
- Trace Control and Configuration Management IRP (32.421 [37], 32.422 [57], 32.423 [104])
- Basic CM IRP (32.600 [32], 32.601 [7], 32.602 [8], 32.603 [9], 32.606 [124]) or Bulk CM IRP (32.611 [125], 32.612 [126], 32.616 [127])
- Kernel CM IRP (32.661 [134], 32.662 [135], 32.666 [136])

#### NRM IRP:

- Generic NRM IRP (32.621 [128], 32.622 [129], 32.626 [130] or 28.620 [34], 28.621 [10], 28.622 [11], 28.623 [12])
- UTRAN NRM IRP (32.641 [131], 32.642 [132], 32.646 [133] or 28.651 [148], 28.652 [149], 28.653 [150])
- E-UTRAN NRM IRP (32.761 [137], 32.762 [138], 32.766 [139] or 28.657 [154], 28.656 [153], 28.659 [156])

# 10 Network Function Virtualization (NFV)

## 10.1 Overview

### Concept, architecture and requirements

- **Concept, architecture and requirements for mobile networks that include virtualized network functions (28.500)**

### Configuration Management

- **Requirements (28.510)**
- **Procedures (28.511)**
- **Stage 2 (28.512)**
- **Stage 3 (28.513)**

### Fault Management

- **Requirements (28.515)**
- **Procedures (28.516)**
- **Stage 2 (28.517)**
- **Stage 3 (28.518)**

### Performance Management

- **Requirements (28.520)**
- **Procedures (28.521)**
- **Stage 2 (28.522)**
- **Stage 3 (28.523)**

### Life Cycle Management

- **Requirements (28.525)**
- **Procedures (28.526)**
- **Stage 2 (28.527)**
- **Stage 3 (28.528)**

## 10.2 Specifications

### **Concept, architecture and requirements for mobile networks that include virtualized network functions – 28.500 [189]**

The purpose of this specification is to describe the management concepts, the management requirements and use cases from operators' perspective for mobile networks that include virtualized network functions which can be part of EPC or IMS, and provides the management architecture for these mobile networks.

### **Configuration Management (CM) for mobile networks that include virtualized network functions – 28.510[190], 28.511 [191], 28.512 [192], 28.513 [193]**

The purpose of these specifications is to define the requirements, procedures, stage 2 and 3 applicable to Configuration Management (CM) of mobile networks that include virtualized network functions which can be part of EPC or IMS.

### **Fault Management (FM) for mobile networks that include virtualized network functions – 28.515 [194], 28.516 [195], 28.517 [196], 28.518 [197]**

The purpose of these specifications is to define the requirements, procedures, stage 2 and 3 applicable to Fault Management (FM) of mobile networks that include virtualized network functions which can be part of EPC or IMS.

### **Performance Management (PM) for mobile networks that include virtualized network functions – 28.520[198], 28.521 [199], 28.522 [200], 28.523 [201]**

The purpose of these specifications is to define the requirements, procedures, stage 2 and 3 applicable to Performance Management (PM) of mobile networks that include virtualized network functions which can be part of EPC or IMS.

**Life Cycle Management (LCM) for mobile networks that include virtualized network functions – 28.525 [202], 528.26 [203], 28.527 [204], 28.528 [205]**

The purpose of these specifications is to define the requirements, procedures, stage 2 and 3 applicable to Life Cycle Management (LCM) of mobile networks that include virtualized network functions which can be part of EPC or IMS.

# 11 Void

# Annex A (Informative): Void

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## Annex B (normative): Features supported

### B.1 Converged management support table

Table B.1.1 below illustrates the "Converged Management" feature support by the individual TS. The intersection of table rows (TS numbers) and columns (features) contains the 3GPP Release number starting from where this feature is supported.

**Table B.1.1: Converged management feature support**

| <b>TS number</b> | <b>Converged management support</b> |
|------------------|-------------------------------------|
| 32.101           | Rel-11                              |
| 32.103           | Rel-11                              |
| 32.150           | Rel-11                              |
| 32.107           | Rel-11                              |
| 32.156           | Rel-11                              |
| 32.157           | Rel-11                              |
| 32.300           | Rel-11                              |
| 28.390           | Rel-12                              |
| 28.611           | Rel-12                              |
| 28.612           | Rel-12                              |
| 28.616           | Rel-12                              |
| 28.620           | Rel-11                              |
| 28.621           | Rel-11                              |
| 28.622           | Rel-11                              |
| 28.623           | Rel-11                              |
| 28.624           | Rel-11                              |
| 28.625           | Rel-11                              |
| 28.626           | Rel-11                              |
| 28.627           | Rel-11                              |
| 28.628           | Rel-11                              |
| 28.629           | Rel-11                              |
| 28.631           | Rel-11                              |
| 28.632           | Rel-11                              |
| 28.633           | Rel-11                              |
| 28.651           | Rel-11                              |
| 28.652           | Rel-11                              |
| 28.653           | Rel-11                              |
| 28.654           | Rel-11                              |
| 28.655           | Rel-11                              |
| 28.656           | Rel-11                              |
| 28.657           | Rel-11                              |
| 28.658           | Rel-11                              |
| 28.659           | Rel-11                              |
| 28.661           | Rel-11                              |
| 28.662           | Rel-11                              |
| 28.663           | Rel-11                              |
| 28.671           | Rel-11                              |
| 28.672           | Rel-11                              |
| 28.673           | Rel-11                              |
| 28.674           | Rel-11                              |
| 28.675           | Rel-11                              |
| 28.676           | Rel-11                              |
| 28.701           | Rel-11                              |
| 28.702           | Rel-11                              |
| 28.703           | Rel-11                              |
| 28.704           | Rel-11                              |
| 28.705           | Rel-11                              |
| 28.706           | Rel-11                              |
| 28.707           | Rel-11                              |
| 28.708           | Rel-11                              |
| 28.709           | Rel-11                              |
| 28.731           | Rel-11                              |
| 28.732           | Rel-11                              |
| 28.733           | Rel-11                              |
| 28.734           | Rel-11                              |
| 28.735           | Rel-11                              |
| 28.736           | Rel-11                              |
| 28.751           | Rel-11                              |
| 28.752           | Rel-11                              |
| 28.753           | Rel-11                              |

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## B.2 Network sharing management support table

There are several use cases and scenarios for network sharing. Table B.2-1 identifies the list of specifications and the status of support with regards to network sharing that satisfy the 3GPP Stage 1 requirements as defined in the present document.

Legend used in the table:

- **Not Applicable (N/A):**  
The specification is not relevant to network sharing: example TS 32.581 [206], TS 32.582 [207].
- **Not supported: Not supported and no proposal to modify in this release:**  
Needs modifications but might/will not be changed in this release.
- **Not required in this release:** The network sharing scenarios and requirements in the present document do not require support in **this release**.
- **Supported in this release:**  
Specification modified to support network sharing scenarios.
- **Supported with no modification:**  
The specification supports network sharing scenarios with no modifications. Examples are generic NRM. Even though this NRM is needed for supporting configuration management for a shared node, there is no change needed to the specification.
- **TBD:** Evaluation in progress.

NOTE: Table B.2-1 is a skeleton and will be populated as the network sharing work is progressing.

The intention of table B.2-1 is to cover all the 3GPP Technical Specifications (TS) with an evaluation remark on support for network sharing. If a TS does not appear in the table, it implies that the TS has not been evaluated for impact to support network sharing.



**Table B.2-1: Network sharing feature support**

| 3GPP TS Number                  | 3GPP specification Title   | Support of network sharing scenarios  |
|---------------------------------|--|---|
| 28.403                          | Performance Management; performance measurements for WLAN  | Not required in this release. Current SA2 standard does not support WLAN from different operators to be connected to the same CN nodes. |
| <a href="#">28.611</a> /612/616 | Evolved Packet Core (EPC) and non-3GPP access Interworking System Network Resource Model (NRM); Integration Reference Point (IRP);       | Not required in this release. Current SA2 standard does not support WLAN from different operators be connected to the same CN nodes     |
| <a href="#">28.620</a>          | Telecommunication management; Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM) Umbrella Information Model (UIM) | Supported with no modification  |
| <a href="#">28.621</a> /622/623 | Telecommunication management; Generic Network Resource Model (NRM) Integration Reference Point (IRP); Requirements                       | Supported with no modification  |
| <a href="#">28.624</a> /625/626 | State management data definition Integration Reference Point (IRP)   | Supported with no modification  |
| <a href="#">28.627</a> /628/629 | Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP);                                    | Not required in this release.   |
| <a href="#">28.631</a> /632/633 | Inventory Management (IM) Network Resource Model (NRM) Integration Reference Point (IRP)   | Not Applicable  |
| <a href="#">28.651</a> /652/653 | Universal Terrestrial Radio Access Network (UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP)                        | Supported in this release.  |
| <a href="#">28.654</a> /655/656 | GSM/EDGE Radio Access Network (GERAN) Network Resource Model (NRM) Integration Reference Point (IRP);                                    | Supported in this release.  |
| <a href="#">28.657</a> /658/659 | Evolved Universal Terrestrial Radio Access Network (E-UTRAN) Network Resource Model (NRM) Integration Reference Point (IRP)              | Supported in this release.  |
| <a href="#">28.661</a> /662/663 | Generic Radio Access Network (RAN) Network Resource Model (NRM) Integration Reference Point (IRP);                                       | Supported with no modification  |
| <a href="#">28.671</a> /672/673 | Home Node B (HNB) Subsystem (HNS) Network Resource Model (NRM) Integration Reference Point (IRP)   | Not Applicable (no plan to apply network sharing concepts to Home Node B (HNB)).  |
| <a href="#">28.674</a> /675/676 | Home enhanced Node B (HeNB) Subsystem (HeNS) Network Resource Model (NRM) Integration Reference Point (IRP)                              | Not Applicable (no plan to apply network sharing concepts to Home enhanced Node B (HeNB)).  |

|                                |  |   |
|--------------------------------|--|---|
| <a href="#">28.701/702/703</a> | Telecommunication management; Core Network (CN) Network Resource Model (NRM) Integration Reference Point (IRP)                           | See 32.631/2/6. Not required in this release (Impact of GWCN, e.g. sharing of SGSN, on existing specs not addressed in this release). |
| <a href="#">28.704/705/706</a> | Telecommunication management; IP Multimedia Subsystem (IMS) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements | Not required in this release.   |
| <a href="#">28.707/708/709</a> | Evolved Packet Core (EPC) Network Resource Model (NRM) Integration Reference Point (IRP)   | Not required in this release (Impact of GWCN, i.e. sharing of MME, on existing specs not addressed in this release).                  |
| <a href="#">28.731/732/733</a> | Transport Network (TN) interface Network Resource Model (NRM) Integration Reference Point (IRP)  | Not Applicable (no plan to apply network sharing concepts to transport network).  |
| 28.734/735/736                 | Signalling Transport Network (STN) interface Network Resource Model (NRM) Integration Reference Point (IRP);                             | Not Applicable (no plan to apply network sharing concepts to signalling transport network).   |
| 28.751/752/753                 | Subscription Management (SuM) Network Resource Model (NRM) Integration Reference Point (IRP); Requirements                               | Not Applicable  |
| <a href="#">32.101</a>         | Principles and high level requirements   | Supported with no modification.   |
| <a href="#">32.102</a>         | Architecture   | Supported with no modification.   |
| <a href="#">32.103</a>         | Integration Reference Point (IRP) overview and usage guide   | Supported with no modification  |
| <a href="#">32.107</a>         | Telecommunication management; Fixed Mobile Convergence (FMC) Federated Network Information Model (FNIM)                                  | Supported with no modification  |
| 32.111-1/2/3/6                 | Fault Management; 3G fault management requirements   | TBD   |
| <a href="#">32.121/122/126</a> | Advanced Alarm Management (AAM) Integration Reference Point (IRP);   | TBD   |
| 32.140                         | Telecommunication management; Subscription Management (SuM) requirements   | Not Applicable  |
| 32.141                         | Telecommunication management; Subscription Management (SuM) architecture   | Not Applicable  |
| <a href="#">32.150</a>         | Integration Reference Point (IRP) Concept and definitions  | Supported with no modification  |
| <a href="#">32.153</a>         | Integration Reference Point (IRP) technology specific templates, rules and guidelines  | Supported with no modification  |
| <a href="#">32.154</a>         | Backward and Forward Compatibility (BFC); Concept and definitions  | Not Applicable  |
| <a href="#">32.155</a>         | Requirements template  | Supported with no modification  |
| <a href="#">32.156</a>         | Fixed Mobile Convergence (FMC) model repertoire  | Supported with no modification  |

|                                |   |  |
|--------------------------------|---|--|
| <a href="#">32.157</a>         | Telecommunication management; Integration Reference Point (IRP) Information Service (IS) template                                       | Supported with no modification                                     |
| <a href="#">32.181/182</a>     | Telecommunication management; User Data Convergence (UDC); Framework for Model Handling and Management                                  | Not Applicable (no plan to apply network sharing concepts to UDC). |
| <a href="#">32.300</a>         | Configuration Management (CM); Name convention for Managed Objects  | TBD  |
| 32.301/302/306                 | Configuration Management (CM); Notification Integration Reference Point (IRP)   | Supported with no modification                                     |
| <a href="#">32.311/312/316</a> | Generic Integration Reference Point (IRP) management  | Supported with no modification                                     |
| <a href="#">32.321/322/326</a> | Test management Integration Reference Point (IRP);  | Supported with no modification                                     |
| <a href="#">32.331/332/336</a> | Notification Log (NL) Integration Reference Point (IRP)   | Supported with no modification                                     |
| <a href="#">32.351/352/356</a> | Communication Surveillance (CS) Integration Reference Point (IRP)   | Not Applicable   |
| <a href="#">32.361/362/366</a> | Entry Point (EP) Integration Reference Point (IRP); Requirements  | Supported with no modification                                     |
| <a href="#">32.371/372/376</a> | Telecommunication management; Security Management concept and requirements  | Supported with no modification                                     |
| <a href="#">32.381/382/386</a> | Telecommunication management; Partial Suspension of Itf-N Integration Reference Point (IRP); Requirements                               | Supported with no modification                                     |
| <a href="#">32.391/392/396</a> | Telecommunication management; Delta synchronization Integration Reference Point (IRP); Requirements                                     | Supported with no modification                                     |
| <a href="#">32.401</a>         | Telecommunication management; Performance Management (PM); Concept and requirements   | Supported with no modification                                     |
| <a href="#">32.404</a>         | Telecommunication management; Performance Management (PM); Performance measurements; Definitions and template                           | Supported with no modification                                     |
| <a href="#">32.405</a>         | Telecommunication management; Performance Management (PM); Performance measurements; Universal Terrestrial Radio Access Network (UTRAN) | TBD  |
| <a href="#">32.406</a>         | Telecommunication management; Performance Management (PM); Performance measurements; Core Network (CN) Packet Switched (PS) domain      | Supported with no modification                                     |

|                                |   |                                |
|--------------------------------|---|--------------------------------|
| <a href="#">32.407</a>         | Telecommunication management; Performance Management (PM); Performance measurements; Core Network (CN) Circuit Switched (CS) domain; UMTS and combined UMTS/GSM | Supported with no modification |
| <a href="#">32.408</a>         | Telecommunication management; Performance Management (PM); Performance measurements; Teleservice  | Not Applicable                 |
| <a href="#">32.409</a>         | Telecommunication management; Performance Management (PM); Performance measurements; IP Multimedia Subsystem (IMS)  | Not required in this release.  |
| <a href="#">32.410</a>         | Telecommunication management; Key Performance Indicators (KPI) for UMTS and GSM   | TBD                            |
| <a href="#">32.411/412/416</a> | Telecommunication management; Performance Management (PM) Integration Reference Point (IRP): Requirements   | Supported with no modification |
| <a href="#">32.421/422/423</a> | Telecommunication management; Subscriber and equipment trace;   | TBD                            |
| <a href="#">32.425</a>         | Telecommunication management; Performance Management (PM); Performance measurements Evolved Universal Terrestrial Radio Access Network (E-UTRAN)                | TBD                            |
| <a href="#">32.426</a>         | Telecommunication management; Performance Management (PM); Performance measurements Evolved Packet Core (EPC) network   | TBD                            |
| <a href="#">32.432</a>         | Telecommunication management; Performance measurement: File format definition   | TBD                            |
| <a href="#">32.435</a>         | Telecommunication management; Performance measurement; eXtensible Markup Language (XML) file format definition  | TBD                            |
| <a href="#">32.436</a>         | Telecommunication management; Performance measurement: Abstract Syntax Notation 1 (ASN.1) file format definition  | TBD                            |
| <a href="#">32.441/442/446</a> | Trace Management Integration Reference Point (IRP)  | TBD                            |
| <a href="#">32.450</a>         | Key Performance Indicators (KPI) for Evolved Universal Terrestrial Radio Access Network (E-UTRAN): Definitions  | TBD                            |
| <a href="#">32.451</a>         | Key Performance Indicators (KPI) for Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Requirements   | TBD                            |

|                                    |  |  |
|------------------------------------|--|--|
| <a href="#">32.452</a>             | Performance Management (PM); Performance measurements Home Node B (HNB) Subsystem (HNS)                        | Not Applicable                                       |
| <a href="#">32.453</a>             | Performance Management (PM); Performance measurements Home enhanced Node B (HeNB) Subsystem (HeNS)             | Not Applicable                                       |
| <a href="#">32.454</a>             | Key Performance Indicators (KPI) for the IP Multimedia Subsystem (IMS); Definitions                            | Not required in this release.                        |
| <a href="#">32.455</a>             | Key Performance Indicators (KPI) for the Evolved Packet Core (EPC); Definitions                                | Not required in this release.                        |
| <a href="#">32.500</a>             | Self-Organizing Networks (SON); Concepts and requirements  | Not required in this release.                        |
| <a href="#">32.501/502/506</a>     | Self-configuration of network elements; Concepts and requirements  | Supported with no modification                       |
| <a href="#">32.511</a>             | Automatic Neighbour Relation (ANR) management;   | TBD (handling of ANR may be impacted by RAN sharing) |
| 521/522/526                        | Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP);          | Not required in this release.                        |
| <a href="#">32.531/532/536</a>     | Software management (SwM); Concepts and Integration Reference Point (IRP)                                      | Not Applicable                                       |
| <a href="#">32.541</a>             | Self-Organizing Networks (SON); Self-healing concepts and requirements   | Not Applicable                                       |
| <a href="#">32.551</a>             | Energy Saving Management (ESM); Concepts and requirements  | Not Applicable                                       |
| <a href="#">32.571/572</a>         | Home Node B (HNB) and Home eNode B (HeNB) management; Type 2 interface   | Not Applicable                                       |
| <a href="#">32.581/582/583/584</a> | Home Node B (HNB) Operations, Administration, Maintenance and Provisioning (OAM&P); Type 1 interface           | Not Applicable                                       |
| <a href="#">32.591/582/593/594</a> | Home enhanced Node B (HeNB) Operations, Administration, Maintenance and Provisioning (OAM&P); Type 1 Interface | Not Applicable                                       |
| <a href="#">32.600/601/602/606</a> | Configuration Management (CM)  | Supported with no modification                       |
| <a href="#">32.611/612/616</a>     | Configuration Management (CM); Bulk CM Integration Reference Point (IRP)                                       | Supported with no modification                       |
| <a href="#">32.621/622/626</a>     | Configuration Management (CM); Generic network resources Integration Reference Point (IRP)                     | Not required in this release.                        |
| <a href="#">32.631/632/636</a>     | Configuration Management (CM); Core network resources Integration Reference Point (IRP)                        | Supported with no modification                       |
| <a href="#">32.661/662/666</a>     | Configuration Management (CM); Kernel CM   | Supported with no modification                       |
| 32.690                             | Telecommunication management; Inventory Management (IM); Requirements  | Not Applicable                                       |

|                |   |                |
|----------------|---|----------------|
| 32.691/692/696 | Inventory Management (IM)<br>Network Resource Model<br>(NRM) Integration<br>Reference Point (IRP) | Not Applicable |
|----------------|---|----------------|

## Annex C (informative): Change history

| Change history |       |           |     |     |  |        |        |
|----------------|-------|-----------|-----|-----|--|--------|--------|
| Date           | TSG # | TSG Doc.  | CR  | Rev | Subject/Comment  | Old    | New    |
| 2010-12        | SP-50 | SP-100764 | --  | --  | Submitted to SA#50 for Information                             | 0.1.0  | 1.0.0  |
| 2011-05        | SP-52 | SP-110272 | --  | --  | Submitted to SA#52 for Approval                                | 1.2.0  | 2.0.0  |
| 2011-06        | SP-52 | --        | --  | --  | Publication  | 2.0.0  | 10.0.0 |
| 2012-06        | SP-56 | SP-120370 | 001 | 2   | Add relation description between IRPs                          | 10.0.0 | 11.0.0 |
| 2012-12        | SP-58 | SP-120783 | 003 | 2   | CR R11 32.103 Add usage description for SON functions          | 11.0.0 | 11.1.0 |
| 2013-03        | SP-59 | SP-130060 | 004 | 2   | Enhancements for Converged Management                          | 11.1.0 | 11.2.0 |
| 2013-09        | SP-61 | SP-130433 | 005 | 1   | correction of references                                       | 11.2.0 | 11.3.0 |
| 2014-06        | SP-64 | SP-140332 | 006 | 2   | Add missing feature support matrix                             | 11.3.0 | 11.4.0 |
|                |       | SP-140359 | 007 | -   | remove the feature support statements                          |        |        |
| 2014-10        |       |           |     |     | Automatic upgrade (MCC)  | 11.4.0 | 12.0.0 |
| 2014-12        | SP-66 | SP-140798 | 009 | -   | Remove the mapping information between 32 series and 28 series | 12.0.0 | 12.1.0 |
|                |       |           | 010 | -   | Add feature support statements for Rel-12                      |        |        |
|                |       | SP-140797 | 012 | -   | Update feature support statement for TS 32.300                 |        |        |
|                |       | SP-140800 | 013 | 2   | Add annex for network sharing management support table         |        |        |
| 2016-01        |       |           |     |     | Update to Rel-13 (MCC)   | 12.1.0 | 13.0.0 |

| Change history |         |           |      |     |     |  |             |
|----------------|---------|-----------|------|-----|-----|--|-------------|
| Date           | Meeting | TDoc      | CR   | Rev | Cat | Subject/Comment  | New version |
| 2016-12        | SA#74   | SP-160855 | 0015 | -   | C   | Alignment with latest SA5 specification list and various enhancements      | 14.0.0      |
| 2018-01        | SA#78   | SP-170964 | 0016 | 1   | F   | Update erroneous references  | 14.1.0      |
| 2018-06        | -       | -         | -    | -   | -   | Update to Rel-15 version (MCC)   | 15.0.0      |
| 2020-07        | SA#88-e | SP-200486 | 0018 | 1   | F   | Add 5G specification information   | 15.1.0      |
| 2020-07        | SA#88-e | SP-200494 | 0017 | 1   | B   | Add QoE Specifications   | 16.0.0      |
| 2020-09        | SA#89e  | SP-200728 | 0025 | 1   | A   | Correction of reference list and adding references throughout the document | 16.1.0      |
| 2020-12        | SA#90e  | SP-201048 | 0031 | -   | A   | Correction of reference in the document                                    | 16.2.0      |
| 2022-03        | SA#95e  | SP-220185 | 0033 | 1   | F   | Remove 5G specification information  | 16.3.0      |



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# History

| <b>Document history</b> |               |             |
|-------------------------|---------------|-------------|
| V16.0.0                 | August 2020   | Publication |
| V16.1.0                 | November 2020 | Publication |
| V16.2.0                 | January 2021  | Publication |
| V16.3.0                 | April 2022    | Publication |
|                         |               |             |