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Universal Mobile Telecommunications System (UMTS);
LTE;
Telecommunication management;
Self-Organizing Networks (SON)
Policy Network Resource Model (NRM)
Integration Reference Point (IRP);
Information Service (IS)
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Foreword

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Contents

Foreword

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

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Introduction

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

32.521: Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP): Requirements

32.522: Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP): Information Service (IS)

32.526: Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP): Solution Set (SS) definitions

1 Scope

The present document is part of an Integration Reference Point (IRP) named Self Organizing Networks (SON) Policy Network Resource Model (NRM) IRP, through which an IRPAgent can communicate management information to one or several IRPManagers concerning SON policies. The SON policy NRM IRP comprises a set of specifications defining Requirements, a protocol neutral Information Service and one or more Solution Set(s).

The present document specifies the protocol neutral SON policy NRM IRP: Information Service (IS).

In order to access the information defined by this NRM, an Interface IRP such as the "Basic CM IRP" is needed (3GPP TS 32.602 [11]). However, which Interface IRP is applicable is outside the scope of the present document.

The present document also contains stage 2 descriptions for those functionalities for the Self-Optimization OAM.

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

[4] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[5] 3GPP TS 32.521: "Telecommunication management; Self-Organizing Networks (SON) Policy Network Resource Model (NRM) Integration Reference Point (IRP): Requirements".

[6] 3GPP TS 36.331: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification".

[7] 3GPP TS 36.423: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); X2 Application Protocol (X2AP)".

[8] 3GPP TS 32.425: "Technical Specification Group Services and System Aspects; Telecommunication management; Performance Management (PM); Performance measurements; Evolved Universal Terrestrial Radio Access Network (E-UTRAN)"

[9] 3GPP TS 32.622: "Telecommunication management; Configuration Management (CM); Generic network resources Integration Reference Point (IRP): Network Resource Model (NRM)"

[10] 3GPP TS 32.762: "Telecommunication management; Configuration Management (CM); Evolved Universal Terrestrial Radio Access Network (E-UTRAN) network resources Integration Reference Point (IRP): Network Resource Model (NRM)"

[11] 3GPP TS 32.602: "Telecommunication management; Configuration Management (CM); Basic CM Integration Reference Point (IRP) Information Service (IS)".

[12] 3GPP TS 36.413: "Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP)".

[13] 3GPP TS 36.314: "Evolved Universal Terrestrial Radio Access (E-UTRA); Layer 2 - Measurements".

[14] 3GPP TS 36.300: " Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2 ".

[15] 3GPP TS 37.320: "Universal Terrestrial Radio Access (UTRA) and Evolved Universal Terrestrial Radio Access (E-UTRA); Radio measurement collection for Minimization of Drive Tests (MDT); Overall description; Stage 2".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TS 32.101 [1], TS 32.102 [2], TS 32.150 [3] and TR 21.905 [4] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TS 32.521 [5], TS 32.101 [1], TS 32.102 [2] and TR 21.905 [4], in that order.

Target: See 3GPP TS 32.521 [5].

Trigger condition: See 3GPP TS 32.521 [5].

Hand-Over parameter Optimisation: See clause 4.3 of this document and Mobility Robustness Optimisation (MRO) are synonyms (see TS 36.300 [14]).

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [4], TS 32.521 [5] 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 [4] and TS 32.521 [5].

CAC	Composite Available Capacity
CDF	Cumulative Distribution Function
EM	Element Manager
eNodeB, eNB	evolved NodeB
E-UTRAN	Evolved Universal Terrestrial Radio Access Network
HO	Handover
HOO	HandOver parameter Optimization
ICIC	Inter Cell Interference Coordination
IOC	Information Object Class
LB	Load Balancing
LBO	Load Balancing Optimization
MRO	Mobility Robustness Optimisation
NM	Network Manager
NRM	Network Resource Model
OAM	Operation Administration Maintenance
RO	RACH Optimization
SON	Self Organizing Networks
UE	User Equipment

4 SON Policy and Optimization Function Definitions

4.1 Monitoring and Management Operations for Self-Optimization

4.1.1 Monitoring and Management Function

4.1.1.1 Usage of Itf-N

For specifically defined Itf-N NRM Interface see clause 5.

4.2 Load Balancing Optimization Function

4.2.1 Objective and Targets

The objective of LB Optimization is to cope with undesired traffic load distribution and to minimize the number of handovers and redirections needed to achieve the load balancing. One of the following targets or the combination of the following targets shall be used. The specific target value or values shall be configured by operators. Operators should assign weights for targets being used.

Targets drawn from the following table can be configured for LBO:

Target Name	Definition	Legal Values
RRC connection establishments failure rate related to load	The number of Failed RRC connection establishments related to load/ The total number of Attempted RRC connection establishments. The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage
E-RAB setup failure rate related to load	The number of E-RAB setup failure related to load/ The total number of attempted E-RAB setup For E-RAB setup failure related to load, the causes 'Reduce load in serving cell' and 'Radio resources not available' defined in TS 36.413 [12] could be used. The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage
RRC Connection Abnormal Release Rate Related to Load	The number of abnormal RRC connection release related to load/ The total number of RRC connection release. The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage
E-RAB Abnormal Release Rate Related to Load	The number of E-RAB abnormal release related to load/ The total number of E-RAB release For E-RAB setup failure related to load, the causes 'Reduce load in serving cell' and 'Radio resources not available' defined in TS 36.413 [12] could be used. The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage
Rate of failures related to handover	(the number of failure events related to handover) / (the total number of handover events) The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage

For the following targets out of the above table, the target values depend on the composite available capacity range in the cell and are defined separately for uplink and downlink. For these tuples can be configured, indicating the capacity ranges together with the target value valid in that range.

RRC connection establishments failure rate related to load,

E-RAB setup failure rate related to load,

RRC Connection Abnormal Release Rate Related to Load,

E-RAB Abnormal Release Rate Related to Load

For the following targets shall be identical with the corresponding targets defined in Handover Optimization.

Rate of failures related to handover

4.2.2 Parameters To Be Optimized

To reach load optimization target, LBO may optimize some mobility settings (HO and/or idle mobility configuration) defined in TS 36.331 [6].

4.2.3 Optimization Method

4.2.3.1 Problem Detection

The problem detection is out of scope of this specification.

4.2.3.2 Problem Solution

The problem solution is out of scope of this specification.

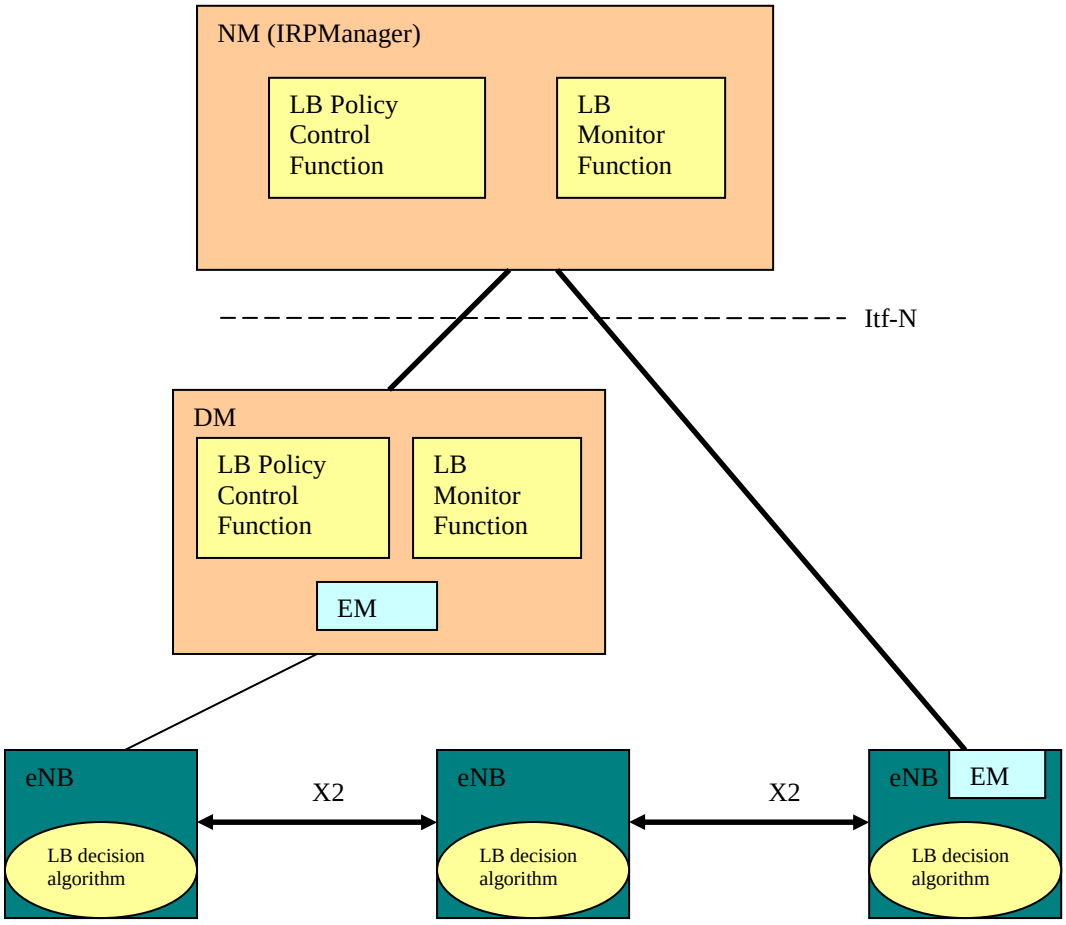
4.2.4 Architecture

4.2.4.1 Definition of Logical Functions

LB Monitor Function: This function is used for monitoring the load balance optimization (e.g. Monitoring related performance counters or alarms).

LB Policy control function: This function is used for configuring the load balance optimization policies.

4.2.4.2 Location of Logical Functions



For Load Balancing, the SON LB decision algorithm is located in eNB. The detailed SON functionalities in eNB are out of scope of this specification.

4.2.5 PM

IRPManager may collect Load balancing related performance measurements. Performance Measurements related with Load balancing are captured in the table below:

Performance measurement name	Description	Related targets
The number of Failed RRC connection establishments related to load	Refer to 3GPP TS 32.425 [8] Failed RRC connection establishments	RRC connection establishments failure rate related to load
The total number of Attempted RRC connection establishments	Refer to 3GPP TS 32.425 [8] Attempted RRC connection establishments	RRC connection establishments failure rate related to load
The number of E-RAB setup failure related to load	Refer to 3GPP TS 32.425 [8] Number of initial SAE Bearers failed to setup	E-RAB setup failure rate related to load
The total number of attempted E-RAB setup	Refer to 3GPP TS 32.425 [8] Number of initial SAE Bearers attempted to setup	E-RAB setup failure rate related to load
The number of abnormal RRC connection release related to load	Number of UE CONTEXT Release Request initiated by eNodeB	RRC Connection Abnormal Release Rate Related to Load
The total number of RRC connection release	Number of Successful UE Context Release	RRC Connection Abnormal Release Rate Related to Load
The number of E-RAB abnormal release related to load	Refer to 3GPP TS 32.425 [8] Number of SAE Bearers requested to release initiated by eNodeB per cause	E-RAB Abnormal Release Rate Related to Load
The total number of E-RAB release	Refer to 3GPP TS 32.425 [8] Number of SAE Bearers successfully released	E-RAB Abnormal Release Rate Related to Load
the number of failure events related to handover	Refer to 4.3.5	Rate of failures related to handover
the total number of handover events	Refer to 4.3.5	Rate of failures related to handover

NOTE: The monitoring of performance measurements will make use of existing PM IRP.

4.3 Handover (HO) Parameter Optimization Function

4.3.1 Objective and Targets

For intra-LTE, one of the following targets or the combination of the following targets shall be used. The specific target value shall be configured by operators. Operators should assign weights for targets being used.

Target Name	Definition	Legal Values
Rate of failures related to handover	(the number of failure events related to handover) / (the total number of handover events) The target is met if the actual rate is smaller than the target value.	Integer [0..100] in unit percentage

The objective of minimizing the number of unnecessary handovers shall always be pursued in case the other target/s configured by the operator is/are achieved. This objective may not need configuration of a target value.

4.3.2 Parameters To Be Optimized

The tables below summarise the handover parameters in TS 36.331 [6].

Table 4.3.2-1. Handover parameters that may be optimized for intra-frequency and inter-frequency handovers

Event	Summary	Tunable parameters
A3	Neighbour becomes offset better than serving	Ofn, Ofs, Ocn, Ocs, Hys, Off, timeToTrigger
A4	Neighbour becomes better than threshold	Ofn, Ocn, Hys, Thresh, Off, timeToTrigger
A5	Serving becomes worse than threshold1 and neighbour becomes better than threshold2	Ofn, Ocn, Hys, Thresh1, Thresh2, Off, timeToTrigger

Table 4.3.2-2. Handover parameters that may be optimised for inter RAT handover

Event	Summary	Tunable parameters
B1	Inter RAT Neighbour becomes better than threshold	Ofn, Hys, Thresh, timeToTrigger
B2	Serving becomes worse than threshold1 and inter RAT neighbour becomes better than threshold2	Ofn, Hys, Thresh1, Thresh2, timeToTrigger

4.3.3 Optimization Method

4.3.3.1 Problem Detection

HO Parameter Optimization Function shall focus on detecting the problem scenarios described in TS 32.521 [5]; namely: too early handovers, too late handovers and inefficient use of NW resources due to HOs. For more information about these scenarios see TS 32.521 [5] section 6.1.3.

The following inputs may be used for the identification of the problem scenarios:

- Event capture and analysis
- UE measurements
- Performance measurements

In event capture and analysis, the eNodeB exploits event information associated with a UE context, such as evidence of previous handovers (UE History, see TS 36.423 [7]) and HO failure details (such as in which cell the handover failed and where the UE re-established the connection).

UE measurements are sent within UE measurement reports and they may indicate whether HOs are too early or too late.

HO-related performance measurements (PMs) collected at the source and / or target eNB can be useful in detecting HO-related issues on the cell level. Since the impact of incorrect HO parameter setting will also be on the cell-level, PMs can provide useful information that can be used to detect and resolve HO-related issues due to incorrect parameter settings.

4.3.3.2 Problem Solution

HO Parameter Optimization Function will aim at optimizing the HO parameters listed in Section 4.3.2 in such way to mitigate the problem scenarios discussed in Section 4.3.3.1. The optimization algorithms will not be specified. The exact set of HO parameters that may be adjusted by the algorithms is dictated by the choice of triggered HO measurements made by the RRM entity in an eNodeB.

4.3.4 Architecture

4.3.4.1 Definition of Logical Functions

HO Parameter Optimization Monitor Function: This function is used for monitoring the handover parameter optimization (e.g. monitoring related performance counters or alarms).

HO Parameter Optimization Policy Control Function: This function is used for configuring the handover parameter optimization policies.

4.3.4.2 Location of Logical Functions

For HandOver (HO) parameter optimization there are several options for the location of the SON algorithm:

1. The SON algorithm is located in the eNB(s).
2. The SON algorithm is located in the EM, the parameter changes are executed in the eNBs.

An example for the first option is shown in figure 4.3.4.2:

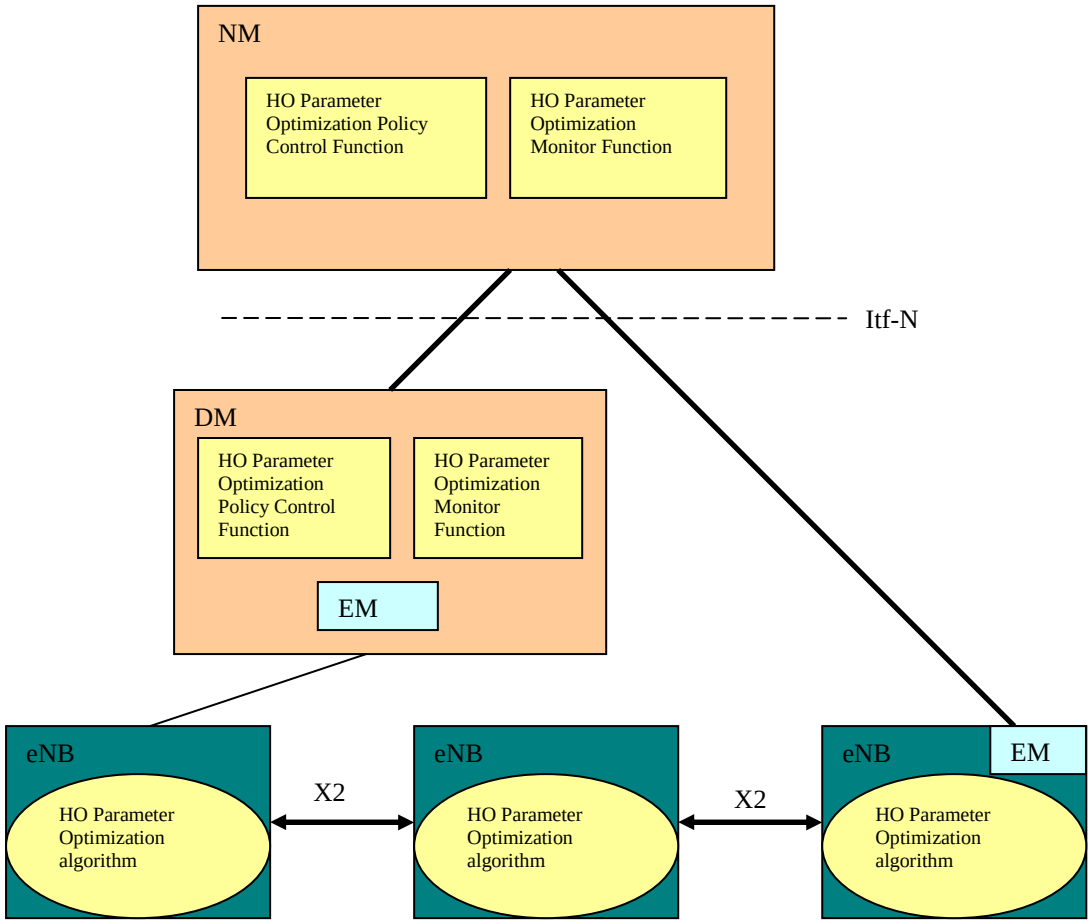


Figure 4.3.4.2: Example when the SON algorithm is located in the eNB(s)

The detailed SON functionalities in eNB are out of scope of this specification.

4.3.5 PM

IRPManager shall collect HO-related performance measurements from the source and / or target eNB which can be useful in detecting HO-related issues on the cell level. The following input can be used for the identification of the problem scenarios specified:

The number of RLF event happened within an interval after handover success.

Performance Measurements related to handover failure are captured in the table below.

The Performance Measurements are for outgoing handovers. Further, they should be available on a cell relation basis.

Performance measurement name	Description	Related targets
Number of handover events	Includes successful handovers plus all identified failures	Rate of failures related to handover
Number of HO failures	All failure cases	Rate of failures related to handover
Number of too early HO failures	Too early HO failure cases	Rate of failures related to handover
Number of too late HO failures	Too late HO failure cases	Rate of failures related to handover
Number of HO failures to wrong cell	HO failures to wrong cell	Rate of failures related to handover

NOTE: The monitoring of performance measurements will make use of existing PM IRP.

4.4 Interference Control Function

4.5 Capacity and Coverage Optimization Function

4.5.1 Objective and Targets

The objective of capacity and coverage optimization is to provide optimal coverage and capacity for the radio network. A tradeoff between capacity and coverage needs to be considered.

The detailed target(s) FFS.

4.5.2 Parameters to be optimized

To reach capacity and coverage optimization targets, the following parameters may be optimized:

- Downlink transmit power
- Antenna tilt
- Antenna azimuth

4.5.3 Optimization Method

4.5.3.1 Problem Detection

The main symptoms of capacity and coverage optimization problems (see TS 37.320 [15]) are:

Coverage hole: A coverage hole is an area where the pilot signal strength is below a threshold which is required by a UE to access the network, or the SINRs of both serving and neighbor cells is below a level needed to maintain the basic service. Coverage holes are usually caused by physical obstructions such as new buildings, hills, or by unsuitable antenna parameters, or just inadequate RF planning. UE in coverage hole will suffer from call drop and radio link failure. Typical phenomenon of coverage hole is either HO failure happens frequently and cannot be optimized by HO parameter optimization or call drop happens frequently and cannot be rescued by RRC re-establishment.

Weak coverage: Weak coverage occurs when the pilot signal strength or the SNR (or SINR) of serving cell is below the level needed to maintain a planned performance requirement (e.g. cell edge bit-rate).

Pilot pollution: In areas where coverage of different cells overlap a lot, interference levels are high, power levels are high, energy consumption is high and cell performance may be low. Typically in this situation UEs may experience high SNR to more than one cell and high interference levels.

Overshoot coverage: Overshoot occurs when coverage of a cell reaches far beyond what is planned. It can occur as an 'island' of coverage in the interior of another cell, which may not be a direct neighbor. Reasons for overshoot may be reflections in buildings or across open water, lakes etc. UEs in this area may suffer call drops or high interference.

DL and UL channel coverage mismatch: DL channel coverage is larger than UL channel coverage is one typical scenario of DL and UL channel coverage mismatch. The UE will suffer UL problems when it moves into the mismatch area.

In a realistic network, these symptoms may be tolerated to a certain level. These symptoms may indicate a real problem when combined with other factors such as frequency of symptoms, duration of symptoms, or affected population.

The following inputs may be used for the identification of the problem scenarios:

- UE measurements
- Performance measurements
- Alarms, other monitoring information e.g. trace data

UE measurements are sent within UE measurement reports and they may indicate the capacity and coverage problem.

Capacity and coverage related performance measurements collected at the source and / or target eNB can be useful in detecting capacity and coverage related issues on the cell level. Minimizing Driver Test (MDT) or HO-related performance measurements may be used also in detecting capacity and coverage related issues on the cell level.

Alarms, other monitoring information e.g. trace data can be correlated to get an unambiguous indication of capacity and coverage problem.

4.5.3.2 Problem Solution

Capacity and coverage optimization function will aim at optimizing the parameters listed in Section 4.5.2 in such way to mitigate the problem scenarios discussed in Section 4.5.3.1.

4.5.4 Architecture

4.5.4.1 Definition of Logical Functions

CCO Monitor Function: This function is used for monitoring the capacity and coverage optimization (e.g. monitoring related performance counters, UE measurements or alarms).

CCO Policy Control Function: This function is used for configuring the capacity and coverage optimization policies.

4.5.4.2 Location of Logical Functions

For capacity and coverage optimization (CCO), there are several options for the location of the centralized CCO SON algorithm:

1. The CCO SON algorithm is located in the DM. The capacity and coverage optimization decision is made by the DM centralized CCO algorithm.
2. The CCO SON algorithm is located in the NM. The capacity and coverage optimization decision is made by the NM centralized CCO algorithm.

An example for the first option is shown in figure 4.5.4.2:

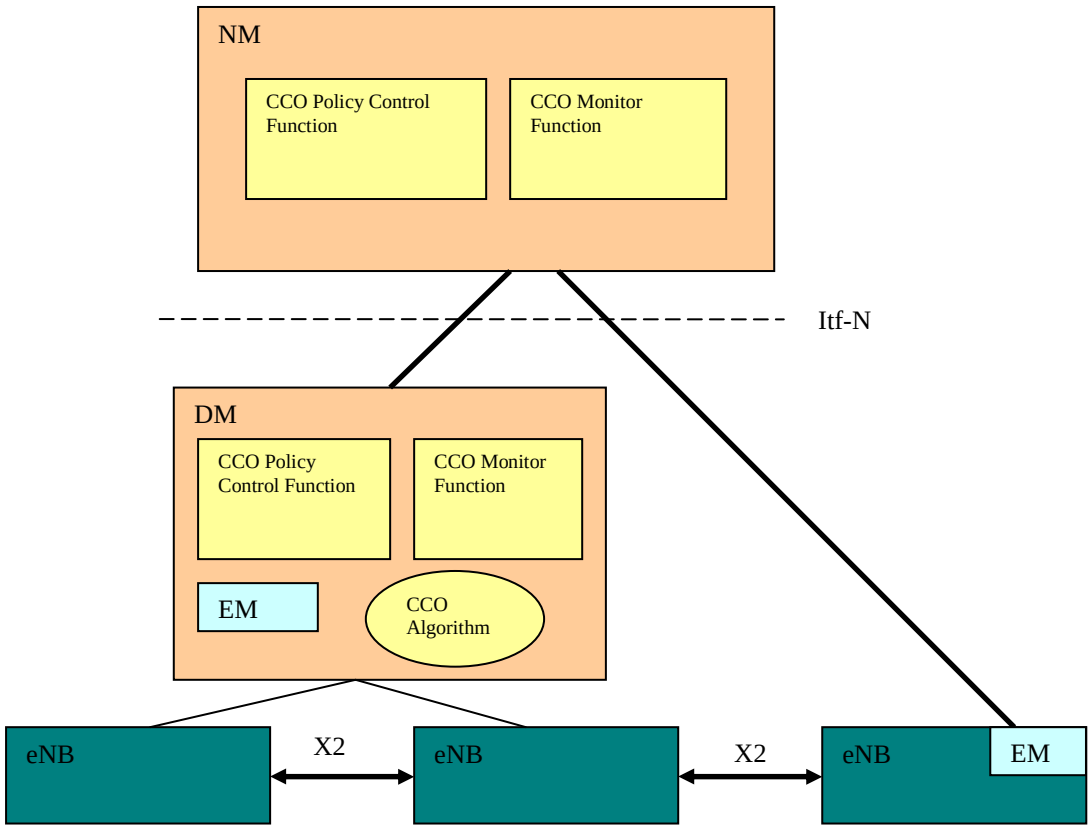


Figure 4.5.4.2: Example when the CCO SON algorithm is located in DM

The detailed CCO SON algorithm in OAM (NM centralized or EM centralized) is out of scope of this specification.

4.5.5 PM

The IRPAgent shall support a capability allowing the IRPManager to collect CCO related performance measurements to know the situation of coverage or interference which may then trigger corresponding optimization procedures. Performance measurements related with CCO are captured in the table below:

Performance measurement name	Description	Comment
Maximum carrier transmit power	Refer to 3GPP TS 32.425 [8] Maximum value of the total carrier power transmitted in a cell.	
Mean carrier transmit power	Refer to 3GPP TS 32.425 [8] Mean value of the total carrier power transmitted in a cell.	

4.6 RACH Optimization Function

4.6.1 Objective and Targets

The objective of RACH Optimization is to automatically set several parameters related to the performance of RACH. One of the following targets shall be used. The specific target value shall be configured by operators.

Target Name	Definition	Legal Values
Access Probability, *AP*	The probability that the UE has access after a certain random access attempt number. The target is met if the actual access probability is higher than the target probability value.	CDF of access attempts. See section 5.5.1
Access Delay Probability, *ADP*	The probability distribution of Access Delay expected to be experienced by UEs accessing the RACH Channel. The target is met if the actual access probability is higher than the target probability value.	CDF of delays. See section 5.5.1

4.6.2 Parameters to be optimized

To achieve RACH optimization target, RACH optimization function may optimize several parameters defined in TS 36.300 [14] section 22.4.3.

4.6.3 Optimization Method

4.6.3.1 Problem Detection

The problem detection is out of scope of this specification since the RACH optimization entity resides in the eNB.

4.6.3.2 Problem Solution

The problem solution is out of scope of this specification since the RACH optimization entity resides in the eNB.

4.6.4 PM

The IRPAgent shall support a capability allowing the IRPManager to collect RACH optimization related performance measurements. Performance measurements related with RACH optimization are captured in the table below:

Performance measurement name	Description	Related targets
Distribution of RACH preambles sent	Refer to 3GPP TS 32.425 [8] Cumulative Distribution of RACH preambles sent by UE	Access Probability, AP
Distribution of RACH access delay	Refer to 3GPP TS 32.425 [8] Cumulative Distribution of RACH Access Delay	Access Delay Probability, ADP

4.7 Optimization coordination

4.7.1 Introduction

For coordination of SON Functions whose outputs are not standardized, the context of optimization coordination is:

1. IRPManager uses standardized capabilities to set the SON Function(s) targets, and where needed their weights.

   Operators should assign weights for targets being used. The weights are used also for the evaluation of the targets. For details see Annex A.

For coordination of SON Functions whose outputs are standardized, the context of optimization coordination is FFS.

4.7.2 Coordination between SON functions below Itf-N and CM operations over itf-N

FFS

4.7.3 Coordination between different SON functions

Note: The coordination between different SON functions should be decided case by case.

4.7.3.1 Coordination between Cell Outage Compensation and Energy Saving Management

4.7.3.1.1 Description

A conflict could arise between energy saving and cell outage compensation in the following scenario.

One or more candidate cells are configured to possibly take coverage of the original cell. The original cell is in energySaving state or is about to enter energySaving state. One or more candidate cells go into outage with the consequence that coverage of the original cell can not be provided any more.

4.7.3.1.2 Prevention

Prevention is hardly possible, except making the cells as outage proof as possible. But cell outages can happen even to the most stable cell in a network.

4.7.3.1.3 Resolution

If the original cell is in energySaving state, it shall leave energySaving state.

If the original cell is about to enter energySaving state, it shall not go into energySaving state until candidate cell outage is recovered and candidate cell is able to provide the coverage.

The original cell may go into the energySaving state after the candidate cell outage is recovered and coverage of the original cell can be taken over by candidate cell again.

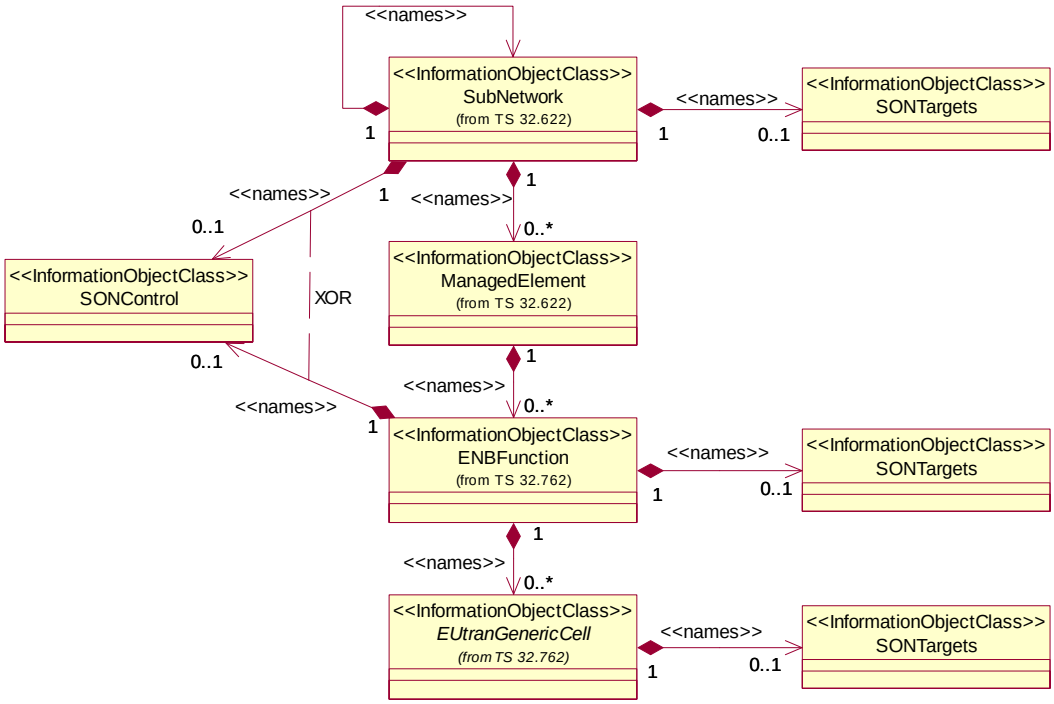
5 Information Object Classes (IOCs)

5.1 Information entities imported and local labels

Label reference	Local label
3GPP TS 32.622 [9], IOC, `Top`	`Top`
3GPP TS 32.622 [9], IOC, `SubNetwork`	`SubNetwork`
3GPP TS 32.762 [10], IOC, `ENBFunction`	`ENBFunction`
3GPP TS 32.762 [10], IOC, `EUtranRelation`	`EUtranRelation`
3GPP TS 32.762 [10], IOC, `EUtranGenericCell`	`EUtranGenericCell`

5.2 Class diagram

5.2.1 Attributes and relationships



NOTE 1: IOC `SONControl` shall be instantiated whenever one or more IOC `SONTargets` are instantiated.

Figure 5.2.1-1: Cell view of SON Policy NRM

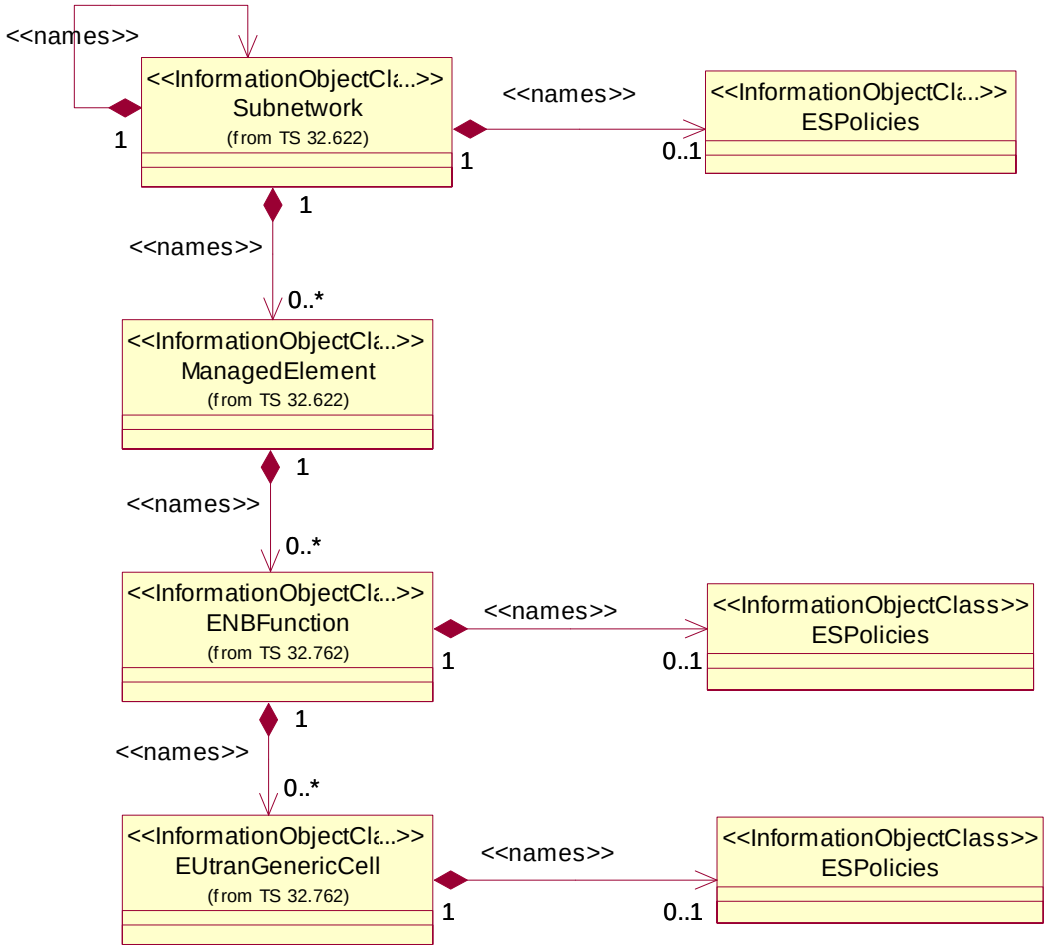


Figure 5.2.1-2: ES Policies NRM IOCs (Containment Relationship)

NOTE 2: Also IOC SONControl is used for ES purposes – see clause 5.3.2.2 – but is not shown in Figure 5.2.1-2 to avoid the impression that there would an additional instance of this IOC be needed for ES.

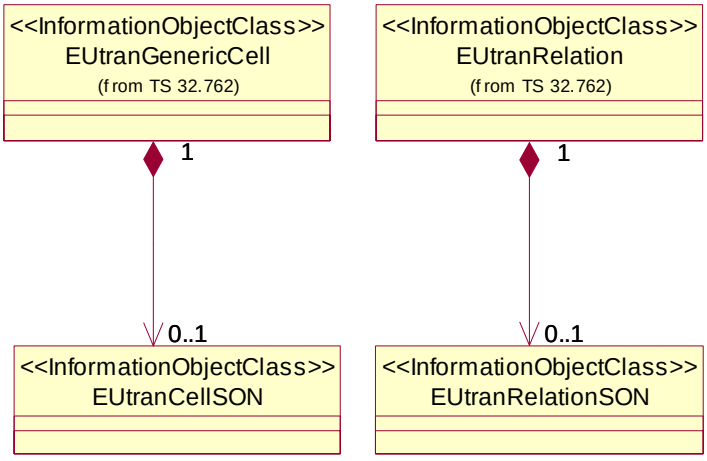


Figure 5.2.1-3: IOCs to control SON on cell or E-UTRAN relation level (Containment Relationship)

5.2.2 Inheritance

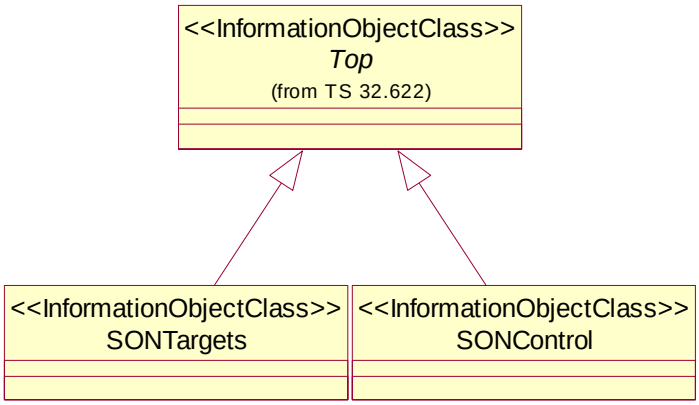


Figure 5.2.2-1: SON Policy NRM Inheritance Hierarchy

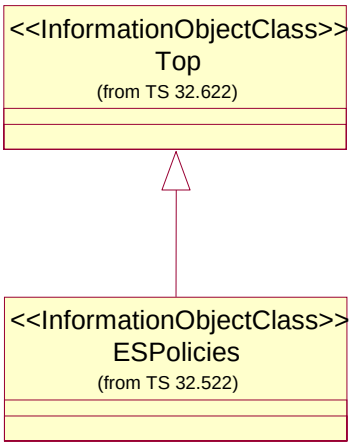


Figure 5.2.2-2: ES Polices NRM IOCs (Inheritance Relationship)

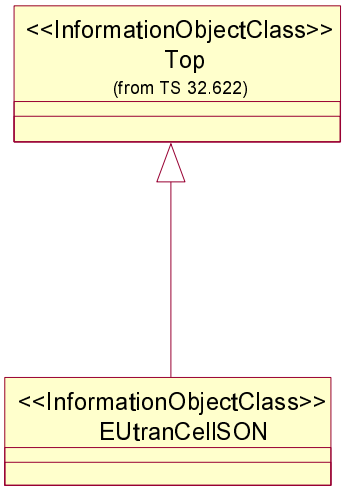


Figure 5.2.2-3: Inheritance for IOC to control SON on cell level

5.3 Information Object Class (IOC) definitions

5.3.1 SONTargets

5.3.1.1 Definition

This IOC represents targets for SON functions and their relative weights.

Target hierarchy rule:

An NRM IOC instance X may name-contain an IOC SONTargets instance T. The rule states that:

- If X name-contains a SONTargets instance T, then T is applicable to X.
- If X and all its superior instances do not name-contain any SONTargets instance, then no SONTargets instance is applicable to X.
- If X does not name-contain any SONTargets instance, but one or more of X"s superior instances name-contain a SONTargets instance, then the SONTargets instance of the superior instance closest to X, in X"s naming tree, is applicable to X.

5.3.1.2 Attributes

Attribute name	Support Qualifier	Read Qualifier	Write Qualifier
hoFailureRate	O *)	M	M
rrcConnectionEstablishmentFailureRateCharacteristic	O *)	M	M
rrcConnectionAbnormalReleaseRateCharacteristic	O *)	M	M
eRabSetupFailureRateCharacteristic	O *)	M	M
eRabAbnormalReleaseRateCharacteristic	O *)	M	M
rachOptAccessProbability	CM **)	M	M
rachOptAccessDelayProbability	CM **)	M	M

*) Note 1: At least one of the attributes shall be supported.

**) Note 2: Only one of these attributes shall be present.

5.3.1.3 Attribute constraints

Name	Definition
rachOptAccessProbability CM Support Qualifier	RACH Optimization is supported and Access Probability is supported as target.
rachOptAccessDelayProbability CM Support Qualifier	RACH Optimization is supported and Access Delay Probability is supported as target.

5.3.1.4 Notifications

The common notifications defined in subclause 5.6.1 are valid for this IOC, without exceptions or additions.

5.3.2 SONControl

5.3.2.1 Definition

This IOC represents the possibility to switch on or off SON functions. This is provided for Handover optimization, Load Balancing optimization, Energy Saving and Cell Outage Compensation. For other SON functions like Coverage and Capacity optimization, RACH optimization etc. this is FFS.

5.3.2.2 Attributes

Attribute name	Support Qualifier	Read Qualifier	Write Qualifier
hooSwitch	CM	M	M
lboSwitch	CM	M	M
esSwitch	CM	M	M
roSwitch	CM	M	M
cocSwitch	CM	M	M

5.3.2.3 Attribute constraints

Name	Definition
hooSwitch CM Support Qualifier	Handover (HO) parameter Optimization function is supported.
lboSwitch CM Support Qualifier	Load Balancing Optimization function is supported.
esSwitch Support Qualifier	The condition is 'Distributed or EM-Centralized ESM architecture is supported'.
roSwitch CM Support Qualifier	RACH Optimization is supported.
cocSwitch Support Qualifier	The condition is 'CoC is supported'. Only allowed to be present, if SONControl is contained in subnetwork IOC instance.

5.3.2.4 Notifications

The common notifications defined in subclause 5.6.1 are valid for this IOC, without exceptions or additions.

5.3.3 ESPolicies

5.3.3.1 Definition

This IOC represents the energy saving policies information. This object class is valid in a distributed ES architecture or in an EM-centralized ES architecture.

5.3.3.2 Attributes

Attribute name	Support Qualifier	Read Qualifier	Write Qualifier
esActivationOriginalCellLoadParameters	CM	M	M
esActivationCandidateCellsLoadParameters	CM	M	M
esDeactivationCandidateCellsLoadParameters	CM	M	M

5.3.3.3 Attribute constraints

Name	Definition
esActivationOriginalCellLoadParameters	The condition is "Intra-RAT ESM is supported AND the cell acts as an original cell".
esActivationCandidateCellsLoadParameters	The condition is "Intra-RAT ESM is supported AND the cell acts as a candidate cell".
esDeactivationCandidateCellsLoadParameters	The condition is "Intra-RAT ESM is supported AND the cell acts as a candidate cell".

5.3.3.4 Notifications

The common notifications defined in subclause 5.6.1 are valid for this IOC, without exceptions or additions

5.3.4 EUtranCellSON

5.3.4.1 Definition

This IOC represents the parameters for control of SON functions on E-UTRAN cell level.

5.3.4.2 Attributes

Attribute name	Support Qualifier	Read Qualifier	Write Qualifier
maximumDeviationHoTrigger	CM	M	M
minimumTimeBetweenHoTriggerChange	CM	M	M

5.3.4.3 Attribute constraints

Name	Definition
maximumDeviationHoTrigger Support Qualifier	The condition is "HOO function is supported".
minimumTimeBetweenHoTriggerChange Support Qualifier	The condition is "HOO function is supported".

5.3.4.4 Notifications

The common notifications defined in subclause 5.6.1 are valid for this IOC, without exceptions or additions.

5.3.5 Void

5.4 Information relationship definitions

None.

5.5 Information attribute definitions

5.5.1 Definition and legal values

Table 5.5.1.1 defines the attributes that are present in the Information Object Classes (IOCs) of the present document.

Table 5.5.1.1: Attributes definitions and legal values

Attribute Name	Definition	Legal Values
cocSwitch	This attribute allows the operator to enable/disable the COC functionality.	Enumerated {on, off}
eRabAbnormalReleaseRateCharacteristic	The target is on the number of E-RAB abnormal release related to load divided by the total number of attempted E-RAB setups. This attribute allows to define for a value the composite available capacity (CAC) range in which the target is valid. For this, it contains one characteristic dependent on Uplink CAC, one for Downlink CAC: eRabAbnormalReleaseRateCharacteristicDownlink and eRabAbnormalReleaseRateCharacteristicUplink. At least one of these charateristics must be present. Together with the characteristic its targetWeight as a SON target is defined as part of this attribute. The characteristics have the following structure: eRabAbnormalReleaseRateCharacteristicDownlink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, eRabAbnormalReleaseRateTarget eRabAbnormalReleaseRateCharacteristicUplink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, eRabAbnormalReleaseRateTarget Remark: Formula for composite available capacity: Available Capacity = Cell Capacity Class Value * Capacity Value For definition of Cell Capacity Class Value and Capacity Value see TS 36.331 [6]. These definitions lead to a value range of a composite available capacity from 0..10000. 36.423 [7] has cell capacity class value as optional parameter in case of intra-LTE load balancing. If cell capacity class value is not present, than 36.423 assumes that bandwidth should be used instead to assess the capacity. This target is suitable for LBO.	lowerEndOfCacRange and upperEndOfCacRange: Integer 0..10000 eRabAbnormalReleaseRateTarget: Integer 0..100 (representing a percentage) targetWeight: Integer 1..N. The higher the number the higher the weight.

eRabSetupFailureRateCharacteristic	The target is on the number of E-RAB setup failures related to load divided by the total number of attempted E-RAB setups. For E-RAB setup failure related to load the causes 'Reduce load in serving cell' and 'Radio resources not available' defined in TS 36.413 are used. This attribute allows to define for a value the composite available capacity (CAC) range in which the target is valid. For this, it contains one characteristic dependent on Uplink CAC, one for Downlink CAC: eRabSetupFailureRateCharacteristicDownlink and eRabSetupFailureRateCharacteristicUplink. At least one of these charateristics must be present. Together with the characteristic its targetWeight as a SON target is defined as part of this attribute. The characteristics have the following structure: eRabSetupFailureRateCharacteristicDownlink: List of one or more entries, each consisting of: LowerEndOfCacRange, UpperEndOfCacRange, eRabSetUpFailureRateTarget eRabSetupFailureRateCharacteristicUplink: List of one or more entries, each consisting of: LowerEndOfCacRange, UpperEndOfCacRange, eRabSetUpFailureRateTarget For CAC see eRabAbnormalReleaseRateCharacteristic This target is suitable for LBO.	lowerEndOfCacRange and upperEndOfCacRange and targetWeight: See eRabAbnormalReleaseRateCharacteristic eRabSetUpFailureRateTarget: Integer 0..100 (representing a percentage)
esActivationOriginalCellLoadParameters	This attributes is relevant, if the cell acts as an original cell. This attribute indicates the traffic load threshold and the time duration, which are used by distributed ES algorithms to allow a cell to enter the energySaving state. The time duration indicates how long the load needs to have been below the threshold.	Threshold: Integer 0..100 (Percentage of PRB usage, see 3GPP TS 36.314 [13]) TimeDuration: Integer (in unit of seconds)
esActivationCandidateCellsLoadParameters	This attributes is relevant, if the cell acts as a candidate cell. This attribute indicates the traffic load threshold and the time duration, which are used by distributed ES algorithms level to allow a n "original" cell to enter the energySaving state. Threshold and duration are applied to the candidate cell(s) which will provides coverage backup of an original cell when it is in the energySaving state. The threshold applies in the same way for a candidate cell, no matter for which original cell it will provide backup coverage. The time duration indicates how long the traffic in the candidate cell needs to have been below the threshold before any original cell which will be provided backup coverage by the candidate cell enters energy saving state.	Threshold: Integer 0..100 (Percentage of PRB usage (see 3GPP TS 36.314 [13])) TimeDuration: Integer (in unit of seconds)

esDeactivationCandidateCellsLoadParameters	This attributes is relevant, if the cell acts as a candidate cell. This attribute indicates the traffic load threshold and the time duration which is used by distributed ES algorithms to allow a cell to leave the energySaving state. Threshold and time duration are applied to the candidate cell when it which provides coverage backup for the cell in energySaving state. The threshold applies in the same way for a candidate cell, no matter for which original cell it provides backup coverage. The time duration indicates how long the traffic in the candidate cell needs to have been above the threshold to wake up one or more original cells which have been provided backup coverage by the candidate cell.	Threshold: Integer 0..100 (Percentage of PRB usage (see 3GPP TS 36.314 [13])) TimeDuration: Integer (in unit of seconds)
esSwitch	This attribute determines whether the energy saving function is enabled or disabled.	On, off
hoFailureRate	This indicates the assigned HOO target of the number of failure events related to handover divided by the total number of handover events, together with its targetWeight. This target is suitable for HOO or LBO.	A set of two numbers: the first indicates a percentage, the second a targetWeight (see eRabAbnormalReleaseRateCharacteristic).
hooSwitch	This attribute determines whether the Handover parameter Optimization Function is activated or deactivated.	On, off
lboSwitch	This attribute determines whether the Load Balancing Optimization Function is activated or deactivated.	On, off
maximumDeviationHoTrigger	This parameter allows the IRPManager to define the maximum allowed absolute deviation of the cell pair specific part of Handover Trigger (as defined in [14] (§22.4.1.4), from the default point of operation.	Integer (+1..+96) Unit: 0.5 dB
minimumTimeBetweenHoTriggerChange	This parameter defines the minimum allowed time interval between two changes of the Handover Trigger performed by MRO.	Integer (0..1440) Unit: Minutes

rachOptAccessDelayProbability	This is a list of target Access Delay probability (AD_P) for the RACH optimization function. Each instance AD_P of the list is the target time before the UE gets access on the random access channel, for the *P* percent of the successful RACH Access attempts with lowest access delay, over an unspecified sampling period. This target is suitable for RO.	Each element of the list, $\boldsymbol{AD_{Pn}}$, is a pair (*a, b*) where *a* is the targetProbability (in %) and *b* is the access delay (in milliseconds). The legal values for *a* are 25, 50, 75, 90. The legal values for *b* are 10 to 560. If $\boldsymbol{AD_{Px}}$"s *a* is larger than that of $\boldsymbol{AD_{Py}}$, then $\boldsymbol{AD_{Px}}$"s *b* must be larger than that of $\boldsymbol{AD_{Py}}$. The number of elements specified is 4. The number of elements supported is vendor specific. The choice of supported values for *a* and *b* is vendor-specific.
rachOptAccessProbability	This is a list of target Access Probability (AP_n) for the RACH optimization function. Each instance AP_n of the list is the probability that the UE gets access on the random access channel within *n* number of attempts, over an unspecified sampling period. This target is suitable for RO.	Each element of the list, $\boldsymbol{AP_n}$, is a pair (*a*, *n*) where *a* is the targetProbability (in %) and *n* is the access attempt number. The legal values for *a* are 25, 50, 75, 90. The legal values for *n* are 1 to 200. If $\boldsymbol{AP_x}$"s *a* is larger than that of $\boldsymbol{AP_y}$, then $\boldsymbol{AP_x}$"s *n* must be larger than that of $\boldsymbol{AP_y}$. The number of elements specified is 4. The number of elements supported is vendor specific. The choice of supported values for *a* and *n* is vendor-specific.
roSwitch	This attribute determines whether the RACH Optimization function is activated or deactivated.	On, off

rrcConnectionAbnormalReleaseRateCharacteristic	The target is on the number of abnormal RRC connection releases related to load divided by the total number of RRC connection releases. This attribute allows to define for a value the composite available capacity (CAC) range in which the target is valid. For this, it contains one characteristic dependent on Uplink CAC, one for Downlink CAC: rrcConnectionAbnormalReleaseRateCharacteristicDownlink and rrcConnectionAbnormalReleaseRateCharacteristicUplink. At least one of these charateristics must be present. Together with the characteristic its targetWeight as a SON target is defined as part of this attribute. The characteristics have the following structure: rrcConnectionAbnormalReleaseRateCharacteristicDownlink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, rrcConnectionAbnormalReleaseRateTarget rrcConnectionAbnormalReleaseCharacteristicUplink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, rrcConnectionAbnormalReleaseRateTarget For CAC see eRabAbnormalReleaseRateCharacteristic This target is suitable for LBO.	lowerEndOfCacRange and upperEndOfCacRange and targetWeight: See eRabAbnormalReleaseRateCharacteristic rrcConnectionAbnormalReleaseRateTarget: Integer 0..100 (representing a percentage)
rrcConnectionEstablishmentFailureRateCharacteristic	The target is on the number of RRC connection establishment failures related to load divided by the total number of attempted RRC connection establishments. This attribute allows to define for a value the composite available capacity (CAC) range in which the target is valid. For this, it contains one characteristic dependent on Uplink CAC, one for Downlink CAC: rrcConnectionEstablishmentFailureRateCharacteristicDownlink and rrcConnectionEstablishmentFailureRateCharacteristicUplink. At least one of these charateristics must be present. Together with the characteristic its targetWeigth as a SON target is defined as part of this attribute. The characteristics have the following structure: rrcConnectionEstablishmentFailureRateCharacteristicDownlink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, rrcConnectionEstablishmentFailureRateTarget rrcConnectionEstablishmentFailureRateCharacteristicUplink: List of one or more entries, each consisting of: lowerEndOfCacRange, upperEndOfCacRange, rrcConnectionEstablishmentFailureRateTarget For CAC see eRabAbnormalReleaseRateCharacteristic This target is suitable for LBO.	lowerEndOfCacRange and upperEndOfCacRange and targetWeigth: See eRabAbnormalReleaseRateCharacteristic rrcConnectionEstablishmentFailureRateTarget: Integer 0..100 (representing a percentage)

5.5.2 Constraints

None.

5.6 Common Notifications

5.6.1 Configuration notifications

Name	Qualifier	Notes
notifyAttributeValueChange	O	
notifyObjectCreation	O	
notifyObjectDeletion	O	

Annex A (informative): Target Achievement Evaluation

To evaluate the result of the optimization the target achievement needs to be evaluated. This can be done by calculating the Total Target Achievement as follows.

The Total Target Achievement is the sum of the products of the individual target achievement (difference between target and performance) and the individual targetWeights:

Total Target Achievement =

$$\text{Sum}_{i=1..n} [(\text{minTarget}_i - \text{performance}_i) \times \text{weight}_i]$$
$$+ \text{Sum}_{j=1..n} [\text{performance}_j - \text{maxTarget}_j) \times \text{weight}_j]$$

where minTarget is a target to be minimized and maxTarget is a target to be maximized.

For targets with a substructure (like `*Characteristic,` see §5.5.1) the above formula is applied to each individual substructure target.

The higher the Total Target Achievement, the better is the result of the optimization.

Annex B (informative): Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2010-03	SA#47	SP-100053	--	--	Presentation to SA for Information and Approval	--	1.0.0
2010-03	--	--	--	--	Publication of SA approved version	1.0.0	9.0.0
2010-09	SA#49	SP-100491	001	--	Remove targets based on not supported by measurements	9.0.0	9.1.0
2010-12	SA#50	SP-100858	003	1	Correcting the support qualifiers of SONControl attributes	9.1.0	9.2.0
2010-12	SA#50	SP-100749	005	-	Disambiguate and correct the description of SON Targets hierarchy	9.1.0	9.2.0
2010-12	SA#50	SP-100833	002	3	Allow EM centralized architecture for Hand-over parameter optimization - Align with 32.500	9.2.0	10.0.0
2010-12	SA#50	SP-100866	004	3	Adding NRM for Energy Saving Management policies and ESM switch	9.2.0	10.0.0
2011-01	--	--	--	-	Correction of misimplementation of CR in clause 5.3.2.3 and CR history correction.	10.0.0	10.0.1
2011-03	SA#51	SP-110098	10	2	Introducing RACH optimization management	10.0.1	10.1.0
2011-03	SA#51	SP-110098	11	-	Rapporteur clean-up for editorial errors	10.0.1	10.1.0
2011-03	SA#51	SP-110100	13	3	Use ESPolicies also for EM centralized architecture	10.0.1	10.1.0
2011-03	SA#51	SP-110100	14	-	Correct cardinality of ESPolicies	10.0.1	10.1.0
2011-03	SA#51	SP-110097	16	-	Add a new attribute into SONControl object class to switch on/off Cell Outage Compensation - Align with 32.541	10.0.1	10.1.0
2011-06	SA#52	SP-110284	18	1	Finalization of Rel-10 SON functionalities	10.1.0	10.2.0
2011-06	SA#52	SP-110284	66	2	Add parameters to control Mobility Robustness Optimization	10.1.0	10.2.0
2011-12	SA#54	SP-110721	70	1	Correction MRO management of HO Trigger	10.2.0	10.3.0
2012-09	SA#57	SP-120558	97	2	Correct candidateCellLoadParameters	10.3.0	10.4.0
2013-03					Editorial correction on the ToC and subclause headers (MCC)	10.4.0	10.4.1
2013-03					Editorial correction of the title of the spec	10.4.1	10.4.2
2013-06	SA#60	SP-130266	137	-	Remove EUtranRelationSON in UML diagram	10.4.2	10.5.0
			138	-	Correction of attribute constraints		

History

Document history		
V10.1.0	May 2011	Publication
V10.2.0	June 2011	Publication
V10.3.0	January 2012	Publication
V10.4.0	September 2012	Publication
V10.4.2	April 2013	Publication
V10.5.0	July 2013	Publication