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Technical Specification

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Concepts and requirements
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Foreword

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Contents

Foreword

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

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

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  - 1 presented to TSG for information;
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- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
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1 Scope

The present document describes the requirements and architecture for the Self Organizing Network (SON) functions within the OAM system. SON includes:

Provision of infrastructure for SON, in the OAM system

- Enabling SON operations
- Provide SON capabilities (each of which can either be distributed or centralised) within the OAM infrastructure, including their management
- Access to SON relevant eNodeB attributes
- Identification of SON relevant eNodeB and UE Measurements
- Access to and transfer of SON relevant eNodeB and UE measurements
- Transfer of SON relevant eNodeB alarms

Define necessary Interface IRPs

- the automation of neighbour relation lists in E-UTRAN and between different 3GPP Radio Access Technologies,
- self establishment of a new eNodeB in the network,
- self-configuration and self-healing of eNodeBs,
- automated coverage and capacity optimisation,
- optimisation of parameters due to troubleshooting,
- continuous optimisation due to dynamic changes in the network,
- automated handover optimisation,
- optimisation of QoS related radio parameters.

The SON concept and architecture are described in clause 4.
The high-level requirements for SON are defined in clause 5.
Use cases for SON are described in clause 5.

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.
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[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 32.501: "Telecommunication management; Self-Configuration of Network Elements; Concepts and Integration Reference Point (IRP) Requirements".

[3] 3GPP TS 32.511: "Telecommunication management; Automatic Neighbour Relation (ANR) management; Concepts and requirements".

[4] 3GPP TS 32.521: "Telecommunication management; Self-Organizing Networks (SON); Self-optimization and self-healing; Concepts and requirements".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Centralised SON : SON solutions where SON algorithms are executed in the OAM System. In such solutions SON functionality resides in a small number of locations, at a high level in the architecture.

Distributed SON : SON solutions where SON algorithms are executed at the NE level. In such solutions SON functionality resides in many locations at a relatively low level in the architecture.

Hybrid SON : SON solutions where part of the SON algorithms are executed in the OAM system, while others are executed at the NE level.

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].

4 Concepts and background

4.1 SON concepts

As a consequence of flattening the access network architecture in E-UTRAN (due to removal of the RNC) it is likely that a network operator will require more Release 8 eNodeBs than Release 7 NodeBs in order to cover an equivalent geographical area. Network operators have also articulated their requirement to have more flexibility over the choice of eNodeB vendor, irrespective of the MME or NMS vendor.

In order to reduce the operating expenditure (OPEX) associated with the management of this larger number of nodes from more than one vendor the concept of the Self-Organizing Network (SON) is 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. In 3GPP Release 8 many of the signalling interfaces between network elements are standardised (open) interfaces. Significant examples in the context of SON are the X2 interface between eNodeBs and the S1 interface between eNodeB and the EPC (e.g. MME, SGW).

If the solution for a particular SON-related use case is best provided at the network level the associated SON algorithm(s) will reside in one or more network elements. This is an example of a distributed SON architecture.

If the solution is best provided in the existing network management system or in an additional standalone SON function or server, then the SON algorithm(s) will most likely reside either at DM or NM level. This is an example of a centralised SON architecture.

It may also result that the solution could require SON functionality partly at the network level and partly in the management system. This is an example of hybrid SON architecture.

For 3GPP Release 8 it has been decided that SON algorithms themselves will not be standardised.

5 Business Level Requirements

5.1 Requirements

5.1.1 General

REQ-SON-CON-01 SON solutions shall provide an easy transition from operator controlled (open loop) to autonomous (closed loop) operation, as the network operator gains more trust in the reliability of the SON.

REQ-SON-CON-02 The SON Architecture and implementation should support network sharing between network operators. The impact of individual shared network topographies on proposed SON solutions shall be decided on a case-by-case basis.

REQ-SON-CON-05 For operator controlled (open loop) SON function, the implementation of any update proposed by the SON function shall take effect only after a response by the Operator.

REQ-SON-CON-06 For closed loop SON function, the implementation of any update proposed by the SON function shall take effect without the need for response by the Operator.

REQ-SON-CON-07 **An** NE can operate with SON function or without SON function and can easily be transferred between these two modes. The ability to suspend/ resume/ enable/ disable the SON function shall be determined on a case by case basis.

REQ-SON-CON-8 An IRPManager shall be able to monitor the specific results of each particular SON function

5.2 Actor roles

IRP Agent. The entity performing the agent role.

IRP Manager. The entity performing the manager role.

Network Operations Staff. During open loop operation, personnel who manually review the results of the SON function at intermediate steps in the particular SON process. The network operations staff decide upon and manually initiate the appropriate next step in the SON process.

5.3 Telecommunications resources

The managed network equipment. The particular equipment and the need for any SON function(s) within it will be specific to each individual use case.

The OAM system. The location of any SON function(s) within the OAM system will also be specific to each individual use case.

SON Function. The SON algorithm and associated processes that automatically determines the optimum configuration, connectivity, or installation parameters for a network element.

5.4 High-level use cases

A high-level use case diagram may be presented. In order to understand the use case by subject matter experts, they should be augmented with a textual description for each use case.
The description should serve two purposes: to capture the domain experts' knowledge and to validate the models in analysis and design phases with respect to the requirements.
An example of a high- level use case diagram is given in Appendix I of M.3020.

5.4.1 e-NodeB Sharing Use Case

e-NodeB Sharing Use Case Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	A new eNodeB shared by more than one Network Operator is successfully taken into service. The MME or MME Pool to which it is attached is aware that this eNodeB serves more than one operator.	
Actors and Roles	Network Operator A – provides MCC/MNC information and provisions the eNodeB. Network Operator B – provides MCC/MNC information and gives provisioning information to Network Operator A.	
Telecom resources	Planning tool of Network Operator A. Shared eNodeB.	
Assumptions	A commercial relationship exists between the Network Operators.	
Pre-conditions	Combined provisioning information from both Network Operators is available to be downloaded to the new eNodeB.	
Begins when	The Network Operators agree to share an eNodeB.	
Step 1 (M)	The operators exchange provisioning data.	
Step 2 (M)	Network Operator A loads both sets of provisioning data into his Planning tool.	
Step 3 (M)	The self-establishment process for installation of a new eNodeB retrieves the combined data from the Planning Tool.	
Ends when (*)	The new eNodeB is in service and its associated MME or MME Pool is aware that it is a shared eNodeB.	
Exceptions	None.	
Post-conditions	Successful if: Provisioning data in the eNodeB matches that in the Planning Tool. MME or MME Pool is provided with correct information and can distinguish between the traffic from each Network Operator that shares the eNodeB. Unsuccessful if: Mismatch between provisioning data in Planning Tool and eNodeB. MME or MME Pool unable to identify either or both of the Network Operators as those which share the eNodeB.	
Traceability (*)	Requirements or use case exposed by the use case.	REQ-SON-CON-02

5.4.2 Transition from Open Loop to Closed Loop Use Case

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	The transition from the state where Network Operations personnel intervene and act as a manual control and authorisation point for outputs from a SON function, to a state where the outputs are used automatically and the personnel merely monitor without intervention.	
Actors and Roles	Network Operations personnel – manually installing or updating information output from a SON function in the target node(s) via use of the planning tool or via the NM/DM at intermediate steps during the open loop phase of the SON implementation. SON Functions – automatically generating SON outputs for review by the Network Operations personnel during open loop operation or for automatic use during closed loop operation.	
Telecom resources	Network Management System SON function.	
Assumptions		
Pre-conditions	Initial SON information is defined manually by the network operator and is resident on the relevant target node(s). The Network Operations personnel defined manual intervention/pause point and forces the SON function to take effect only after a response/confirmation by the Operator. The SON is running in Open Loop.	REQ-SON-CON-05 [1]
Begins when	The Network Operator decides to transit from Open Loop to Closed Loop NOTE: The transition may only occur once the operator has gained trust in the reliability of the SON.	
Step 1 (O)	The Network Operations personnel remove the manual intervention/pause point either all at once or gradually. The Network Operations personnel allow the SON function to run in Closed Loop	
Step 2 (M)	The Network Operations personnel periodically monitor the automatically updated SON information and verify that network performance continues to meet or exceed planned targets.	
Ends when (*)	The SON function operates in a closed-loop mode; the SON function takes effect without the need for response by the Operator	REQ-SON-CON-06 [1]
Exceptions	The Network Operator disregards the SON function and reverts to manual Operation of the Network without any intervention by the SON function, if the latter generates SON information that results in unexpected network performance.	
Post-conditions	The SON function is in use and is automatically producing appropriate SON information for the target node(s).	
Traceability (*)	Requirements or use case exposed by the use case.	REQ-SON-CON-01 [1]

6 Specification level requirements

6.1 Requirements

6.1.1 General

It is likely that only a subset of SON functions can be standardised within the timeframe of the first release of the EPS. For that reason a step-by-step roll out of SON functions should be provided.

6.1.2 SON in a Multi-Vendor network

REQ-SON-CON-003 Self-establishment and self-optimisation shall be supported in a multiple vendor environment. Standardised procedures and OAM interfaces are needed to avoid cost-intensive mediation between different vendor nodes and side effects due to different detailed solutions (e.g. different optimisation algorithm leads to ping-pong effects and swinging phenomena).

REQ-SON-CON-004 The standardised information made available to SON algorithms shall be consistent, independent of the vendor.

6.1.3 Self-Establishment of a new eNodeB

Requirements for Self-Establishment of a new eNodeB can be found in TS32.501 [2].

6.1.4 Automatic Neighbour Relation Management

Requirements for Automatic Neighbour Relation Management can be found in TS32.511 [3].

6.1.5 Self-Optimisation, Self-Healing, Coverage and Capacity Optimisation, and Handover Optimisation

Requirements for Self-Optimisation, Self-Healing, Coverage and Capacity Optimisation, and Handover Optimisation can be found in TS32.521 [4].

6.1.6 Continuous Optimisation due to Dynamic Changes in the Network

REQ-SON-CNO-CON-01: An IRPManager shall be able to configure a list of valid Physical Cell Identifiers (PCI) in the eNB in order to allow the eNB to choose an appropriate PCI for a cell from within this list to support distributed PCI assignment. The list of PCIs shall be cell-specific.

REQ-SON-CNO-CON-02: An IRPManager shall be able to configure a valid PCI in the eNB to support centralized PCI assignment. The PCI shall be cell-specific.

REQ-SON-CNO-CON-03: IRPAgent shall support either the distributed or the centralized PCI assignment or both.

REQ-SON-CNO-FUN-01: IRPAgent shall inform IRPManager about the PCI that is selected for each cell.

REQ-SON-CNO-FUN-02: IRPAgent shall inform IRPManager about the reason for changing the PCI for a cell.

REQ-SON-CNO-FUN-03: IRPAgent shall inform IRPManager if a valid PCI cannot be found in the list of PCIs configured by IRPManager.

6.2 Actor roles

Actors for Self-Establishment of new eNodeBs can be found in TS32.501 [2].

Actors for Automatic Neighbour Relation Management can be found in TS32.511 [3].

Actors for Self-Optimisation, Self-Healing, Coverage and Capacity Optimisation, and Handover Optimisation can be found in TS32.521 [4].

6.3 Telecommunications resources

Telecommunications resources for Self-Establishment of new eNodeBs can be found in TS32.501 [2]..

Telecommunications resources for Automatic Neighbour Relation Management can be found in TS32.511 [3].

Telecommunications resources for Self-Optimisation, Self-Healing, Coverage and Capacity Optimisation, and Handover Optimisation can be found in TS32.521 [4].

6.4 Use cases

6.4.1 SON in a Multi-Vendor network

6.4.1.1 Use Case Replacement of eNodeB of Vendor A with one of Vendor B.

Use case stage	Evolution/Specification	<<Uses>> Related use
Goal	Seamless replacement of eNodeB from one vendor with that from another. Standardised procedures and OAM interfaces are needed to avoid cost-intensive mediation between different vendor nodes and side effects due to different detailed solutions. No adaptaption of the Input data to the SON functions is necessary due to the replacement of the eNodeB of Vendor A with eNodeB of Vendor B.	
Actors and Roles	The Network Operations personnel periodically monitor the automatically updated SON information, eNodeB performance, and Network Evolution Plan and verify that a particular eNodeB is to be replaced. SON Functions – automatically generating SON outputs for automatic use during closed loop operation.	
Telecom resources	Network Management System SON function. eNodeB	
Assumptions	Initial SON information is defined manually by the network operator and is resident on the eNodeB from Vendor B.	
Pre-conditions	The SON function is activated on the eNodeB of a Vendor A The SON function operates in a closed-loop mode.	
Begins when	The eNodeB of vendor A is identified for replacement by the Network Operator.	
Step 1 (M)	The eNodeB of vendor Vendor B is physically installed in the Network Operator's network.	
Step 2 (M)	The eNodeB of vendor B is Self-established. The procedure is described in [2]. The eNodeB of vendor B is Self-configured. The procedure is described in [2]	REQ-SON-CON-03 [1]
Step 3 (M)	Further SON functions are activated on the eNodeB.	
Ends when (*)	The eNodeB of Vendor B is connected to the operator's network and traffic is cutover to it from the eNodeB of Vendor A. The SON functions are operating, reliably producing appropriate information that results in expected network performance.	REQ-SON-CON-04 [1]
Exceptions		
Post-conditions	The eNodeB of Vendor B is operating. The SON function is in use and is automatically producing appropriate SON information.	
Traceability (*)	Requirements or use case exposed by the use case.	REQ-SON-CON-04 [1]

6.4.2 Self-Establishment of a new eNodeB

Specific use cases for Self Establishment of a new eNodeB can be found in TS32.501 [2].

6.4.3 Automatic Neighbour Relation Management

Specific use cases for Automatic Neighbour Relation Management can be found in TS32.511 [3].

6.4.4 Self-Optimisation,Self-Healing, Coverage and Capacity Optimisation, and Handover Optimisation

Specific use cases for Self-Optimisation, Self- Healing, Coverage and Capacity Optimisation, and Handover Optimisation can be found in TS32.521 [4],

6.4.5 Continuous Optimisation due to Dynamic Changes in the Network

Annex A (informative): Change history

Change history							
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