**3GPP T****SG-RAN WG3 Meeting #108-e R3-204480**

**Online, 1st - 10th June 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.300** | **CR** |  | **rev** |  | **Current version:** | **16.1.0** |  |
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| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME |  | Radio Access Network | **x** | Core Network |  |

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|  |
| ***Title:***  | Addition of SON features |
|  |  |
| ***Source to WG:*** | CMCC, Huawei, ZTE, Nokia, Nokia Shanghai Bell，CATT, Samsung, Ericsson, Qualcomm Incorporated, LG Electronics, NTT DOCOMO |
| ***Source to TSG:*** |  |
|  |  |
| ***Work item code:*** | NR\_SON\_MDT-Core |  | ***Date:*** |  2020-06-15 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | Add the support of SON for NR |
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| ***Summary of change:*** | **RAN3 #105 (R3-194776):**To capture agreements for NR SON into stage 2 specification:* Creating sepcific sections for NR SON
* Implement agreements

**RAN3 #105bis (R3-196157)*** Capture agreements on MRO, including corrections of connection failure, adding support of inter-system unnecessary HO and ping pong

**RAN3 #106 (R3-197577)*** Add MRO O&M requirement description

**RAN3 #107-e*** R3-200375: Add mobility settings change
* R3-200674: Clarification to Inter-System unnecessary HO
* R3-201324: MRO OAM correction
* R3-201374: Refinement of MLB description
* R3-201378: Add UE history information description
* R3-201390: Support of RACH optimization

**RAN3 #107bis-e*** R3-202819: Update RLF report descriptions
* Rapporteur to fix editorial changes raised in R3-201738
* R3-202825: Add load balancing action based on HO description; capture agreements

**RAN3 #108-e*** R3-204348: re-structure of MRO section and corrections
* Add more co-source companies
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| ***Consequences if not approved:*** | NR SON features are not supported |
|  |  |
| ***Clauses affected:*** | 15.X (new), 15.X.1 (new), 15.X.2 (new), 15.X.3 (new), 15.X.4 (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

**--------------------------------------------------Start of the change---------------------------------------------------**

## 15.X Self-optimisation

### 15.X.1 Support for Mobility Load Balancing

#### 15.X.1.1 General

The objective of mobility load balancing is to distribute load evenly among cells and among areas of cells, or to transfer part of the traffic from congested cell or from congested areas of cells, or to offload users from one cell, cell area, carrier or RAT to achieve network energy saving. This can be done by means of optimization of cell reselection/handover parameters and handover actions. The automation of such optimisation can provide high quality user experience, while simultaneously improving the system capacity and also to minimize human intervention in the network management and optimization tasks.

Intra-RAT and intra-system inter-RAT load balancing scenarios are supported.

In general, support for mobility load balancing consists of one or more of following functions:

- Load reporting;

- Load balancing action based on handovers;

- Adapting handover and/or reselection configuration.

#### 15.X.1.2 Load reporting

The load reporting function is executed by exchanging load information over the Xn/X2/F1/E1 interfaces.

The following load related information should be supported which consists of,

- Radio resource usage (per-cell and per SSB area PRB usage: DL/UL GBR PRB usage, DL/UL non-GBR PRB usage, DL/UL total PRB usage, and DL/UL scheduling PDCCH CCE usage);

- TNL capacity indicator (UL/DL TNL offered capacity and available capacity);

- Cell Capacity Class value (UL/DL relative capacity indicator);

- Capacity value (per cell, per SSB area and per slice: UL/DL available capacity);

- HW capacity indicator (offered throughput and available throughput over E1, percentage utilisation over F1);

- RRC connections (number of RRC connections, and available RRC Connection Capacity);

- Number of active UEs.

To achieve load reporting function, Resource Status Reporting Initiation & Resource Status Reporting procedures are used.

15.X.1.3 Load balancing action based on handovers

The source cell may initiate handover due to load. The target cell performs admission control for the load balancing handovers. A handover preparation related to a mobility load balancing action is distinguishable from other handovers, so that the target cell is able to apply appropriate admission control.

#### 15.X.1.4 Adapting handover and/or reselection configuration

This function enables requesting of a change of handover and/or reselection parameters at target cell. The source cell that initialized the load balancing estimates if it is needed to change mobility configuration in the source and/or target cell. If the amendment is needed, the source cell initializes mobility negotiation procedure toward the target cell.

The source cell informs the target cell about the new mobility setting and provides cause for the change (e.g. load balancing related request). The proposed change is expressed by the means of the difference (delta) between the current and the new values of the handover trigger. The handover trigger is the cell specific offset that corresponds to the threshold at which a cell initialises the handover preparation procedure. Cell reselection configuration may be amended to reflect changes in the HO setting. The target cell responds to the information from the source cell. The allowed delta range for HO trigger parameter may be carried in the failure response message. The source cell should consider the responses before executing the planned change of its mobility setting.

All automatic changes on the HO and/or reselection parameters must be within the range allowed by OAM.

### 15.X.2 Support for Mobility Robustness Optimization

#### 15.X.2.1 General

Mobility Robustness Optimisation aims at detecting and enabling correction of following problems:

- Connection failure due to intra-system or inter-system mobility;

- Inter-system Unnecessary HO (too early inter-system HO from NR to E-UTRAN with no radio link failure);

- Inter-system HO ping-pong.

MRO provides means to distinguish the above problems from NR coverage related problems and other problems, not related to mobility.

#### 15.x.2.2 Connection failure

##### 15.x.2.2.1 General

For analysis of connection failures, the UE makes the RLF Report available to the network.

The UE stores the latest RLF Report, including both LTE and NR RLF report until the RLF report is fetched by the network or for 48 hours after the connection failure is detected.

The UE only indicates RLF report availability and only provides the RLF report to the network if the current RPLMN is a PLMN that was present in the UE's EPLMN List or was the RPLMN at the time the connection failure was detected. In case RLF happens in an E-UTRA cell, the UE makes the LTE RLF Report available to NG-RAN nodes and eNB(s), and in case RLF happens in an NR cell the UE makes the NR RLF Report available to gNB(s).

If the LTE RLF Report is reported to a NG-RAN node, and the last serving node is an E-UTRAN node, the NG-RAN node may transfer it to the E-UTRAN node by triggering the Uplink RAN configuration transfer procedure over NG and the E-UTRAN node can take this into account as defined in TS 36.300 [2].

##### 15.X.2.2.2 Connection failure due to intra-system mobility

One of the functions of Mobility Robustness Optimization is to detect connection failures that occur due to Too Early or Too Late Handovers, or Handover to Wrong Cell. These problems are defined as follows:

- [Intra-system Too Late Handover] An RLF occurs after the UE has stayed for a long period of time in the cell; the UE attempts to re-establish the radio link connection in a different cell.

- [Intra-system Too Early Handover] An RLF occurs shortly after a successful handover from a source cell to a target cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in the source cell.

- [Intra-system Handover to Wrong Cell] An RLF occurs shortly after a successful handover from a source cell to a target cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the target cell.

In the definition above, the "successful handover" refers to the UE state, namely the successful completion of the RA procedure.

**Detection mechanism:**

A failure indication may be initiated after a UE attempts to re-establish the radio link connection at NG-RAN node B after a failure at NG-RAN node A. NG-RAN node B may initiate the Failure Indication procedure towards multiple NG-RAN nodes if they control cells which use the PCI signalled by the UE during the re-establishment procedure. The NG-RAN node receiving this selects the UE context that matches the received Failure Cell ID and C-RNTI, and, if available, uses the shortMAC-I to confirm this identification, by calculating the shortMAC-I and comparing it to the received IE.

A failure indication may also be sent to the node last serving the UE when the NG-RAN node fetches the RLF REPORT from UE by triggering:

- the Failure Indication procedure over Xn,

- the Uplink RAN configuration transfer procedure and Downlink RAN configuration transfer procedure over NG.

The detailed detection mechanisms for too late handover, too early handover and handover to wrong cell are carried out through the following in the NG-RAN node that served the UE before the reported connection failure:

- [Intra-system Too Late Handover]

There is no recent handover for the UE prior to the connection failure e.g. the UE reported timer is absent or larger than the configured threshold (e.g. Tstore\_UE\_cntxt)

- [Intra-system Too Early Handover]

There is a recent handover for the UE prior to the connection failure e.g. the UE reported timer is smaller than the configured threshold (e.g. Tstore\_UE\_cntxt), and the first re-establishment attempt cell/the cell UE attempts to re-connect is the cell that served the UE at the last handover initialisation.

- [Intra-system Handover to Wrong Cell]

There is a recent handover for the UE prior to the connection failure e.g. the UE reported timer is smaller than the configured threshold (e.g. Tstore\_UE\_cntxt), and the first re-establishment attempt cell/the cell UE attempts to re-connect is neither the cell that served the UE at the last handover initialisation nor the cell that served the UE where the RLF happened or the cell that the handover was initialized toward.

The "UE reported timer" above indicates the time elapsed since the last handover initialisation until connection failure.

In case of Too Early Handover or Handover to Wrong Cell, the NG-RAN node receiving the failure indication may inform the NG-RAN node controlling the cell where the mobility configuration caused the failure by means of the Handover Report procedure over Xn or the Uplink RAN Configuration Transfer procedure over NG. This may include the RLF report.

**Retrieval of information needed for problem analysis**

In order to retrieve relevant information collected at the network side as part of the UE context, the UE provides C-RNTI used in the last serving cell. If the cause for the failure is identified as a "Too Early HO" or a "HO to Wrong Cell", the NG-RAN node controlling the last serving cell shall, include in the HANDOVER REPORT message the C-RNTI used in the source cell of the last completed handover before the failure. If the NG RAN node controlling that source cell provided the Mobility Information, it is also included in the HANDOVER REPORT message. If used, the Mobility Information is prepared at the source NG RAN node of a handover and may refer to or identify any handover-related data at this NG RAN node.

**Handling multiple reports from a single failure event**

In case the RRC re-establishment fails and the RRC connection setup succeeds, MRO evaluation of intra-RAT mobility connection failures may be triggered twice for the same failure event. In this case, only one failure event should be counted.

#### 15.X.2.2.3 Connection failure due to inter-system mobility

One of the functions of Mobility Robustness Optimization is to detect connection failures that occurred due to Too Early or Too Late inter-system handovers. These problems are defined as follows:

- [Inter-system/ Too Late Handover] An RLF occurs after the UE has stayed in a cell belonging to an NG-RAN node for a long period of time; the UE attempts to re-connect to a cell belonging to an E-UTRAN node.

- [Inter-system/ Too Early Handover] An RLF occurs shortly after a successful handover from a cell belonging to an E-UTRAN node to a target cell belonging to an NG-RAN node; the UE attempts to re-connect to the source cell or to another cell belonging to an E-UTRAN node.

**Detection mechanism:**

A failure indication may be sent to the node last serving the UE when the NG-RAN node fetches the RLF REPORT from UE by triggering:

- the Failure Indication procedure over Xn,

- the Uplink RAN configuration transfer procedure and Downlink RAN configuration transfer procedure over NG.

In case the last serving node is an E-UTRAN node, the detection mechanism proceed as deined in TS 36.300 [2].

In case the last serving node is an NG-RAN node, the detection mechanisms for Too Late Inter-system Handover and Too Early Inter-system Handover are carried out through the following:

* [Too Late Inter-system Handover]

The connection failure occurs while being connected to a NG-RAN node, and there is no recent handover for the UE prior to the connection failure i.e., the UE reported timer is absent or larger than the configured threshold, e.g., Tstore\_UE\_cntxt, and the first node where the UE attempts to re-connect is a E-UTRAN node.

* [Too Early Inter-system Handover]

The connection failure occurs while being connected to a NG-RAN node, and there is a recent inter-system handover for the UE prior to the connection failure i.e., the UE reported timer is smaller than the configured threshold, e.g., Tstore\_UE\_cntxt, and the first cell where the UE attempts to re-connect and the node that served the UE at the last handover initialisation are both E-UTRAN node.

The "UE reported timer" above indicates the time elapsed since the last handover initialisation until connection failure. The UE may make the RLF Report available to an NG-RAN node. The NG-RAN node may forward the information using the FAILURE INDICATION message over Xn or by means of the Uplink RAN configuration transfer procedure and Downlink RAN configuration transfer over NG to the node that served the UE before the reported connection failure.

In case the failure is a Too Early Inter-system Handover, the NG-RAN node receiving the failure indication may inform the E-UTRAN node by means of the Uplink RAN Configuration Transfer procedure over NG. This may include the RLF report.

#### 15.X.2.3 Inter-system Unnecessary HO

One of the purposes of inter-system Mobility Robustness Optimisation is the detection of a non-optimal use of network resources. In particular, in case of inter-system operations and when NR is considered, the case known as Unnecessary HO to another system is identified. The problem is defined as follows:

- UE is handed over from NR to E-UTRAN even though quality of the NR coverage was sufficient for the service used by the UE. The handover may therefore be considered as unnecessary HO to another system (i.e. EPS) (too early inter-system HO without connection failure).

In inter-system HO, if the serving cell threshold (NR cell) is set too high, and cell in another system (i.e. EPS) with good signal strength is available, a handover to another system may be triggered unnecessarily, resulting in an inefficient use of the networks. With a lower threshold the UE could have continued in the source system (5GS).

To be able to detect the Unnecessary HO to another system, a gNB node may choose to put additional coverage and quality condition information into the HANDOVER REQUIRED message in the Handover Preparation procedure when an inter-system HO from gNB to another system occurs. The RAN node in the other system, upon receiving this additional coverage and quality information, may instruct the UE to continue measuring the cell(s) in source system during a period of time, while being connected to another system, and send periodic or single measurement reports to the node in other system. When the period of time indicated by the node in source system expires, the RAN node in the other system, may evaluate the received measurement reports with the coverage/quality condition received during the inter-system HO procedure and decide if an inter-system unnecessary HO report should be sent to the gNB in the source system.

The inter-system unnecessary HO report shall only be sent in cases where, in all UE measurement reports collected during the measurement period, any cells in the source system exceed the radio coverage and/or quality threshold (the radio threshold RSRP, RSRQ or/and SINR and the measurement period are indicated in the additional coverage and quality information in the Handover Preparation procedure). If an inter-system handover towards 5GS is executed from EPS within the indicated measurement period, the measurement period expires. In this case, the eNB in EPS may also send the HO Report. No HO Report shall be sent in case no NR cell could be included, or if the indicated period of time is interrupted by an inter-system handover to a system different than 5GS.

The RAN node in the source system (5GS) upon receiving of the report, can decide if/how its parameters (e.g., threshold to trigger Inter-system HO) should be adjusted.

#### 15.X.2.4 Inter-system Ping-pong

One of the functions of Mobility Robustness Optimization is to detect ping-pongs that occur in inter-system environment. The problem is defined as follows:

- A UE is handed over from a cell in a source system (e.g. 5GS) to a cell in a target system different from the source system (e.g. EPS), then within a predefined limited time the UE is handed over back to a cell in the source system, while the coverage of the source system was sufficient for the service used by the UE. The event may occur more than once.

The solution for the problem may consist of the following steps:

1) Statistics regarding inter-system ping-pong occurrences are collected by the responsible node.

2) Coverage verification is performed to check if the mobility to other system was inevitable.

The statistics regarding ping-pong occurrence may be based on evaluation of the *UE History Information* IE in the HANDOVER REQUIRED message. If the evaluation indicates a potential ping-pong case and the source NG\_RAN node of the 1st inter-system handover is different than the target NG-RAN node of the 2nd inter-system handover, the target NG-RAN node may use the HANDOVER REPORT message or the UPLINK RAN CONFIGURATION TRANSFER message to indicate the occurrence of potential ping-pong cases to the source NG-RAN node.

If NG-RAN coverage during the potential ping-pong event needs to be verified for the purpose of determining corrective measures, the Unnecessary HO to another system procedure may be used

#### 15.X.2.5 O&M Requirements

All automatic changes of the HO and/or reselection parameters for mobility robustness optimisation shall be within the ranges allowed by OAM and specified below.

The following control parameters shall be provided by OAM to control MRO behaviour:

- Maximum deviation of Handover Trigger
 This parameter defines the maximum allowed absolute deviation of the Handover Trigger, from the default point of operation defined by the parameter values assigned by OAM.

- Minimum time between Handover Trigger changes
This parameter defines the minimum allowed time interval between two Handover Trigger change performed by MRO. This is used to control the stability and convergence of the algorithm.

Furthermore, in order to support the solutions for detection of mobility optimisation, the parameter Tstore\_UE\_cntxt shall be configurable by the OAM system.

### 15.X.3 Support for RACH Optimization

RACH optimization is supported by UE reported information made available at the NG RAN node and by PRACH parameters exchange between NG RAN nodes.

The contents of the RACH information report comprise of the following:

* Contention detection indication per RACH attempt
* Indexes of the SSBs and number of RACH preambles sent on each tried SSB listed in chronological order of attempts.
* Indication whether the selected SSB is above or below the *rsrp-ThresholdSSB* threshold per RACH attempt.

#### 15.X.4 UE History Information from the UE

The source NG-RAN node collects and stores the UE History Information for as long as the UE stays in one of its cells.

The UE may report the UE history information when connecting to a cell of the NG-RAN node.

When information needs to be discarded because the list is full, such information will be discarded in order of its position in the list, starting with the oldest cell record. If the list is full, and the UE history information from the UE is available, the UE history information from the UE should also be discarded.

The resulting information is then used in subsequent handover preparations by means of the Handover Preparation procedures over the NG and XN interfaces, which provide the target NG-RAN node with a list of previously visited cells and associated (per-cell) information elements. The Handover Preparation procedures also trigger the target NG-RAN node to start collection and storage of UE history Information and thus to propagate the collected information.

**--------------------------------------------------End of the change-----------------------------------------------------**