**3GPP TSG-RAN3 Meeting #108-e R3-20xxxx**

**E-meeting, 1-11 June, 2020**

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| *CR-Form-v12.0* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **36.300** | **CR** |  | **rev** |  | **Current version:** | **16.1.0** |  |
|  | | | | | | | | |
| *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 | **X** |

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| ***Title:*** | Addition of SON features | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, Nokia, Nokia Shanghai Bell, ? | | | | | | | | | |
| ***Source to TSG:*** | RAN3 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_SON\_MDT-Core | | | | |  | ***Date:*** | | | 2020-06-18 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | *Rel-16* |
|  | *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 can be 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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | It was agreed to introduce inter-system ping-pong MRO for LTE, MLB for EN-DC, and cross-system reporting of connection failure due to intra-LTE mobility. | | | | | | | | |
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| ***Summary of change:*** | | Add the general descriptions for inter-system ping-pong MRO for LTE, and MLB for EN-DC. Describe the case of RLF Report being received in an NG-RAN node. | | | | | | | | |
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| ***Consequences if not approved:*** | | The general description is missing and the specification is incomplete. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 22.4.1.2, 22.4.1.2.X(new), 22.4.2.1, 22.4.2.2, 22.4.2.X(new) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 36.413 CR 1710  TS 36.423 CR 1373  TS 38.300 CR  TS 38.401 CR 0116  TS 38.413 CR 0237  TS 38.420 CR 0019  TS 38.423 CR 0221  TS 38.460 CR 0031  TS 38.463 CR 0142  TS 38.470 CR 0064  TS 38.473 CR 0441 | | |
| ***affected:*** | |  | **x** | Test specifications | | | | TS/TR ... CR ... | | |
| ***(show related CRs)*** | |  | **x** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | - RAN3#107b: added the agreed R3-202865  - Resubmitted to RAN3#108e  - RAN3#108: added the agreed R3-203232, Editorial: fixed reference | | | | | | | | |

*Start of the change*

### 22.4.1 Support for Mobility Load Balancing

#### 22.4.1.1 General

The objective of load balancing is to distribute cell load evenly among cells or to transfer part of the traffic from congested cells. This is done by the means of self-optimisation of mobility parameters or handover actions.

Self-optimisation of the intra-LTE and inter-RAT mobility parameters to the current load in the cell and in the adjacent cells can improve the system capacity compared to static/non-optimised cell reselection/handover parameters. Such optimisation can also minimize human intervention in the network management and optimization tasks.

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.

Triggering of each of these functions is optional and depends on implementation. Functional architecture is presented in Figure 22.4.1.1-1.



Figure 22.4.1.1-1: Functional architecture of SON load balancing

#### 22.4.1.2 Load reporting

The load reporting function is executed by exchanging cell specific load information between neighbour eNBs over the X2 interface (intra-LTE scenario) or S1 (inter-RAT scenario and EN-DC scenario).

##### 22.4.1.2.1 Load reporting for intra-LTE scenario

The load information consists of:

- radio resource usage (UL/DL GBR PRB usage, UL/DL non-GBR PRB usage, UL/DL total PRB usage);

- HW load indicator (UL/DL HW load: low, mid, high, overload);

- TNL load indicator (UL/DL TNL load: low, mid, high, overload);

- (Optionally) Cell Capacity Class value (UL/DL relative capacity indicator: the same scale shall apply to E-UTRAN, UTRAN and GERAN cells when mapping cell capacities on this value);

- Capacity value (UL/DL available capacity for load balancing as percentage of total cell capacity).

NOTE 1: Capacity value is expressed in available E-UTRAN resources.

NOTE 2: A cell is expected to accept traffic corresponding to the indicated available capacity.

##### 22.4.1.2.2 Load reporting for inter-RAT scenario

The load information consists of:

- Cell Capacity Class value (UL/DL relative capacity indicator: the same scale shall apply to E-UTRAN, UTRAN, GERAN and eHRPD cells when mapping cell capacities on this value);

- Capacity value (UL/DL available capacity for load balancing as percentage of total cell capacity).

NOTE 1: Capacity value is expressed in available E-UTRAN resources.

NOTE 2: A cell is expected to accept traffic corresponding to the indicated available capacity.

Event-triggered inter-RAT load reports are sent when the reporting node detects crossing of cell load thresholds.

Load information shall be provided in a procedure separated from existing active mode mobility procedures, which shall be used infrequently and with lower priority with respect to the UE dedicated signalling.

##### 22.4.1.2.X Load reporting for EN-DC scenario

The load reporting function is executed by the way that an en-gNB provides its load information toward an eNB over the X2 interface.

For an NR cell, the following load related information should be supported which consists of:

- Radio resource usage (per-SSB-area PRB usage: DL/UL/SUL GBR PRB usage, DL/UL/SUL non-GBR PRB usage, DL/UL/SUL total PRB usage, and DL/UL/SUL 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 (UL/DL available capacity);

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

#### 22.4.1.3 Load balancing action based on handovers

The source cell may initiate handover due to load (see clauses 10.1.2 and 10.2.2). The target cell performs admission control for the load balancing handovers. A handover preparation related to a mobility load balancing action shall be distinguishable from other handovers, so that the target cell is able to apply appropriate admission control.

#### 22.4.1.4 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.

*Next change*

### 22.4.2 Support for Mobility Robustness Optimisation

#### 22.4.2.1 General

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

- Connection failure due to intra-LTE or inter-RAT mobility;

- Unnecessary HO to another RAT (too early IRAT HO with no radio link failure);

- Inter-RAT ping-pong;

- Inter-system ping-pong.

#### 22.4.2.2 Connection failure due to intra-LTE mobility

One of the functions of Mobility Robustness Optimisation 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:

- [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.

- [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.

- [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.

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

Solution for failure scenarios consists of one or more of following functions:

- Detection of the failure after RRC re-establishment attempt;

- Detection of the failure after RRC connection setup;

- Retrieval of information needed for problem analysis.

Triggering of each of these functions is optional and depends on situation and implementation.

**Detection of the failure after RRC re-establishment attempt:**

Detection mechanisms for Too Late Handover, Too Early Handover and Handover to Wrong Cell are carried out through the following:

- [Too Late Handover]  
If the UE attempts to re-establish the radio link connection in a cell that belongs to eNB B, indicating as the last serving cell a cell belonging to eNB A, different from eNB B, then eNB B may report this event to eNB A by means of the RLF Indication Procedure. eNB A may then use information in the RLF INDICATION message to determine whether the failure occurred in the serving cell.

- [Too Early Handover]  
If the target cell belongs to an eNB B different from the eNB A that controls the source cell, the eNB B may send a HANDOVER REPORT message indicating a Too Early Handover event to eNB A upon eNB B receives an RLF INDICATION message from eNB A and if eNB B has sent the UE CONTEXT RELEASE message to eNB A related to the completion of an incoming handover for the same UE within the last Tstore\_UE\_cntxt seconds or there exists a prepared handover for the same UE in eNB B.

- [Handover to Wrong Cell]  
If the type of the failure is Radio Link Failure and the target cell belongs to eNB B that is different from the eNB A that controls the source cell, the eNB B may send a HANDOVER REPORT message indicating a Handover To Wrong Cell event to eNB A upon eNB B receives an RLF INDICATION message from eNB C, and if eNB B has sent the UE CONTEXT RELEASE message to eNB A related to the completion of an incoming handover for the same UE within the last Tstore\_UE\_cntxt seconds or there exists a prepared handover for the same UE in eNB B. This also applies when eNB A and eNB C are the same. The HANDOVER REPORT message may also be sent if eNB B and eNB C are the same and the RLF Indication is internal to this eNB.   
If the type of the failure is Handover Failure during a handover from a cell in eNB A, and the UE attempts to re-establish the radio link connection to a cell in eNB C, then eNB C may send a RLF INDICATION message to eNB A.

The detection of the above events, when involving more than one eNB, is enabled by the RLF Indication, Handover Report and MME Configuration Transfer procedures.

The RLF Indication procedure may be initiated after a UE attempts to re-establish the radio link connection at eNB B after a failure at eNB A. The RLF INDICATION message sent from eNB B to eNB A shall contain the following information elements:

- Failure Cell ID: PCI of the cell in which the UE was connected prior to the failure occurred;

- Reestablishment Cell ID: ECGI of the cell where RL re-establishment attempt is made;

- C-RNTI: C-RNTI of the UE in the cell where UE was connected prior to the failure occurred;

- shortMAC-I (optionally): the 16 least significant bits of the MAC-I calculated using the security configuration of the source cell and the re-establishment cell identity;

- UE RLF Report Container (optionally): the RLF Report received from the UE, as specified in TS 36.331 [16];

- Reestablishment Cause (optionally): provided by the UE during the RRC connection re-establishment attempt.

eNB B may initiate RLF Indication towards multiple eNBs if they control cells which use the PCI signalled by the UE during the re-establishment procedure. The eNB A 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.

The Handover Report procedure is used in the case of recently completed handovers, when a failure occurs in the target cell (in eNB B) shortly after it sent the UE Context Release message to the source eNB A. The Handover Report procedure is also used when an RLF occurs before the UE Context Release message is sent, if the random access procedure in the target cell was completed successfully. The HANDOVER REPORT message contains the following information:

- Type of detected handover problem (Too Early Handover, Handover to Wrong Cell);

- ECGI of source and target cells in the handover;

- ECGI of the re-establishment cell (in the case of Handover to Wrong Cell);

- Handover cause (signalled by the source during handover preparation);

- C-RNTI allocated for the UE in the source cell (if available);

- Mobility Information (optionally);

- UE RLF Report (optionally): the RLF Report received from the UE and forwarded in the RLF INDICATION message.

UE may provide the RLF Report to the eNB after successful RRC re-establishment. The radio measurements contained in the RLF Report may be used e.g. to identify coverage issues as the potential cause of the failure. The cause for the RLF contained in the RLF Report may be used to identify the cause of the failure and exclude the events that are irrelevant for MRO evaluation.

**Detection of the failure after RRC connection setup:**

In case the RRC re-establishment fails or the UE does not perform any RRC re-establishment, the UE makes the RLF Report available to the eNB after reconnecting from idle mode. The RLF Report is described in clause 22.4.5. Availability of the RLF Report at the RRC connection setup procedure is the indication that the UE suffered from a connection failure and that the RLF Report from this failure was not yet delivered to the network. The RLF Report from the UE includes the following information:

- The E-CGI of the last cell that served the UE (in case of RLF) or the target of the handover (in case of handover failure). If the E-CGI is not known, the PCI and frequency information are used instead.

- E-CGI of the cell that the re-establishment attempt was made at.

- E-CGI of the cell that served the UE at the last handover initialisation, i.e. when message 7 (*RRCConnectionReconfiguration*) was received by the UE, as presented in Figure 10.1.2.1.1-1.

- Time elapsed since the last handover initialisation until connection failure.

- An indication whether the connection failure was due to RLF or handover failure.

- The radio measurements.

- C-RNTI allocated for the UE in the last serving cell.

- RLF trigger of the last RLF that was detected.

- Time elapsed from the connection failure till RLF Report signalling.

The eNB receiving the RLF Report from the UE may forward the report to the eNB that served the UE before the reported connection failure using the RLF INDICATION message. In case the RLF Report is received in an NG-RAN node (as defined in TS 38.300 [79]), it may be delivered to the eNB that served the UE before the reported connection failure using the MME Configuration Transfer procedure. The radio measurements contained in the RLF Report may be used e.g. to identify coverage issues as the potential cause of the failure. The cause for the RLF contained in the RLF Report may be used to identify the cause of the failure and exclude the irrelevant events that are irrelevant for MRO evaluation.

Detection of Too Late Handover, Too Early Handover and Handover to Wrong Cell is carried out through the following:

- [Too Late Handover]  
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.

- [Too Early Handover]  
There is a recent 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 re-establishment attempt cell is the cell that served the UE at the last handover initialisation.

- [Handover to Wrong Cell]  
There is a recent 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 re-establishment attempt cell 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 initialised 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 eNB receiving the RLF INDICATION message may use the HANDOVER REPORT message to inform the eNB controlling the cell where the mobility configuration caused the failure.

**Retrieval of information needed for problem analysis**

The information needed for detailed problem analysis may be retrieved from both, the UE and the network sides. The information that is collected at the UE is provided to the network with the RLF Report, which may be forwarded to the last serving node in the RLF INDICATION message and, in case of "Too Early HO" or "HO to Wrong Cell", further in the HANDOVER REPORT message.

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 eNB controlling the last serving cell shall, if supported, include in the HANDOVER REPORT message the C-RNTI used in the source cell of the last completed handover before the failure. If the eNB controlling that source cell provided the Mobility Information, it is included in the HANDOVER REPORT message. If used, the Mobility Information is prepared at the source eNB of a handover and may refer to or identify any handover-related data at this eNB.

**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-LTE mobility connection failures may be triggered twice for the same failure event. In this case, only one failure event should be counted.

#### 22.4.2.X 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. E-UTRAN) to a cell in a target system different from the source system (e.g. NG-RAN), 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 E-UTRAN node of the 1st inter-system handover is different than the target E-UTRAN node of the 2nd inter-system handover, the target E-UTRAN node may use the HANDOVER REPORT message to indicate the occurrence of potential ping-pong cases to the source E-UTRAN node.

*End of the change*