**3GPP TSG-SA5 Meeting #155 *S5-243277***

Jeju, Korea, 27 - 31 May 2024

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **28.552** | **CR** | **0578** | **rev** | **1** | **Current version:** |  |  |
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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:*** | Add measurements for MLB related handover | | | | | | | | | |
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| ***Source to WG:*** | Intel | | | | | | | | | |
| ***Source to TSG:*** | S5 | | | | | | | | | |
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| ***Work item code:*** | PM\_KPI\_5G\_Ph4 | | | | |  | ***Date:*** | | | 2024-05-17 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | B |  | | | | | ***Release:*** | | | Rel-19 |
|  | *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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
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| ***Reason for change:*** | | As defined in TS 38.300 [49], MLB aims 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. MLB can be done by means of optimization of cell reselection/handover parameters and handover actions. MLB may be supported by the legacy hard-coded design or by AI/ML capabilities.  For the handover actions triggred by MLB, the handover may succeed or fail, which will impact user’s experience. The improper handover parameters settings for MLB may cause the same issues that MRO is dealing with, such as too early or too late handover, handover to wrong cell, ping-pong handover.  Therefore, the performance of MLB related handovers for handover failures needs to be monitored to evaluate the MLB function, and the associated AI/ML model(s) if they are used. | | | | | | | | |
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| ***Summary of change:*** | | Added measurements related to MLB;  Added use case for monitoring the MLB | | | | | | | | |
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| ***Consequences if not approved:*** | | The MLB related handovers cannot be monitored. | | | | | | | | |
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| ***Clauses affected:*** | | 5.1.1.x (new), A.x (new) | | | | | | | | |
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|  | | **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:*** | |  | | | | | | | | |

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| **First modified section** |

#### 5.1.1.x Measurements related to MLB

##### 5.1.1.x.1 Inter-gNB handovers for MLB

###### 5.1.1.x.1.1 Number of requested inter-gNB handover preparations for MLB

a) This measurement provides the number of handover preparations requested by the source gNB CU for MLB.

b) CC.

c) On transmission of HANDOVER REQUIRED message (see TS 38.413 [11]) by the gNB CU to the AMF, or transmission of HANDOVER REQUEST message (see TS 38.423 [13]) by the source gNB CU to target the target gNB CU, where the message contains the cause IE set to “Reduce Load in Serving Cell” or “Resource Optimisation Handover”. Each message increments the relevant subcounter per cause by 1.

d) Each measurement is an integer value.

e) MM.HoPrepInterReqMLB.ResOpt;  
MM.HoPrepInterReqMLB.RedLoad;

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.1.2 Number of successful inter-gNB handover preparations for MLB

a) This measurement provides the number of successful handover preparations for MLB received by the source gNB CU.

b) CC.

c) On receipt of HANDOVER COMMAND message by the gNB CU from the AMF (see TS 38.413 [11]), or receipt of HANDOVER REQUEST ACKNOWLEDGE message (see TS 38.423 [13]) from the target gNB CU, indicating that the resources for the handover have been prepared at the target NR cell CU, where the message corresponds to a previously requested inter-gNB handover preparations for MLB (see clause 5.1.1.x.1.1).

d) Each measurement is an integer value.

e) MM.HoPrepInterSuccMLB.ResOpt;  
MM.HoPrepInterSuccMLB.RedLoad;

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.1.3 Number of failed inter-gNB handover preparations for MLB

a) This measurement provides the number of failed handover preparations received by the source gNB CU for MLB. This measurement is split into subcounters per failure cause.

b) CC.

c) On receipt of HANDOVER PREPARATION FAILURE message (see TS 38.413 [11]) by the gNB CU from the AMF, or receipt of HANDOVER PREPARATION FAILURE message (see TS 38.423 [13]) from the target gNB CU, indicating that the preparation of resources at the target NR cell CU has failed, where the message corresponds to a previously requested inter-gNB handover preparations for MLB (see clause 5.1.1.x.1.1). Each message increments the relevant subcounter per failure cause by 1.

d) Each subcounter is an integer value.

e) MM.HoPrepInterFailMLB.*cause;*Where *cause* identifies the failure cause of the handover preparations for MLB.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.1.4 Number of requested inter-gNB handover executions for MLB

a) This measurement provides the number of outgoing inter-gMB handover executions requested by the source gNB for MLB.

b) CC.

c) On transmission of *RRCReconfiguration* message to the UE requesting the inter-gNB handover from the source gNB CU to the target gNB CU (see TS 38.331 [20]), corresponding to the previously requested inter-gNB handover preparations for MLB (see clause 5.1.1.x.1.1).

d) Each measurement is an integer value.

e) MM.HoExeInterReqMLB.ResOpt;  
MM.HoExeInterReqMLB.RedLoad.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.1.5 Number of successful inter-gNB handover executions for MLB

a) This measurement provides the number of successful inter-gNB handover executions for MLB received by the source gNB.

b) CC.

c) On receipt at the source gNB of UE CONTEXT RELEASE [13] over Xn from the target gNB following a successful inter-gNB handover for MLB; or, if handover is performed via NG, on receipt of UE CONTEXT RELEASE COMMAND [11] from AMF following a successful inter-gNB handover for MLB, where the message denotes a handover corresponding to the a previously requested inter-gNB handover executions for MLB (see clause 5.1.1.x.1.4).

d) Each measurement is an integer value.

e) MM.HoExeInterSuccMLB.ResOpt;  
MM.HoExeInterSuccMLB.RedLoad.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.1.6 Number of failed inter-gNB handover executions for MLB

a) This measurement provides the number of failed inter-gNB handover executions at a source gNB for MLB.

b) CC.

c) This counter is incremented when failure occurs for the handover execution triggered by MLB. It is assumed that the UE context is available in the source gNB. The following events corresponds to a previously requested inter-gNB handover executions for MLB (see clause 5.1.1.x.1.4):

1) On reception of NGAP UE CONTEXT RELEASE COMMAND [11] from AMF indicating an unsuccessful inter gNB handover;

2) On reception of RrcReestablishmentRequest [20] where the reestablishmentCause is handoverFailure, from the UE in the source gNB, where the reestablishment occurred in the source gNB;

3) On expiry of a Handover Execution supervision timer in the source gNB;

4) On reception of XnAP RETRIEVE UE CONTEXT REQUEST [13] in the source gNB, when the reestablishment occurred in another gNB.

The failure causes for UE CONTEXT RELEASE COMMAND are listed in [11] clause 9.3.1.2, this message increments the relevant subcounter per failure cause by 1.

As one handover failure might cause more than one of the above events, duplicates need to be filtered out.

d) Each subcounter is an integer value.

e) MM.HoExeInterFailMLB.UeCtxtRelCmd.*cause;*MM.HoExeInterFailMLB.RrcReestabReq;  
MM.HoExeInterFailMLB.HoExeSupTimer;  
MM.HoExeInterFailMLB.RetrUeCtxtReq.

Where *cause* identifies the failure cause of the UE CONTEXT RELEASE COMMAND message.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

##### 5.1.1.x.2 Intra-gNB handovers for MLB

###### 5.1.1.x.2.1 Number of requested intra-gNB handover executions for MLB

a) This measurement provides the number of outgoing intra-gNB handover executions triggered by MLB.

b) CC.

c) On transmission of *RRC Reconfiguration* message triggred by MLB to the UE requesting the handover from the source NRCellCU to the target NRCellCU (see TS 38.331 [20]).

d) A single integer value.

e) MM.HoExeIntraReqMLB.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

###### 5.1.1.x.2.2 Number of successful intra-gNB handover executions for MLB

a) This measurement provides the number of successful intra-gNB handover executions for MLB received by the source NRCellCU.

b) CC.

c) On reception of *RRC ReconfigurationComplete* message from the UE to the target NRCellCU indicating a successful intra-gNB handover (see TS 38.331 [20]) corresponding to a handover execution request triggered by MLB (see clause 5.1.1.x.2.1).

d) A single integer value.

e) MM.HoExeIntraSuccMLB.

f) NRCellCU;  
NRCellRelation.

g) Valid for packet switched traffic.

h) 5GS.

##### 5.1.1.x.3 Classified handovers for MLB

###### 5.1.1.x.3.1 Classified handover failures caused by intra-system MLB

a) This measurement provides the number of classified handover failure events detected during the intra-system MLB within 5GS. The measurement includes separate subcounters for various handover failure types, classified as "Intra-system too early handover", "Intra-system too late handover" and "Intra-system handover to wrong cell", see TS 38.300 [49] clause 15.5.2.

b) CC.

c) The measurements of too early handovers, too late handovers and handover to wrong cell events are obtained respectively by accumulating the number of failure events detected by gNB during the intra-system MLB within 5GS, see TS 38.300 [49].

d) Each measurement is an integer value.

e) HO.IntraSysMLB.TooEarly  
 HO.IntraSysMLB.TooLate  
HO.IntraSysMLB.ToWrongCell

f) NRCellCU  
NRCellRelation

g) Valid for packet switched traffic.

h) 5GS.

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| **Next modified section** |

# A.x Monitoring of MLB performance

As defined in TS 38.300 [49], MLB aims 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. MLB can be done by means of optimization of cell reselection/handover parameters and handover actions. MLB may be supported by the legacy hard-coded design or by AI/ML capabilities.

For the handover actions triggered by MLB, the handover may succeed or fail, which will impact user’s experience. The improper handover parameters settings for MLB may cause the same issues that MRO is dealing with, such as too early or too late handover, handover to wrong cell, ping-pong handover.

Therefore, the performance of MLB related handovers for handover failures needs to be monitored to evaluate the MLB function, and the associated AI/ML model(s) if they are used.