**3GPP TSG RAN meeting #104 RP-240xxx**

**Shanghai, China, June 17-20, 2024**

*NOTE: RAN specific additions are added in blue.*

**Source: Apple Inc, China Telecom**

**Title: Revised Work Item: NR mobility enhancements Phase 4**

**Document for: Approval**

**Agenda Item: 9.3.2.1**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

Title: NR mobility enhancements Phase 4

Acronym: NR\_Mob\_Ph4

Unique identifier: 1020091

NOTE: For new WIs/SIs leave the Unique identifier empty and make a proposal for an Acronym.

 For a revised WI/SI: Take Unique identifier and acronym as shown in 3GPP workplan.

 If this is a RAN WID including Core and Perf. part, then Title, Acronym and Unique identifier refer to the feature WI.

 Please tick (X) the applicable box(es) in the table below:

 Either:

|  |  |
| --- | --- |
| **This WID includes a Core part** | **X** |
| **This WID includes a Performance part** | **X** |

 or:

|  |  |
| --- | --- |
| **This WID includes a Testing part** |  |
| **and it addresses the following 3GPP work area:** | **Radio Access** |  |
| **Core Network** |  |
| **Services** |  |

Potential target Release: Rel-19

NOTE: In case of contradiction with the target dates of clause 5, clause 5 determines the target release.

# 1 Impacts

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Affects:** | UICC apps | ME | AN | CN | Others (specify) |
| **Yes** |  | X | X |  |  |
| **No** | X |  |  | X |  |
| **Don't know** |  |  |  |  |  |

# 2 Classification of the Work Item and linked work items

### 2.1 Primary classification

This description is either a …

|  |  |
| --- | --- |
|  | Study Item |

or a

|  |
| --- |
| Normative Work Item:*tick applicable boxes below* |
|  | Stage 1 |
| X | Stage 2 |
| X | Stage 3 |
|  | Other (e.g. testing) |

### 2.2 Parent Work Item

For a brand-new topic, use “N/A” in the table below. Otherwise indicate the parent Work Item.

|  |
| --- |
| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

NOTE: RAN agreed some time ago, that it describes the feature WI + Core/Perf. part WI or Testing part WI in one WID. Therefore the table above should include the feature WI data (In case the feature covers Core and Perf. part, please list under Working Group the leading WG of the Core part).

### 2.3 Other related Work Items and dependencies

|  |
| --- |
| Other related Work/Study Items (if any) |
| **Acronym** | Unique ID | Title | Nature of relationship |
| NR\_mob\_enh2 | 940098 | Further NR Mobility Enhancements | WI for Mobility Enhancements in previous release (Rel-18) |
|  |  |  |  |

NOTE: Also related or dependent WIs/SIs in other TSGs shall be indicated here.

**Dependency on non-3GPP (draft) specification**:

# 3 Justification

Layer 1/Layer 2 Triggered mobility (LTM) was introduced in Rel-18 and can offer improvements in handover latency and interruption time compared to Layer 3 based mobility. However, LTM as introduced in Rel-18 also has a number of limitations compared to Layer 3 mobility. This Rel-19 work item aims to remove a number of these limitations.

LTM operation is only supported for mobility between cells of the same gNB (same CU). Depending on the deployment of the network this may significantly limit the opportunities to use LTM. By enabling LTM operation between cells of different gNBs (i.e. inter-CU) then the network will be able gain the benefits of LTM for a far greater number of handovers.

Layer 3 mobility uses layer 3 measurement reporting which supports UE evaluated events for triggering of measurement reports and reduces signalling overhead compared to periodic measurement reporting. Such event triggering is not supported by the L1 measurements that are used for LTM mobility.

L1 measurements for LTM procedures are limited to SSB measurements. Expanding L1 measurements to include CSI-RS can address this limitation and can be expected to enable greater throughput on the target cell immediately after cell switch.

Layer 3 mobility has evolved over several releases. Conditional handover (CHO) and other conditional mobility procedures (CPAC, SCPAC) were developed to achieve high robustness by enabling the procedure to be executed without necessitating a signalling exchange with source cell beforehand. LTM as introduced in Rel-18 offers short interruption time but not with the same level of robustness as the conditional L3 mobility procedures. In Rel-19, enhancements should be specified so that the system can benefit from both the high robustness and short interruption.

# 4 Objective

### 4.1 Objective of SI or Core part WI or Testing part WI

* Specify support for inter-CU Layer1/Layer 2 Triggered Mobility (LTM) [RAN2, RAN3]
	+ Prioritize the case when CU is acting as MN when DC is not configured
	+ When DC is configured with inter-CU LTM configured either in MN or in SN but not both at the same time:
		- As secondary priority, support the case where CU is acting as SN and MN is unchanged
		- As secondary priority, support the case where CU is acting as MN and SN is unchanged or SN is released
	+ Specify support for subsequent LTM mobility procedures aiming to avoid RRC configuration between cell switches as per Rel-18 LTM
		- Coordination with SA3 needed with respect to security key handling
	+ Note: Rel. 18 intra-CU LTM procedure is considered as baseline for adding inter-CU support
* Measurements related enhancements for purpose of supporting LTM: [RAN2, RAN1]
	+ Measurement related enhancements are applicable to Intra-CU MCG/SCG LTM and Inter-CU MCG/SCG LTM
	+ Specify necessary components to support event triggered L1 measurement reporting [RAN2, RAN1]
		- RAN1 and RAN2 to progress independently on the event triggered measurements objectives of their respective MIMO and Mobility enhancement WIs. Review progress at RAN#105 to see if any modification of objectives is required to avoid/manage any overlap in the work
	+ Specify support for CSI-RS measurements for LTM procedures and enable CSI-RS based beam management, and/or other necessary physical layer operations on candidate cells before LTM [RAN1]
* Specify support of conditional LTM [RAN2, RAN3, RAN1]
	+ Specify UE evaluated conditions for triggering LTM
	+ Aim to support conditional LTM including subsequent LTM
	+ Prioritise intra-CU LTM
	+ Checkpoint to review objective at RAN#105. RAN WG work to not start before this checkpoint
* Specify RRM requirements related to the above objectives as necessary [RAN4]

### 4.2 Objective of Performance part WI

NOTE: Leave empty if the WI proposal does not contain a RAN performance part.

* Specify RRM performance requirements related to the core objectives as necessary [RAN4]

### 4.3 RAN time budget request (not applicable to RAN5 WIs/SIs)

NOTE: For all new RAN related WIs/SIs which are not led by RAN WG5 the WI/SI rapporteur has to fill out the attached Excel table to request time budgets for corresponding RAN WG meetings.
The Excel table has to be filled out for all affected RAN WGs and up to the target date of the WI/SI.
One time unit (TU) corresponds to ~ 2 hours in the meeting.
If no TU is needed, then leave the field empty otherwise enter a number >0 in the field.

 For revisions of already approved WI/SI descriptions: Please remove the Excel table from the WID/SID's zip file. The time budgets are already recorded. If you want to modify them, then this has to be done via the status report and not via a revised WID/SID.

 If this WID is covering Core and Performance part, then please fill out one line for each part in the attached Excel table.

**additional comments to the time budget request in the attached Excel table:**

# 5 Expected Output and Time scale

|  |
| --- |
| **New specifications** *{One line per specification. Create/delete lines as needed}* |
| Type  | TS/TR number | Title | For info at TSG#  | For approval at TSG# | Remarks |
|  |  |  |  |  |  |

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
By default a new specs can only be new for one of both parts.

|  |
| --- |
| **Impacted existing TS/TR** *{One line per specification. Create/delete lines as needed}* |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
| 38.331 | NR RRC signalling changes to support mobility enhancements | RAN#109 | Core part |
| 38.306 | Necessary UE capabilities to support mobility enhancements | RAN#109 | Core part |
| 38.300 | Possible changes to NR Stage-2 specification | RAN#109 | Core part |
| 37.340 | Possible changes to MR-DC Stage-2 specification | RAN#109 | Core part |
| 38.321 | Possible changes to NR MAC specification | RAN#109 | Core part |
| 38.401 | Possible changes to NG-RAN architecture description | RAN#109 | Core Part |
| 38.413 | Possible changes to NR Stage 3 NG-AP to support mobility enhancements | RAN#109 | Core part |
| 38.420 | Possible changes to NR Stage 2 Xn-AP to support mobility enhancements | RAN#109 | Core part |
| 38.423 | Possible changes to NR Stage 3 Xn-AP to support mobility enhancements | RAN#109 | Core part |
| 38.470 | Possible changes to NR Stage 2 F1-AP to support mobility enhancements | RAN#109 | Core part |
| 38.473 | Possible changes to NR Stage 3 F1-AP to support mobility enhancements | RAN#109 | Core part |
| 37.483 | Possible changes to NR Stage 3 E1-AP to support mobility enhancements | RAN#109 | Core part |
| 38.212 | Possible changes to introduce L1/L2 mobility enhancements | RAN#108 | Core part |
| 38.213 | Possible changes to introduce L1/L2 mobility enhancements | RAN#108 | Core part |
| 38.214 | Possible changes to introduce L1/L2 mobility enhancements | RAN#108 | Core part |
| 38.133 | Requirements to support mobility enhancements | RAN#109 | Core part |
| 38.133 | Requirements to support mobility enhancements | RAN#111 | Performance part |

NOTE: If this is a RAN WI including Core and Perf. part, then all new Core part specs have to be listed first and then all new Perf. part specs. Indicate "Core part" or "Perf. part" under Remarks for each spec.
If an existing spec is affected by both (Core part and Perf. part), then it has to be listed twice with appropriate approval dates.

# 6 Work item Rapporteur(s)

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NOTE: The first listed Rapporteur has the overall responsibility for this WI (incl all secondary tasks).

# 7 Work item leadership

Primary WG: RAN2

Secondary WGs: RAN1, RAN3, RAN4

# 8 Aspects that involve other WGs

NOTE: For RAN WIs: Section 8 applies only toWGs outside of TSG RAN because all RAN WG aspects have to be covered in section 4.

Coordination with SA3 needed with respect to security key handling for subsequent LTM procedures aiming to avoid RRC configuration between cell switches as per Rel-18 LTM. Coordination expected to be initiated by RAN2 via LS.

# 9 Supporting Individual Members

*{At least 4 supporting Individual Members are needed. There is an expectation that these companies will provide resources to progress the work. Note that having 4 supporting companies is a necessary but not sufficient condition: the usual TSG approval process by consensus is needed for the WID approval.}*

|  |
| --- |
| Supporting IM name |
| LG Electronics |
| Fujitsu |
| NEC |
| Huawei |
| HiSilicon |
| CATT |
| Transsion Holdings |
| MediaTek Inc. |
| Intel Corporation |
| SONY |
| FGI |
| InterDigital |
| Sharp |
| Lenovo  |
| Motorola Mobility |
| NTT DOCOMO |
| Apple Inc |
| Nokia |
| Nokia Shanghai Bell |
| Ericsson |
| Verizon |
| Xiaomi |
| Spreadtrum Communications |
| OPPO |
| China Telecom |
| vivo |
| Qualcomm |
| ZTE Corporation |
| Sanechips |
| Telefónica  |
| Samsung |
| Futurewei |
| Semtech |
| CMCC |
| ITRI |
| Kyocera |
| KT Corp |
| Deutsche Telekom |
| Vodafone |
| HONOR |
| New H3C |
| Ruijie Networks |
| TCL |
| China Unicom |
| KDDI |
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