**3GPP TSG RAN Meeting #109 RP-25xxxx**

**Beijing, China, Sept. 15-18, 2025**

**Source: OPPO, Interdigital**

**Title: Revised WI: Artificial Intelligence (AI)/Machine Learning (ML) for mobility in NR**

**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: Artificial Intelligence (AI)/Machine Learning (ML) for mobility in NR

Acronym: NR\_AIML\_Mob

Unique identifier: 1081087

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-20*

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) |
| FS\_NR\_AIML\_Mob | RAN WG2, RAN WG4 | 1020084 | Study on AI (Artificial Intelligence)/ML (Machine Learning) for mobility in NR |

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\_AIML\_air | 1020093 | WID on Artificial Intelligence (AI)/Machine Learning (ML) for NR Air Interface | *the solution on LCM procedure in this work item can be digested for NR\_AIML\_Mob* |

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

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

# 3 Justification

Legacy L3 handover scheme based on historical measurement result(s) and/or event(s) could be problematic when e.g. either UE’s mobility is high and/or among micro cells of high density. Initial study shows that measurement prediction based on AI algorithm has the potential to predict measurement result(s) in future so that proactive handover scheme can help improve handover performance. Furthermore, such measurement prediction functionality can enable saving measurement efforts in either temporal domain or frequency domain. Hence in Rel19, a study item i.e. FS\_NR\_AIML\_Mob is approved to study use case for mobility within NR system.

Among 3 use cases in Rel19 study item, RRM measurement prediction and measurement event prediction for cell level measurement result are focused. Extensive simulations for RRM measurement prediction, measurement event prediction including corresponding SLS are conducted on high priority scenarios i.e. FR2 intra-frequency temporal domain case A (i.e., prediction of measurements in a prediction window by using historical actual measurements in an observation window), FR1 intra-frequency temporal domain case B (similar to case A, but predicted measurement result(s) in previous prediction window are skipped), and FR1 inter-frequency prediction.

The study on temporal domain case A is to verify the motivation i.e. how much handover performance can be improved based on predicted measurement results/event in future. For purely RRM measurement prediction, it has been observed that the performance i.e. the average L3 RSRP prediction accuracy within a certain prediction window is less than 1dB. And AI algorithm outperforms non-AI algorithm e.g. sample and hold. The performance gain against non-AI increases in more challenging scenario e.g. with higher UE speed and longer prediction window etc. The further simulation on measurement event prediction based on temporal domain case A show high F1 score, on top of which SLS indicates that HOF rate decreased quite many compared to legacy handover procedure.

The study on temporal domain case B is to verify the motivation i.e. whether the degradation of handover performance is acceptable while partial measurement is skipped. For purely RRM measurement prediction, RAN2 has observed that prediction accuracy e.g. with 50% MRRT (measurement reduction rate in temporal domain) of less than 1 dB is observed. High F1 score is observed for the measurement event prediction based on temporal domain case B and it is concluded in corresponding SLS that minor or even no handover performance degradation is observed.

The study on frequency domain prediction experiences comparable prediction accuracy for RRM measurement prediction in temporal domain. It means network could get measurement result of cells of one frequency layer without any measurement as long as co-located cells of another frequency is measured. And thus, the demand on measurement gap can be relaxed and user throughput can be improved.

Generalization aspect of the AI mobility model is evaluated for RRM measurement prediction, and it is observed that the generalization issue is minor across UE speeds and cell configurations. The inter-frequency prediction has generalization issue for GC#1. However, the model trained with mixed dataset i.e. GC#2 with knowledge of prediction direction bears close performance to baseline. It means generalization issue can be resolved with proper way. Generalization case #1(GC#1) and 2(GC#2) are described in TR 38.744 section 5.2.2.2.

After observing above mentioned evaluation performance, RAN2 carried out analysis of specification impact for solution to facilitate LCM procedure for both UE sided model and network sided model including applicability reporting, inference configuration/report, performance monitoring and data collection etc. RAN2 recommended that following scenarios and/or sub-cases for normative work on RRM measurement prediction and measurement event prediction:

- For UE sided model (RRM measurement and measurement event prediction), intra-frequency temporal domain case A, intra-frequency temporal domain case B and inter-frequency domain prediction for co-located case;

- For network sided model (RRM measurement prediction), at least RRM sub-case 2 (i.e., prediction of L3 Cell-level measurement result(s) based on actual L3 cell-level measurement results) of intra-frequency temporal domain case A for inference input report and all scenarios and sub-cases for data collection.

# 4 Objective

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

The objectives of this work item focused on AI/ML-assisted mobility in RRC\_CONNECTED mode, wherein RRM measurement prediction and measurement event prediction could be applied. Only functionality-based LCM procedures are supported. In general, the RRM measurement configuration and reporting frameworks in RRC layer are taken as baseline.

The objectives are as the following:

* Specify support for RRM measurement prediction and measurement event prediction for UE sided models [RAN2]:
* Temporal domain prediction case A and case B, and Frequency domain prediction for co-located cases are supported.
* L3 Cell level predication is supported

Note 1: For UE sided model, spatial domain prediction is not supported.

Note 2: For UE sided model, L3 beam level prediction is not supported.

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* For both RRM measurement prediction and measurement event prediction, specify signalling and protocol aspects to enable LCM functionality management for UE sided model including [RAN2]:
* UE capability request and response procedure
* Applicability report for both full and partial configuration approach
* Inference configuration and inference report
* Performance monitoring performed in UE or network side, based on which network can manage UE sided functionality
* UE sided data collection
* For measurement event prediction:
	+ Measurement event A1~A6 are in the scope in this release

Note3: Data transfer and model delivery for UE sided model are out of scope of this WI. And model related choices can be up to UE’s implementation.

* For RRM measurement prediction, specify signalling and protocol aspects to enable LCM functionality management for network sided model including [RAN2]:
* Inference input report for at least RRM sub-case 2 of intra-frequency temporal domain case A for L3 cell prediction
* Inference input report for RRM sub-case 5 of all scenarios for L3 beam level prediction
* Network sided data collection for all scenarios and all RRM sub-cases of both L3 cell level and L3 beam level prediction, at least
	+ - UE is configured to log RRM measurement results.
		- UE supports periodical logging and L3 event triggered logging.
		- UE can indicate logged data availability.

Note 4: All scenarios in this objective refer to intra-frequency domain case A and case B, inter-frequency prediction and spatial domain prediction.

Note5: The above objectives are to be based on the LCM framework for Rel-19 AI/ML for NR air interface WI as much as possible.

* For both RRM measurement prediction and measurement event prediction [RAN4]:
* Specify core requirements for the use cases and scenarios supported by the previous objectives for UE sided model
* Specify LCM-related core requirements to support the LCM functionality management for UE sided functionalities, if any

Note 6: In RAN#112 to decide whether direct event prediction will be supported depending on RAN2 and RAN4 conclusions

### 4.2 Objective of Performance part WI

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

The objectives are as the following:

For both RRM measurement prediction and measurement event prediction [RAN4]:

* Specify RRM performance requirements and test cases for the corresponding use cases
* Specify necessary performance requirements and test cases for LCM procedures, if any

### 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 |
| 38.300 | NR; NR and NG-RAN Overall Description | RAN#115 | Core part |
| 38.331 | NR; Radio Resource Control (RRC) Protocol Specification | RAN#115 | Core part |
| 38.306 | NR; User Equipment (UE) radio access capabilities | RAN#115 | Core part |
| 38.133 | NR; Requirements for support of radio resource management | RAN#115 | Core part |
| 37.320 | Radio measurement collection for Minimization of Drive Tests (MDT); Overall description;  | RAN#115 | Core part |
| 38.133 | NR; Requirements for support of radio resource management | RAN#117 | Perf 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)

Zhongda Du, OPPO, duzhongda@oppo.com

Oumer Teyeb, InterDigital, oumer.teyeb@interdigital.com

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

# 7 Work item leadership

Primary: RAN WG2

Secondary: RAN WG4

# 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.

# 9 Supporting Individual Members

|  |
| --- |
| Supporting IM name |
| OPPO |
| InterDigital |
| CATT |
| Samsung |
| Tejas Networks |
| Xiaomi |
| ZTE Corporation  |
| Sanechips |
| Spreadtrum  |
| UNISOC |
| Ofinno |
| MediaTek Inc. |
| Ericsson |
| Telefónica |
| vivo |
| NVIDIA |
| Nokia |
| ITL |
| LG Electronics |
| Kyocera Corporation |
| NEC |
| CBN |
| China Broadnet |
| Huawei |
| HiSilicon |
| Lenovo |
| Motorola mobility |
| China Telecom |
| CMCC |
| China Unicom |
| III |
| ITRI |
| Qualcomm |
| Verizon |
| Sharp |
| Intel Corporation |
| SK Telecom |
| KDDI |
| KT Corp. |
| Orange |
| ETRI |
| NTT Docomo |
| Fujitsu |
| FirstNet |
| VIAVI Solutions |
| CHTTL |
| Fraunhofer IIS  |
| Fraunhofer HHI |
| SONY |
| Transsion Holdings |
| Apple Inc. |
| Charter Communications |
| AT&T |
| BT |
| CAICT |
| HONOR |