Pro3GPP TSG-RAN WG3 Meeting #114-e Draft R3-215911

E-meeting, 1– 10 Nov, 2021

**Agenda item: 18.4.3**

**Source: CATT (moderator)**

**Title:**  **CB: # AIRAN3\_Mobility -** **Summary of email discussion**

**Document for: Approval**

# 1 Introduction

**CB: # AIRAN3\_Mobility**

**- Converge on the left issues on the input/output, feedback, solution**

**- Merging any agreement parts; provide TP if agreeable**

**- Capture agreements and open issues**

(CATT - moderator)

Summary of offline disc in [R](file:///D%3A%5CMeetings%5CRAN3%23113%5CCB%5CInbox%5CR3-214222.zip)3-215911

Two phases of this email discussion:

* Phase 1 Deadline: **18:00PM UTC, 5th Nov**.
* Phase 2 Deadline : **8:00AM UTC, 9thNov**, Try to have an agreeable TP in the 2nd phase discussion before online session.

# 2 For the Chairman’s Notes

# 3 Discussion for the first round

## 3.1 Use case

In [5130], it is proposed to include AI-based beam training and tracking strategies of millimeter wave communication especially in the high-speed rail scenario into the use case description part for AI based mobility management

**Q4.1-1 Companies are invited to provide views on whether the new use case on AI-based beam training and tracking strategies of millimetre wave communication should be introduced in** AI based mobility management **in RAN3.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| InterDigital | No | These topics are better handled in air interface AI studies (upcoming in R18) |
| Huawei | No | We think it should be the common understanding that the current SI should focus on the agreed use cases. |
| Lenovo, Motorola Mobility | No | Similar view as InterDigital and Huawei |
| NEC | No | These look like RAN1 topics. |
| Intel | No | Agree it would be better to study in Rel-18 AI/ML air interface. |
| Samsung | No | Same view as InterDigital and Huawei. |
| Nokia | No | This scenario should not be prioritized in this study. It can be considered later as part of Rel. 18. Beam management (intra-cell mobility) is a different use case from mobility which covers PCell handover or PSCell change. |
| ZTE | No | Focus on the agreed high-priority use cases. |
| LGE | No | Agree the views above |
| Ericsson | No | Not in scope of RAN3 and of this study |
| CATT | No. | Agree with InterDigital. |

**Moderator’s summary: All companies agree not to** **include the use case on millimeter wave communication.**

**Proposal : It is proposed** **not to include the use case on millimeter wave communication.**

In [5666],it is proposed to introduce the following events for **Reduction of the probability of unintended events associated with mobility case:**Successful HO with underlying issue, too early or to late PSCell change, triggering PSCell change to wrong PSCell.

**Q4.1-2 Companies are invited to provide views on whether the above events should be included or not.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| InterDigital | Yes | We are ok with adding these  |
| Huawei | Yes | We think these are the main cases that can be significantly promoted by AI. |
| Lenovo, Motorola Mobility | Yes |  |
| Intel | Yes |  |
| Samsung | Not sure | We may focus on single connectivity for this SI. If we have time after single connectivity case, we can study the DC case. So prefer to delay the DC case study. |
| Nokia | Yes | Those events can be included as unintended events to be optimized. However, it would be good to clarify that PSCell change is different from PCell handover.PCell handover refers to the change of Primary Cell by means of handover procedure (baseline handover, conditional handover or DAPS HO).PSCell change can be MN-initiated or SN-initiated and is performed using the PSCell change procedure of Rel. 15 or Conditional PSCell Change (CPC) of Rel. 17. |
| CMCC | Yes | We are fine to add thses events. |
| ZTE | Not sure | Share same view as SS. Focus on single connectivity |
| LGE | Yes  | Fine to add the events |
| Ericsson | Not ok | We agree that Successful HOs could be included. However too early /too late PSCell change etc are part of MRO for PSCell change that has not been even started in RAN3. That is, we do not even have a definition for those PSCell related events. Nevertheless, we can take successful HO into consideration |
| CATT | Not sure | Maybe we could focus on single connectivity first  |

**Moderator’s summary: 8 companies are OK with the proposal while 4 companies have concern on discuss DC case in current stage. Since it seems there is no concern raised to include successful HO as an event, we propose to introduce it.**

**Proposal: It is proposed to** **introduce Successful HO with underlying issue for Reduction of the probability of unintended events associated with mobility case.**

## 3.2 Solutions and standard impacts

### 3.2.1 General

In [4816], it is proposed to add a new chapter *Locations for* *AI/ML Model Training and AI/ML Model Inference* and move the listed options for the location of AI/ML Model Training and AI/ML Model Inference into this chapter.

**Q3.2.1-1 Companies are invited to provide their views on the restructure i.e. a dedicated chapter for all possible options on the location of AI/ML Model Training and AI/ML Model Inference.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support/not support** | **Comment** |
| InterDigital | Support | We need to do this or something like this. Having text in the section 5.3.2 is frowned upon in drafting specifications if there are subsections 5.3.2.1, 5.3.2.2. This is just editorial. A different heading for the new 5.3.2.1 is ok, this is just our suggestion. As said this is just editorial, I am surprised that this is taking so much discussion: from section 5.4 of 21.801 (3GPP Drafting rules) the current 5.3.2 is not permitted no text can exist in 5.3.2 if there is a 5.3.2.1: |
| Huawei | No strong opinion | The more important is to make things clear, as to the structure, either way could work. What is missing is that we think for offline training, technically it should not be located inside RAN. |
| Lenovo, Motorola Mobility |  | No strong view, current structure looks good too.  |
| Intel |  | We think the current structure is look enough. |
| Samsung | No strong view | No strong view about it. But it is better to keep all three use case in consistence. |
| Nokia | No strong view |  |
| CMCC | No strong view |  |
| ZTE | No strong view | Current structure is fine. |
| LGE | No strong view |  |
| CATT | No strong view |  |
|  |  |  |

**Moderator’s summary: Most companies have no strong opinion, one company support and one company think it is not needed. There is further clarification from the proponent of the proposal that the current structure is not allowed based on 3GPP rule.**

**Based on the discussion and the clarification from the proponent of the proposal, we propose to follow the proposal as well as the 3GPP rule.**

**Proposal 3: It is proposed to** **add a new chapter *Locations for AI/ML Model Training and AI/ML Model Inference* and move the listed options for the location of AI/ML Model Training and AI/ML Model Inference into this chapter.**

In [5479], it is proposed to introduce the following bullets in general part.

1. For the AI/ML Mobility Use Case, a gNB can train and execute an ML model to determine which UE configuration it can provide to its UEs. Subsequently, a gNB provides its neighbours with network performance predictions that Ues will observe when they are handed over to it.

The main intention of introducing this bullet is copied as below:

*In case the source gNB has multiple possible target gNBs for handover, all satisfying radio conditions, the source may estimate the UE configuration at each candidate target gNB and make a more informed decision on the target node. This could also help to improve CHO preparations to the best possible candidate target cells. This can save unnecessary resource reservations to target gNBs that are not selected finally by the source gNB as well as unnecessary signaling to release the resources through handover cancellation messages.*

1. Capture the different options on locations of *AI/ML Model Training and AI/ML Model Inference for* trajectory prediction.

The different options are as blew:

*Considering the locations of AI/ML Model Training and AI/ML Model Inference for mobility solution, following two options are considered:*

* *The AI/ML Model Training function is deployed in OAM, while the Model Inference function resides within the RAN node*
* *Both the AI/ML Model Training function and the AI/ML Model Inference function reside within the RAN node*

*Furthermore, for CU-DU split scenario, following option is possible:*

* *AI/ML Model Training is located in CU-CP or OAM, and AI/ML Model Inference function is located in CU-CP*
1. The study should consider solutions to obtain data for trajectory prediction of a given UE beyond the next cell change with the following reasons.

*Considering UE could not always support location report and only limited trajectory prediction can be supported in legacy networks by using UE history information from neighbour NG-RAN nodes, it is proposed to enable a NG-RAN node to obtain not only information about the next cell change (handover or cell-reselection), but also UE mobility information over a number of cell changes a UE makes into the future. With this, it can give network an enhanced view of UE trajectory which can be used to improve HO related actions.*

1. Capture the requirements for trajectory prediction as below:
* Restrict the amount of mobility history information only to gNBs that have requested such information
* Allow to obtain information on Ues that camped also in idle mode on cells under the gNB.

The rationale to introduce this bullet is copies as follows:

*One simple way of obtaining trajectory information over a number of cell changes, to be used for the training phase of an ML algorithm at the gNB (gNB-CU), is to mandate each of the gNBs that have served a UE to inform all previous serving gNBs where the UE was connected/camped on about UE mobility information, e.g., visited cell/radio measurements. However, it is likely that only a minority of gNBs will require such training information. Therefore, systematically sending this information would introduce a lot of extensive signaling and would not be preferable. A first requirement for a trajectory prediction solution should therefore be that UE mobility information for training purpose is only sent to gNBs that request such information. A second requirement is to obtain information on Ues that camped in idle mode on cells under the gNB.*

**Q3.2.1-2 Companies are invited to provide their views on the above 4 bullets.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Views** | **Further Comment** |
| Huawei | 1. Not sure the benefits
2. Clarifications needed
3. Clarifications needed

In principle yes but | 1. We think the AI/ML inference output should be able to make a reasonable decision for each UE, since the decision could be per UE basis, and input for each UE is different, not sure what additional considerations needed.
2. We already agreed that training could be located in different place, it seems that this proposal is for trajectory prediction only? And any specific points/issues to be addressed here?
3. In general we agree that trajectory prediction should be useful, which could be used as input for HO decision, but what this proposal means, the trajectory info should include “*a number of cell changes a UE makes into the future*”?

Just try to understand the exact meaning, the first bullet seems to say that gNB should initiate the request for mobility history? And the second bullet requires the mobility history information should support idle? |
| Lenovo, Motorola Mobility | Yes: (2)(3)(4)No: (1) | (1) generating UE configuration based on AI looks a new use case, which is rather general, shall be decoupled from mobility optimization. Regarding the use case itself, it is a bit too early to consider in our view.  |
| Intel | 1) Not sure2) ok3) seems not necessary4) yes for first point, No second point | For 1), RRC configuration of one UE contains many aspects, certain optimization also needs to check with RAN2 whether it’s feasible or not.For 2), we also think continuous model training in NG-RAN for model training in OAM should be supported.For 3), if we understand the proposal correctly, it is proposed to predict not only the next target cell, but also target cell in future? We think it may be not be necessary to generate prediction so long time in advance.For 4), for collecting information from IDLE mode UE, we need to check with RAN2 on the feasibility. |
| Samsung | No to (1)Seems not need to (2) due to already agreedYes to (3)Yes to (4) | (1) It is a little bit confused that how it is benefit for mobility optimization.(2) This one already captured in the TR and we may remove the FFS of UE trajectory prediction in model output.(3) We agree trajectory prediction can help to do mobility optimization decision. For “beyond the next cell”, actually it depends on the granularity of trajectory prediction.(4) Yes. To avoid unnecessary data collection, UE reports the mobility related on based on request. |
| Nokia | Yes to (1), (2), (3), (4) | (1): Current HO procedure could be improved if the source gNB had access to predictions of the UE Configuration that could be provided by a Target gNB before the HO is initiated. For instance, the source node can be informed by the target node about the likelihood a PDU session that is associated with a particular slice is not admitted during the handover preparation. (2), (3) AI/ML Trajectory prediction could be Trained in OAM or in RAN (CU-CP) and inference can be in gNB (CU-CP). For Training an AI/ML Trajectory prediction algorithm UE Mobility History information available at gNB (CU) could be analysed and exploited. Having trajectory prediction information over a number of cell changes (not only one cell change) can improve related HO actions. (4) Even though AI/ML Trajectory prediction over a set of next cells can improve HO, some restrictions should be added to control the amount of exchanged information; not all nodes need to support AI/ML Trajectory prediction. Trajectory both of Connected Ues as well as Ues in Idle/Inactive mode could be recorded.Answering to Huawei’s questions, we have an existing mechanism in place, the mobility history, which we can further study to obtain trajectory information for mobility. We could study how this mechanism can be extended to enable prediction of upcoming cell changes. Depending on algorithm, maybe we need to predict the next 3 cell changes or to monitor a certain UE as it traverses different gNBs. At the same time, we need to put some requirements to limit the amount of information we communicate over the interfaces to only those nodes that need this extended mobility history information. On the idle mode UE information, the second bullet says that when possible the obtained trajectory is not only for connected mode Ues but also for idle mode Ues to maintain the continuity of the trajectory information.  |
| CMCC | No for (1), (2)Yes to (3) and (4) | 1. Seems a new use case.
2. Has been agreed in last meeting
3. (4)Trajectory prediction is useful
 |
| ZTE | Yes: 2), 4)No: 1)Needs Clarification for 3) | 1. To train and execute an ML model to determine which UE configuration, we think, it is out of current mobility optimization use cases.
2. The solutions are already agreed in the last meeting. And we also agree that trajectory prediction should be supported in the CU/DUC architecture.
3. We agree that trajectory prediction is important part in the Mobility Optimization. And UE historical location and handover information may be the input for the trajectory prediction. But in this proposal, what’s the meaning of “*UE mobility information over a number of cell changes a UE makes into the future*”?

We agree to study the second point how to obtain information on Ues that camped also in idle mode in order to collect consecutive information for AI/ML model. |
| Ericsson | 1. OK2. OK3. Not clear4. Not OK | For 3, it is not clear how the current Mobility History from the UE and Mobility History Information are not sufficient.For 4, we are of the opinion that the UE should provide its current speed and that the RAN will calculate a UE trajectory, but it will not signal it to neighbour nodes. The prediction made by the RAN is used by the node itself to predict which mobility target is the best one. There is no point signalling this information to a neighbour node, as the neighbour node may run a similar prediction. |
| CATT | 1) Agree.2) Agree.3) This is not a proposal.4) Neutral for the first bullet, the second bullet we disagree. |  |

**Moderator’s summary:**

**1): 6 Nok, 3 OK**

**2): All are OK with the bullet however 3 companies think it already been captured in the TR**

**3): 5 OK, 3 Not clear, 1 NOK**

**4):2 NOK for first bullet,2 NOK for second bullet,1 request for further clarification on both of the bullets.6 ok for both of the bullets.**

**Proposal:** **It is proposed to agree the second bullet try to capture it in the TR**

In [5474],there are two proposals regard to the general part：

1. Remove the listed options on the location of Model training and Model Inference for CU/DU split scenario and only clarify that Model Inference can be in the gNB-CU.
2. To improve the mobility decisions at a gNB (gNB-CU), a gNB can request mobility feedback from a neighbouring node. Details of the procedure are FFS.

**Q3.2-3 Companies are invited to provide their views on the above proposals.**

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| --- | --- | --- |
| **Company** | **Views** | **Further Comment** |
| Huawei | Fine |  |
| Lenovo, Motorola Mobility | 1) see comment2) ok | We can remove 1) if Model Inference in DU is not proposed by any company. We agree that assuming both training and inference in CU could be a start point .  |
| NEC | 1. Not sure
2. Maybe
 | 1. It is better to also consider split architecture.
2. First need to see procedure.
 |
| Intel | Ok with both. |  |
| Samsung | (1) Maybe(2) OK | For (1), prefer to training in OAM or CU, inference in CU. |
| Nokia | (1) Not OK completely(2) OK | (1): We need to capture still the different solutions where Training can be placed in OAM or in the CU since this yields different flow charts. |
| CMCC | 1. No
2. Yes
 | Agree with Lenovo. |
| ZTE | 1. No
2. Yes
 | 1. For the real-time requirement, Model training and model inference could be located in the NG-RAN side. And it can not be precluded that trajectory prediction could be supported in the CU/DU split scenario. We propose not to remove this option.
2. Agree that a gNB can request mobility feedback from a neighbouring node.
 |
| Ericsson | Yes to both | We would like to clarify that we would like to keep the description of Training in OAM and Inference in RAN. We believe that inference will be done at the gNB-CU, so either we can specify that or simply specify that inference is done at the gNB. |
| CATT | Agree. | 2) can be a kind of data collection in our understanding, for generating model performance feedback. |

**Moderator’s summary:Views are quite split on bullet 1 while all companies support bullet 2**

**Proposal:** **Agreed that a gNB can request mobility feedback from a neighbouring node to improve the mobility decisions at a gNB (gNB-CU). Details of the procedure are FFS.**

In [5666],it is proposed to capture that offline training is in OAM and online training is in NG-RAN node.Futhurmore,it is proposed to add a note that it is not precluded that offline training could be deployed in the gNB by implementation. **Q3.2.1-4 Companies are invited to provide their views on the above proposals.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Views** | **Further Comment** |
| Huawei | Agree | As the proponent, of course we think we need to make things clearer.  |
| Lenovo, Motorola Mobility |  | It would be beneficial to clarify what is really online training and offline training. Maybe it can be discussed based on exact solution.  |
| NEC |  | Options for Model Training and Model Inference were discussed before and included into draft TP. Not sure proposed text adds new information. |
| Intel | Agree with comment | We also propose to allow continue model training in Ng-RAN based on received model from OAM in R3-215270.How to capture the note can be discussed in phase 2. |
| Samsung | Seems no need | The online and offline training are distinguished by whether to update the model during inference stage by new-collected data. The choice of online/offline training and detailed training algorithm are out of scope. It is reasonable to put offline training in OAM and online training in RAN. But the training in the TR includes both online and offline ones. And the current options in TR can cover both online/offline cases. |
| Nokia | No need | We think that there is a general understanding that offline training is in OAM and online training in the RAN. We are afraid that such clarification would create more confusion. |
| CMCC | No need | Share the view with Nokia and Samsung. |
| ZTE | No need | The current statement in the TR is enough. Since it is not precluded that offline training could be deployed in the gNB by implementation, why we need to distinguish between offline training and online training in the statement. |
| Ericsson | Not needed | We do not see the need to differentiate between online and offline training, which are anyhow techniques related to the model implementation and learning process. By acknowledging in 3GPP that there is online and offline training (and nothing else), we are favouring one type of model implementation. We should instead be model agnostic. Training therefore includes all possible types of training |
| CATT | OK |  |

**Moderator’s summary:4 support with one think it should be discussed based on exact solution while 6 oppose.**

**No consensus is reached**

### 3.2.2 AI/ML Model Training in OAM and AI/ML Model Inference in a NG-RAN node

In [5526], it is proposed to introduce a flowchart which clearly describes the interaction between UE and NG-RAN node as well as the interaction between NG-RAN node and OAM. The intention is to make the solution much integrity and stable.

In [5666], there is also proposal to have a flowchart which also include mobility enhancement cases.

**Q3.2.2-1 Companies are invited to provide their views on whether the new introduced flowchart is needed or not. If it is needed, whether the description on each step is agreeable?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| Huawei | Yes | We think to introduce a flow chart would be better to describe the mechanisms. |
| Lenovo, Motorola Mobility | Yes: [5526]No: [5666] | OK to describe the OAM-RAN solution with a flowchart as in [5526]. We can work on the exact wording in the second round.For RAN-RAN solution, we prefer to add necessary steps/elements on top of the current flowchart.  |
| Intel | Ok with [5526] | The details can be discussed in updated TP in phase 2. |
| Samsung | Prefer [5526] | Prefer to keep the same style as current flowchart in 5.3.2.2 in the TR. |
| Nokia | No because | [5666]: The figure illustrated here is one possibility which is in principle correct, but it is limited to a source receiving predicted load info over the interfaces from the neighbours and calculating predicted serving load. In our view, we should capture a more general mobility procedure that is flexible what information/predictions can be received from the neighbours.[5526]: We haven’t agreed yet on the Model Deployment/Update and Model Performance Feedback arrows so at least these arrows are not agreeable by us. |
| CMCC | Ok with [5526] | The details can be discussed in updated TP in phase 2. |
| ZTE | Prefer [5526] | Details could be discussed in the 2nd round. |
| LGE | Ok with [5526] |  |
| Ericsson | No to both | We have similar comments as Nokia. [5666] has a very detailed procedure description including parts we have not even discussed. [5526] focusses on model deployment and update whis is very controversial and not agreeable.We would like to suggest to look at the diagram in [5474], which is similar to that of [5526] but without the model training and model deployment parts. |
| CATT | Yes for both. | Some detail should be FFS, but we need not discuss them here. |
|  |  |  |

**Moderator’s summary: 8 are OK with the change from 5526 while 2 are not OK. Majority are not OK with the change from 5666.**

**Propose to follow the proposal from 5526 based on the view from majority.**

**Proposal:** **Introduce a flowchart which clearly describes the interaction between UE and NG-RAN node as well as the interaction between NG-RAN node and OAM.**

In [5270], it is proposed to add description that *NG-RAN node can also continue model online training based on the received AI/ML model from OAM.*The main reason is as follows*:*

*Mobility optimization has higher requirement to real-time performance. The real environment of each NG-RAN node is very essential to making the most accurate decision for mobility optimization. Hence, supporting continuous/further training at NG-RAN node on top of received AI/ML model from OAM is very important for mobility optimization use case.*

**Q3.2.2-2 Companies are invited to provide their views on whether** *NG-RAN node can also continue model online training based on the received AI/ML model from OAM***.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| Huawei | Yes | We think that, for online training, this should be a typical way that NG-RAN could perform online training over a trained model received from OAM. |
| Lenovo, Motorola Mobility |  | It would be beneficial to clarify what is really online training and offline training. Maybe it can be discussed based on exact solution.  |
| NEC | Yes | This could be possible |
| Intel | Yes | We are the proponent. |
| Samsung | Yes | It is possible to continue the online training to update the model based on received one from OAM.  |
| Nokia | Yes | It will be many times the case that a gNB receives from OAM a pretrained ML Model that will need to retrain according to its physical environment in an online manner. |
| CMCC | Yes | This could be possible |
| ZTE | Yes | The solution on online training should also be supported. |
| LGE | Yes | Should be allowed |
| Ericsson | No | It is obvious to us that model updates can be performed at the RAN e.g. online. However, there are several different ways to updating a model and what is known in AI terminology as online training is only one of them. We do not see the need to specify that online training can be performed at the RAN. What would we gain in terms of interface design clarity?  |
| CATT | Yes |  |

**Moderator’s summary: Only one company is not OK while all others are OK**

**Proposal:** **Add description that *NG-RAN node can also continue model online training based on the received AI/ML model from OAM.***

In [5666],it is proposed to introduce escription on the impact to Xn interface as below

**Potential standard impacts:**

* **Xn interface impact:**
	+ Delivery of the UE trajectory/mobility/performance prediction from the source NG-RAN node to the target NG-RAN node;
	+ Predicted load info from candidate target NG-RAN node to source NG-RAN node
	+ Performance Feedback of the received UE trajectory/mobility/performance prediction from the target NG-RAN node to the source NG-RAN node.

**Q3.2.2-3 Companies are invited to provide their views on above proposal.**

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| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| InterDigital | No  | We don’t disagree with the points made but this information is or should be included in the input and output data sections  |
| Huawei | Yes | The messages mentioned above are necessary for mobility enhancements. |
| Lenovo, Motorola Mobility | Yes |  |
| Intel | Yes |  |
| Samsung | Yes in general | Yes in general, but just one confusion. It is a little confused about why need to transfer the UE performance prediction and how this exchange can contribute to the mobility optimization. |
| Nokia | Yes |  |
| CMCC | Yes |  |
| ZTE | Yes | Mobility related prediction could be exchanged between NG-RAN nodes.For bullet3, we think performance feedback of the received UE trajectory/mobility/performance prediction is to be transferred to the model inference part. (source NG-RAN node or CU or DU) |
| LGE | Yes |  |
| Ericsson | No to the trajectory and mobility, yes to the rest | First of all it would be very difficult to define a “trajectory” as it would imply that RAN nodes share the same location references. Secondly, exporting a UE trajectory is a very security sensitive topic, which we would not open up.Finally, we do not see the point of exporting a trajectory outside the RAN. The RAN can derive and use a trajectory to predict which is the best target cell. After that the UE is handed over and the target predicts the trajectory according to up to date measurements. No need to signal it over Xn. |
| CATT | Yes for the first bullet and the third bullet. Neutral for the second. |  |
|  |  |  |

**Moderator’s summary:Among the 11 companies,1 company think these information should be input/output and 1 company is not OK with UE trajectory/mobility, others do not object all of the bullets.**

**Based on the view form majority, propose to introduce the impact to Xn interface.**

**Proposal: The following is introduced in the TR**

**Potential standard impacts:**

* **Xn interface impact:**
	+ Delivery of the UE trajectory/mobility/performance prediction from the source NG-RAN node to the target NG-RAN node;
	+ Predicted load info from candidate target NG-RAN node to source NG-RAN node
	+ Performance Feedback of the received UE trajectory/mobility/performance prediction from the target NG-RAN node to the source NG-RAN node.

### 3.2.3 AI/ML Model Training and AI/ML Model Inference in NG-RAN node

Currently, in the flowchart, there are 8 steps while only 7 steps in the procedure description, there are several alternatives to fix this part

* 1. In the procedure text, add description on step 8 and keep the flowchart unchanged[5526][5563][5332]
	2. In the flow chart, change the step 8 as handover initiation procedure and also add description on step 8[4816]
	3. In the flow chart, add step 9 which is the feedback from NG-RAN node 2 to NG-RAN node 1 and add the description on it[5270][5474]

**Q3.2.3-1 Companies are invited to provide their views on which alternative are preferred**

|  |  |  |
| --- | --- | --- |
| **Company** | **Which alternative are preferred** | **Further Comment** |
| InterDigital | 2 | Step 8 should be described so 1) is an alternative. We made step 8 a box since HO and related include messages to the UE. We are not against adding a step 9 as in 3) |
| Huawei | Slightly prefer 1) |  |
| Lenovo, Motorola Mobility | Maybe 1) and 3) | No strong view as the figure reflects the information flow correctly.  |
| Intel | Ok with 1) and 3) | For 2), it is not clear to us what is the handover initiation and what optimal actions are refereed in the description. |
| Samsung | 1 and 3 | The trajectory prediction to target node and performance feedback of handed over Ues can help to do proper mobility optimization decision. |
| Nokia | 3 | Adding step 9 gives a more complete picture. |
| CMCC | 1 and 3 |  |
| ZTE | Prefer 1 | “NG-RAN node1 may send the predicted trajectory to NG-RAN node2 via handover request message for subsequent optimization.” |
| LGE | 1 and 3 |  |
| Ericsson | 3 | Step 9 is an obviously missing step according to our current agreements |
| CATT | 1 and 3 |  |

**Moderator’s summary: 8 is OK with 1 and 7 is OK with 3**

**Proposal: It is proposed to add description on step 8 and keep the flowchart unchanged.**

There are some other proposals on this topic as below:

1) In [5526] and [5563], it is proposed to include UE predicted trajectory in handover request message for NG-RAN node 1 to NG-RAN node 2 for future mobility optimization. The proposal also applied to 3.2.2.

2) In [5332], it is proposed to introduce two steps via which NG-RAN node 1 could obtain input from NG-RAN node 2 for model training and model inference separately.

3) In [4816],it is proposed to introduce Xn procedure to allow NG-RAN node 1 receives asynchronously reports from neighbour NG-RAN node2 for model training.

4) In [4816], it is proposed to clarify that report from UE and other adjacent NG-RAN node could be repeated for several times.

5) In [4816], it is proposed to clarify that the UE measurement report serve as reference data for real-time or near real time mobility optimization.

6) In [5474],it is proposed to introduce a class 1 procedure to allows NG RAN node 1 to subscribe to the Mobility

Feedback Update of the neighbouring NG RAN nodes.

**Q3.2.3-2 Companies are invited to provide their views on above bullet****s**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| InterDigital | Yes for 3,4,5Maybe on 1, 2, 6 | First to clarify 3 – we introduce a message from NG-RAN node 2 because there are inputs from neighbouring NG-RAN nodes. The Xn procedure is not a new one (but could be SHR, RLF report, or other messages.Not necessarily against 1 or 6 but we feel it is not necessary to discuss exactly which messages are to be added or modified. The work item can decide that.For 2 we mostly agree, but it is not clear we need two separate messages from NG-RAN node 2.  |
| Huawei | See comments | Technically most of the proposals are not wrong, but not sure if we should step into such detailed discussion, e.g. a new procedure, how UE predicted trajectory info is exchanged (even, if there is a need to exchange), whether class 1 or class 2 should be used or not; especially for 5) and we don’t understand what real-time or near real time means, we think measurement report from UE could be used for model training and inference as well, what else?  |
| Lenovo, Motorola Mobility | Yes: 2) 3)  | 1) whether to send the predicted trajectory in HO request message can be FFS. 4)5) not sure if there is any spec impact6) procedure used to subscribe feedback can be FFS.  |
| Intel | 1) No2) ok3) ok4) 5) not sure what is the spec impact6) ok |  For 1), we don’t think UE predicted trajectory is the output of mobility use case. |
| Samsung | Yes: 1), 2), 6)Maybe: 3), 4), 5) | For 3), it is a little bit confused about the “asynchronously reports”. Maybe more clarification is required.For 4), it seems reasonable, but relies on the specific reporting procedure. Prefer to discuss it during WI phase.For 5), a little bit confused about “real-time” and “near-real-time”. Maybe more clarification is required. |
| Nokia | 1), :Yes2), 3), 4), 5) 6) : No | 2) We don’t need to separate these steps. It will be up to the receiving node how to interpret the data, and how to use them for Model Training or Model Inference.3) What is the meaning of asynchronous reports and how is that different from what we can support today?4): Not needed. It should be clear that this is just to illustrate the procedure and that more than one reports should be send by neighbouring nodes.5): is not needed in our view.6): We could support that NG RAN node 1 requests from a neighbour NG RAN node Mobility Feedback, but it is unclear to us how a subscription to this information can help. Does subscription mean that this information could be broadcasted to multiple NG-RAN nodes? How can this improve Handover as opposed to a regular XnAP procedure? |
| CMCC | Yes for 1)No for others | It seems that 2)-6) are too detailed at this stage. |
| ZTE | Yes: 1) 2) | 1. More clarification on “asynchronously reports”. Does it mean transferring input information from neighbouring nodes via Xn interface.
2. Not sure whether it has specification impacts.
3. From our perspective, no need to indicate whether UE measurement report is real-time or near real-time.

We are fine to introduce a class 1 procedure. |
| InterDigital |  | To answer various questions – more clarification on point 3 The current diagram shows inputs from the UE into the model, there are also inputs from other NG-RAN nodes (for example SON reports, SHR, RLF) these come in at different times to UE measurements thus the statement that is comes in asynchronously to the UE measurement reports. These messages are existing message (like UE measurements are existing) and include potential other messages.  |
| Ericsson | Wait for these details | These are details that should be discussed once we have a clear and definitive list of information to be exchanged and a definitive message sequence chart. We suggest to focus on the latter aspects first. |
| CATT | Yes: 1) 4) 5) 6)Yes but: 2) 3) | For 2) 3) that should be dashed at least. It can work without load prediction. |
|  |  |  |

**Moderator’s summary:**

**First bullet: 5/9 companies are OK, 4 companies think it is too detail and would like to discussion during normative phase**

**Second bullet: 5/9 companies are OK,** **2 companies are not OK,2 companies would like to wait.**

**Third bullet:** **4/9 companies are OK, 2 companies are not OK, 2 companies would like to wait**

**Fourth bullet: 4/9 companies are OK**

**Fifth bullet: 3/9 companies are OK**

**Sixth bullet: 4/9 companies are OK**

**No agreement are reached**

### 3.2.4 Input data

There are still 5 FFSs on the input data which is required for mobility management and different views are provided in [4816][5270][5332][5479][5526][5528][5563][5699].The input data which is still FFS is as below:

**Input Information from UE:**

* a)FFS UE historical location information from MDT, e.g., Latitude, longitude, altitude, cell ID
* b)FFS predicted traffic

**Input Information from the neighbouring RAN nodes:**

* c) Position, resource status, FFS QoS parameters of historical HO-ed UE (e.g., loss rate, delay, etc.)
* d)FFS Information about the performance of handed over Ues

*e)FFS on whether new UE measurements are needed.*

**Q3.2.4-1 Companies are invited to provide their views on whether the above information could be used as input data for mobility management?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| InterDigital | Yes | For UE historical location from MDT, we moved it to the 3rd bullet since it also includes UE historical information, we kept the FFS in our contribution but are ok with removing the FFS. We also clarified in this UE history bullet clarify it is collected over time, not by a single UE message, to avoid confusion with UE history passed as a group over Xn.  |
| Huawei | In general yes, but | Anyway we think there should be further discussions on each detailed parameter case by case, e.g. it should be useful for some KPI info such as loss rate, delay, throughput, but we may have to confirm one by one during normative phase. And maybe we need to clarify here the difference between QoS parameters of historical HO-ed UEs and performance of HO-ed UEs; For new UE measurement, we think FFS should be kept. |
| Lenovo, Motorola Mobility | Yes: a)No: b)Maybe no: c) d) | b) RAN3 shall avoid tackling solutions which requires UE AI/ML capability, e.g., asking UE to provide predicted traffic.If after every HO event, the target node will provide feedback about UE performance after HO, then the source node automatically knows all the information about historical performance after HO, or? Then there maybe no need to provide extra “performance of HO-ed UEs”  |
| Intel | No to a) | As explained in [5270], regarding to the UE historical location information from MDT, as specified in TS38.331 [3], *LocationInfo* is used to transfer detailed location information available at the UE to correlate measurements and UE position information. It will be reported to the network as measurement results. The exact latitude, longitude, altitude information of the UE are encoded in *locationCoordinate* IE carried in *CommonLocationInfo*. This information cannot be decoded at NG-RAN.  |
| Samsung | Yes except (b) | For (b), UE involvement is still under discussion, So prefer to delay the discussion of UE inference based on the conclusion of UE involvement.For (c) and (d), Yes. The performance of handed over UEs from neighbor nodes can evaluate the impact of the strategy generated from AI/ML model. For example, in reinforcement learning, the performance data can be set as the reward for model training to improve the model efficiency. Apart from that, they can also describe the node status to provide reference for handover decision. One of the mobility optimization objective is to guarantee the QoS performance for the UE during mobility, so QoS parameters should be contained in the performance feedback, such as loss rate, delay, etc., to improve the handover robustness and user experience. |
| Nokia | Input from UE: NoInput from neighbouring RAN nodes: We support resource status  | Input for UE: It is unclear if UE is willing to provide such detailed location information and whether details, on this granularity, would have a considerable improvement in performance. Also, on predicted traffic, it seems to assume that UE can perform AI/ML predictions which is not our current understanding for the scope of the study. Input from neighbouring RAN nodes: We are not sure what this position from the neighbour gNB in the input reflects. On UE measurements we support to keep the FFS.  |
| CMCC | Yes for all. | Both a and b are beneficial for handover decision. Also, the c and d from neighbouring nodes are helpful. |
| ZTE | Yes: a)No: b)Neural: c), d) | 1. UE historical information could be reported to RAN via enhanced MDT measurement.
2. UE capability to AI/ML is out of RAN3 scope. We recommend not to discuss the predicted information from UE at current stage.

c),d) These information is used for the reinforcement learning. The benefits need further discussion. |
| LGE | Yes: a)Yes: b)Yes d) |  |
| Ericsson | Yes to all | We acknowledge that information from the UE, especially b) could be controversial, although we find this useful. We would therefore prioritise a), c) and d) |
| CATT | No for B) | We prefer to postpone the discussion on precition function located in UE side to Rel-18. |

**Moderator’s summary:**

**a: 2 NOK while 9 OK**

**b:5 NOK while 5 OK**

**c:3 NOK while 7 ok**

**d:2 NOK while 8 OK**

**Based on the view of majority, it is proposed to agree a and d**

**Proposal:** **For the input, it is proposed to remove the FFS on historical location information from MDT, e.g., Latitude, longitude, altitude, cell ID and Information about the performance of handed over UEs.**

**Some other information proposed to be included as input data is listed below：**

Information from CN (the input can be based on the information from AI based CN function):

* 1)UE mobility statistics parameters, e.g., UE location statistics (duration of the time slot) [5528]
* 2)UE mobility predications, e.g., predicated UE location information in the analytical period[5528]

Information from the neighbor RAN nodes:

* 3)Load prediction[5332]
* 4)UE’s successful DC offloading information in the past and received from neighboring RAN nodes[5528]
* 5)Information about the performance of handed over UEs and offloaded DC Ues[5528]
* 6)Estimated Network Performance (if the neighbour RAN node is a Target gNB)[5479]
* 7)Cost of CHO Handover preparation e.g., reflecting the impact in terms of preparation time [5479]
* 8)UE performance prediction/estimation[5474]
* 9)UE dwelling time per cell[5474]
* 10)RAN visible QoE metrics e.g., buffer level[5474]

Information from UE:

* 11)Near-term UE location information in the future, e.g. future location received from UE’s application layer, future location predicted by AI/ML model at the UE side[5270]
* 12)RAN visible QoE metrics e.g., buffer level[5474]
* 13)Trajectory information, e.g.UE speed[5474]
* 14)UE Mobility history information[5474]
* 16)SON Reports of handovers that are successful handover report,[5474]

Input Information from Local node:

* 17)UE’s CQI, SRS(local node) [5270]
* 18) Remove the bullet UE trajectory prediction output (will be used by the RAN node internally)[5474]

Input Information from LMF:

* 18)Historical UE location information[5270]
* 19)Predicted UE location information[5270]

**Q3.2.4-2 Companies are invited to provide their views on whether the above information could be used as input data for mobility management?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| Huawei | See comments | (1), (2): not needed for now. For RAN related use case, we are not sure what useful info RAN could get from CN;For 3), this was also discussed in LB use case, technically the load prediction info might be also useful for mobility decision；For 4) and 10), not sure if there are any obvious benefits to mobility optimization.OK for 5) 6) 7) 9), we could further discuss the need of them, maybe we could just list one of them as example.For 4), 8) and 10), not sure the benefits to mobility optimization, e.g. RAN visible QoE metrics, they are mainly for resource usage evaluation, what’s the need to predict a UE’s performance, etc.OK for 14) and 16), they are normal SON or MDT related info concerning mobility; for other information listed in (11~16), it seems that RAN could generate them, there are overlaps here, e.g. UE trajectory prediction could be done by RAN.For 17) and 18), we are not sure, does mobility require precise positioning info from LMF, maybe not needed.In general, some of those info might be useful, but not sure we should go one by one, we could start from what might not be needed for the moment, e.g.: we think further discussions are needed on whether there is a need to get information from CN; why RAN visible QoE metric is useful to mobility enhancements; for trajectory prediction, if RAN could do that, why we need from UE? Similar comments to UE performance prediction/estimation. |
| Lenovo, Motorola Mobility | Yes: 3) 10) 12) 16) | 1) 2) 18) 19)have CN impact which may be better to avoid for now.4)5) If after every HO event, the target node will provide feedback about UE performance after HO, then the source node automatically knows all the information about historical performance after HO, or? Then there maybe no need to provide extra “performance of HO-ed UEs”6) need to clarify what is network performance 7) is very AI/ML algorithm dependent8) does it mean neighbour node will predict the UE performance and provide the info to source node before HO execution? Not sure how it can be done. 9) seems more like rewarding/feedback information?11) that requires some application involvement, shall not be considered for now. 13) 14) 15) how is it different from those in Q3.2.4-1?17) HO is normally made based on L3 measurement, we don’t see the need to use L1 measurement for HO decision for now. 18) don’t see why not using the predicted trajectory locally if available.  |
| Intel | Yes to 1) 2) 3) 11) 16) 17) 18) 19) | For RV QoE, it is not clear to us how RV QoE is beneficial to mobility optimization. For information from CN and LMF, we are ok to combine them as the same bullet. |
| Samsung | Yes: 3), 10), 12), 13), 14), 15), 16) | For 1) 2) 18) 19): same view as Lenovo. At this stage, it is better to avoid CN impact.For 4) 5), it is DC related. Prefer to focus on normal case firstly. And if we have time after normal case, we can study DC case then.For 6), it is a little confused about what the network performance is.For 7), it is implementation related.For 8) 9), maybe need more clarification, including how to do and what is the benefit.For 11), whether and how to involve UE are still under discussion. Prefer to delay the discussion about inference in UE.For 13) 14) 15), support them. But it seems they are same as “a)FFS UE historical location information from MDT, e.g., Latitude, longitude, altitude, cell ID” in 4.2.4-1. We may just remove “FFS”.For 17), not clear about the benefit.For 18), the trajectory prediction exchange can help node to do further mobility decision. So it may not be used by node internally. |
| Nokia | Information from the Core/LMF: No Information from Neighbour NG-RAN nodes: 3),4),5), 6)7), 9) :OK8), 10): Not OKInformation from UE11), 12), 13), 15): Not OK14),16: OKInput from Local node: Not OK | 13) and 15): We think that Trajectory information from the network would be a more reliable source of UE location. It would also have less UE impacts8): For a UE to predict its performance we would need to assume that UE is capable of providing AI/ML predictions. To our understanding this is not in the scope of this study. 10,12): Unclear how QoE information can be useful for the mobility use case.11),13),15): We support that UE location/trajectory is calculated by the network and not through UE reporting. In our view, network cannot rely on UE to provide its location information since it may not be willing to do so.Input data from local node: UE’s CQI and SRS could be useful, but we are missing the standardization impacts from those. Trajectory prediction output could help a neighbouring node better prepare its resources for a possible HO. |
| CMCC | Information from the Core/LMF: No Information from Neighbour NG-RAN nodes: 3),4),5), 6)7), 9) ,10):OK8) needs clarificationInformation from UE12), 13), 14),15), 16): OK11): Not OKInput from Local node: 17) OKInput Information from LMF: Not OK |  |
| ZTE | Yes: 3), 13), 14), 15) | 1) 2) 18) 19): Share same view as SS and LenovoWhy we need to remove the bullet UE trajectory prediction output, since UE trajectory prediction is one important part of mobility optimization. |
| LGE | Yes: 1) 2) Yes: 3) 4) 5) 9) 14) 15) | For 1) and 2), we are fine to consider in later release |
| Ericsson | No: 1, 2, 6, 7, 18, 19Yes: 3, 4, 5, 8-17  | We do not believe the RAN needs information from CN that are not already known and useful.We do not understand what is meant by “Estimated Network Performance”. The target cannot give an estimation if preparation has not occurred. But if it occurred, then the HO needs to happen and there is no time for target estimaitons…We do not think the cost of CHO preparation is needed, as this is pretty much implementation specific (how to quantify it?)We do not think there are information from LMF that are not already known and useful |
| CATT | OK for 1) 2) 3) 6) 8) 12) 14) 17) | We think the input form network from long term statistic would be beneficial for the mobility in NG-RAN side.We share the view that DC case could be taken as low priority. Also, we do not expect to discussion the prediction function located in UE side in current stage. It could be discussed in Rel-18. |

**Moderator’s summary: Among all the inputs proposed, there is no object on 3).For other bullets,there are at least 3 companies are not OK with it.**

**Proposal:** **It is proposed to add Load prediction as input**

### 3.2.5 Output data

One FFS i.e. *FFS* *UE trajectory prediction (Latitude, longitude, altitude of UE over a future period of time)* is left on the output data. Among the contributions which discuss this issue, only one company thinks *UE trajectory prediction* should not be the output data[5270][5474] while the others[5056][5332][5526][5563][5699] [5528]support to keep it as output data.

The main reason not to include *UE trajectory prediction as output data* is as follows:

* Location information reported in measurement report depends on the positioning procedure. The detailed location information (e.g. longitude, latitude, altitude, etc) is transparent to NG-RAN node.
* It is considered UE trajectory prediction is performed and collocated with nodes which can perform legacy positioning calculation and already have UE’s location information, i.e. UE and LMF, which can reduce frequency of exchanging UE history location information and reduce complexity.
* It is not needed to predict the trajectory information at the local node as this can be derived from UE speed and UE position

**The reason to keep** *UE trajectory prediction as output data* is as follows:

* + - Outputting RRC decisions directly based on raw inputs collected throughout the network may not fully utilise the benefit of AI/ML and UE trajectory prediction can be used as input for the mobility decision.
		- Deploying the AI/ML function of UE location prediction at the UE or the LMF has drawbacks comparing to the UE location prediction in NG-RAN node.For example, it is too energy and timing consumption to do it in UE side and LMF is far from Uu interface.
		- It is not necessary to make the geographical location information an input of model inference of geographical location prediction—in a sense the UE geographical location prediction module can be integrated with the UE positioning module.
		- UE trajectory prediction could be transferred to the target NG-RAN node for reference via Handover request. Hence, UE trajectory prediction should also be included as the output data.

**Q3.2.5-1 Companies are invited to provide their views on whether** *UE trajectory prediction* **could be regarded as output data?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| Huawei | See comments | Maybe the first thing is, trajectory prediction is anyway needed, and it even could be outcome of inference, then technically there are two approaches here, one is that this is just used as an input for traditional HO decision making; the other is that this is used as input for another model training for HO decision. |
| Lenovo, Motorola Mobility | Yes | As explained by the moderator.  |
| Intel | No | The key difference between the two options is not whether handover decision is by AI/ML model or by legacy behavior. The key difference is the location of AI/ML model for UE trajectory prediction. As we explained in the contribution [5270], performing UE trajectory in RAN requires data transfer of UE location information from either UE or LMF to RAN, where RAN originally is transparent to such information. This will introduce a huge signaling impact to the system. |
| Samsung | Yes | As explained by the moderator. |
| Nokia | Yes | Trajectory prediction information can help a neighbouring Gnb make better handover decisions. So, we support sending it as part of the Output data. |
| CMCC | Yes | Agree with the analysis of the moderator. |
| ZTE | Yes | UE trajectory prediction (Latitude, longitude, altitude of UE over a future period of time) is output of the trajectory prediction. UE trajectory prediction has been captured in the TR37.817 as one mobility use case. In addition, the mobility optimization decision could be generated by AI/ML Model or conventional method based on the predicted trajectory. |
| LGE | Yes |  |
| Ericsson | Only as an internal output | Firstly, the predicted UE trajectory calculation does not need to be carried out with AI. IF a UE is located as x, y, z, it is moving with speed xx and with an angle of yy, then a trajectory can be reliably derived by e.g. linear extrapolation. Secondly, we do not see the reason why the trajectory should be sent to target RAN. The use case is based on the optimal selection of a target cell, which is done by the source RAN. Namely, source RAN is the Actor. Why should target RAN subscribe to reception of a trajectory, for a UE that is not even serving? |
| CATT | Yes |  |

**Moderator’s summary: 8 companies are OK while 2 companies are not OK**

**Proposal: It is proposed to remove the FFS on UE trajectory prediction as output.**

**Some other proposals to introduce more output data or to update on the existing output data are listed below：**

* 1)Target PSCell in PSCell addition and change[5332](new)
* 2)Candidate PSCells in CPAC[5332](new)
* 3)UE trajectory prediction (Latitude, longitude, altitude of UE over a future period of time)

Estimated arrival probability in CHO and relevant accuracy and confidence interval[5332]

* 4)Predicted handover target node, candidate cells in CHO, may together with the accuracy and confidence of the predi[5332]
* 5)the predicated target SN node IDs for DC together with the confidence of the predication[5528](new)
* 6)Validity time corresponding to predicted handover cells and predicted candidate cells[5270]
* 7)Estimated arrival probability, priority and handover execution timing of predicted candidate target cellsand relevant confidence interval[5270]
* 8)Estimated arrival probability (particularly for CHO, but is relevant for all HO types) and relevant confidence interval for HO and data forwarding optimization strategies[4816]
* 9)Predicted handover target node in the case of legacy and DAPS HO, list of candidate cells in CHO, together with the confidence of the prediction[4816]
* 10)Traffic predictions for resource allocation purposes in mobility (for CA/DC activation/deactivation and Data Forwarding decisions.) [4816](new)

**Q3.2.5-2 Companies are invited to provide their views on whether the above information could be output data?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| InterDigital | Yes on 1,2,5Yes on 8Yes on 9Yes on 10 Open to 3, 6 | Bullets 1, 2, and 5 should be combined to handle DC issuesBullet 3 (part) 7 or 8 modify the same text. Estimated arrival probability is relevant for CHO but it applies in general to HO, so we like wording in 8 better but would support adding accuracy to the text as per in the second line of 3.This overlaps with 4, Predicted handover target node applies to all handover times (list of candidates for CHO) |
| Huawei | See comments | Some of them are overlappedOK for 1) 3) 5) 7) 8) 9) 10); 4) should be output of inference, but as commented, we are not sure the benefits of accuracy and confidence, 9) is subset of 4)? Again, we are not sure if we should go through one by one, maybe we could start from some of them, e.g. 1), 9)? |
| Lenovo, Motorola Mobility | Yes: 1)2)3)4)6)Maybe: 8) |  |
| Intel | Ok to 1) 2) 4) 5) 6) 7) 8) 9)  | We see there’s some overlap between 4) 7) 8) and 9). It would be good to merge the proposals following prediction for target HO, prediction for CHO, etc. |
| Samsung | Yes to 3) 4) 6) 7) 8) 9) 10)Yes for 1) 2) 5) but may delay the DC case discussion | For 1) 2) 5), they are DC related. We may focus on normal case firstly. If time allows, we can continue to study DC cases after normal case. |
| Nokia | 1),2), 4), 5), 7), 8),9) :OK3), 6), 10) : Not OK | 3) It is not obvious that UE will be willing to provide its detailed coordinates to the network.4),5),7) 8),9) Ok, but we do not support sending the confidence/accuracy of the prediction. 6): We think that validity time can be indicated by sending a new prediction when the previous measurement is invalid.10) For traffic predictions we prefer to have feedback from RAN2.  |
| CMCC | Yes for all | But maybe we should start from some essential information due to limited time. |
| ZTE | OK for 3) 4) 8) 9) 10) | We don’t agree the output information carried with accuracy. |
| LGE | Yes for 1),2), 3), 4), 5) |  |
| Ericsson | Yes to 1) 2) 6) | A suggestion to Moderator. The discussion becomes very dispersive and impossible to converge on with such super broad questions. The moderato should filter out the important parts to let the discussion progress and NOT include all the possible proposals in all possible papers submitted. |
| CATT | Ok for 3) 4) 6) 9) |  |

**Moderator’s summary: For each output proposed, there are at least 3 companies are not OK with it.**

**It seems no convergence could be reached. Based on the discussion, moderator would like to discuss the following issue to facilitate the discussion in the subsequent meeting**

**Proposal:** **Should DC case be included in the Rel-17 discussion or not? If it is, is there any priority on the mobility related use case between SA and MR-DC/NR-DC?**

### 3.2.6 Others

In [5332], it is proposed to introduce a chapter for rewarding information as below:

5.3.2.x Rewarding Information

* The feedback from the target SpCell or the UE whether the mobility decision is good or not (e.g. if mobility is successful)

In [5270],it is proposed to introduce a chapter for feedback as below

5.3.2.5 Feedback

* Throughput, packet delay of the handed-over UE, etc

**Q3.2.6-1 Companies are invited to provide their views on above proposals**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/no** | **Further Comment** |
| Huawei  | Not needed | Rewarding information is part of model training itself, we already agreed to have feedback, not sure what else we need, then maybe there is no need to introduce a new chapter. |
| Lenovo, Motorola Mobility | Yes | Both are fine, the point is to capture some feedback/rewarding information which can be used to update the AI model.  |
| Intel | Ok | We are the proponent. |
| Samsung | No to rewarding informationYes to feedback | The rewarding information is up to model training algorithm design, which is out of RAN3 scope. In details, whether need to and how to define the reward value are implementation-specific. Prefer to define the feedback parameters, and leave reward info to implementation.For the feedback, performance of handed-over UE can be the one to evaluate the action to improve the model training efficiency or to describe the current node status to provide the reference information for model inference. So it is beneficial. |
| Nokia | No | We should consider feedback on a case by case basis. In this isolated way, it is unclear how the feedback or reward can improve AI/ML Mobility. |
| CMCC | Not sure for rewarding informationYes to feedback | Feedback information can be used to update the AI model. |
| ZTE | Not needed for rewarding | Feedback information is needed for model updating/retraining. Details could be further discussed. |
| LGE | For the time being, No |  |
| Ericsson | No to Reward InformationYes to feedback | We already discussed whether to include explicit reward information descriptions and we concluded that reward information is specific of one learning technique, so not ok to include.We support to specify types of feedback, which we also agreed in the functional framework |
|  |  |  |

**Moderator’s summary:**

**For feedback: 3 companies are not OK while 6 companies are ok**

**For rewarding information: 7 companies are not OK while 2 companies are ok**

**No agreements are reached.**

# Discussion for second round

Based on the discussion in the first round, we tried to propose the following agreement according to the view form majority as below:

**1 Not to include the use case on millimetre wave communication.**

**2 Introduce Successful HO with underlying issue for Reduction of the probability of unintended events associated with mobility case.**

**3 Add a new chapter *Locations for AI/ML Model Training and AI/ML Model Inference* and move the listed options for the location of AI/ML Model Training and AI/ML Model Inference into this chapter.**

**4 It is proposed to capture the different options on locations of AI/ML Model Training and AI/ML Model Inference for trajectory prediction. In section 5.3.2.1, i.e. Locations for AI/ML Model Training and AI/ML Model Inference, take UE trajectory prediction as an example.**

**5 Agree that a gNB can request mobility feedback from a neighbouring node to improve the mobility decisions at a gNB (gNB-CU). Details of the procedure are FFS.**

**6 Introduce a flowchart which clearly describes the interaction between UE and NG-RAN node as well as the interaction between NG-RAN node and OAM.**

**7 Add description that *NG-RAN node can also continue model online training based on the received AI/ML model* from OAM.**

**8 Introduce descriptions on the impact to Xn interface as below:**

**Potential standard impacts:**

* **Xn interface impact:**
	+ Delivery of the UE trajectory/mobility/performance prediction from the source NG-RAN node to the target NG-RAN node;
	+ Predicted load info from candidate target NG-RAN node to source NG-RAN node
	+ Performance Feedback of the received UE trajectory/mobility/performance prediction from the target NG-RAN node to the source NG-RAN node.

**9 Add description on step 8 and keep the flowchart unchanged.**

**10 For the input, it is proposed to remove the FFS on historical location information from MDT, e.g., Latitude, longitude, altitude, cell ID and Information about the performance of handed over UEs.**

**11 Add Load predictions as input.**

**12 For ouput, remove the FFS on UE trajectory prediction.**

At the same time, we provide draft TP which reflect the above conclusion and upload in the draft folder. Please provide your comments on the proposed agreement in the table below if any. Companies are also invited to provide update on the TP directly.

**Question: Please provide your comments on the above proposed conclusion**

|  |  |  |
| --- | --- | --- |
| **Company** | **Support/not support** | **Comment** |
| Lenovo, Motorola Mobility | Comment on 7, 8 | 7: We need to first define what is online training, if companies really want to introduce the term “online training” in the TR. 8: we don’t need to capture “potential Xn impact” now. We can wait when it becomes clear, e.g., predicted load info exchange over Xn interface may be introduced in the load balancing use case discussion.  |
| Nokia | 1,2,3,4,5,6,8,9, 11,12: OK7: OK but10: Not OK | 6: OK but in the figure 5.3-1 of the TP, steps 5 and 8 on model Deployment and Model Performance Feedback are still controversial in the AI/ML Framework CB discussions. 7: Is OK but it is a bit questionable why we need to make this statement.10: We don’t support to send historical location information from MDT. Our thinking is that a UE may not be willing to provide this information to the network, which makes it hard to rely on. Also, the provision of historical information by the UE may require UEs to report information in different ways. Since RAN2 is not involved in the study, we are reluctant to consider this information. Cell ID is ok but it is also available through other network reports. |
| Ericsson | 1-Support2-Support3-Neutral4-No Support5-Support6-No Support7-Support8-No Support9-No Support10- Support11- Support12-No Support | On 4. First of all it is very challenging to represent a UE trajectory across different RAN nodes. This implies that RAN nodes know each other´s geographical location. Secondly we do no t understand why this information needs to be exchanged. The use case is on mobility prediction for served UEs. Signalling to a RAN node the trajectory of a UE that is not served by that RAN seems to point at mobility prediction for non served UEs, and we do not understand the utility of that.On 6. Interaction between RAN and OAM is out of scope and should not be describedOn 7. We do not understand what is the use of signalling the UE Trajectory. This shall be removed.On 8: we do not understand why should the UE trajectory be signalledOn 9, we suggest to capture the subscription request messages which are request of information from the Model Inference functionOn 12: We agree with the removal of the FFS if it can be agreed that UE trajectory is an internal output to the node hosting the Model Inference function |
| Samsung | Support except 4, 8, 11 | P4: the location for model training and inference is a general one for mobility optimization, so that it seems no need to add “trajectory prediction as an example”.P8: For the first bullet, it is a little bit confused about why UE performance prediction is needed to contribute the mobility optimization. Prefer to delete “/performance” of the first bullet.For trajectory prediction information, the exchange of it can provide the reference information for target node to make further mobility optimization decision. So OK for trajectory prediction of the first bullet.P11: actually OK for this. But just one minor comment. We have the common understanding to use “resource status” instead of “load”. So it is better to reword it as “resource status prediction”. |
| Intel | support: 1, 2, 3, 5, 6, 7, 9, 11not support: 4, 8, 10, 12 | P4: agree with SS, e.g. UE trajectory prediction is not needed.P8: we don’t think UE trajectory information should be exchanged between NG-RAN nodes; additionally, for load information, not sure whether this is necessary to be considered as mobility optimization output, considering we have considered such output in load balancing use case.For 10: from phase 1 email discussion, companies didn’t explain how RAN can interpret latitude, longitude and altitude information from MDT report or RLF report, handover failure, measurement report, etc. In TS38.331, all UE location information is encapsulated in a container using octet string using *CommonLocationInfo* IE in *LocationInfo*. Hence, NG-RAN node cannot decode any information from the container. We don’t think it is technically correct based on existing RRC signaling. If the proposal is to introduce new signaling to report longitude, latitude and altitude, we suggest not discussing such information in this SI, as it highly depends on positioning procedure. For 11: Considering ES and LB also consider UE trajectory, we suggest splitting UE trajectory as a separate use case to avoid duplicate discussion. If not, we are ok to compromise it as internal output as mentioned by Ericsson. |
| Huawei | See comments | For 8, we are not clear what UE transmission performance would help or not…suggest to remove.For 10, we think it is enough to have cell based as the granularity, not sure why the longitude/latitude etc. such precise info would be needed for mobility decision. But in general, the mobility history info could be helpful. |

# References

|  |  |  |
| --- | --- | --- |
| [R3-214816](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-214816.zip) | Correction of Mobility Optimization - Solutions and standards impacts (InterDigital ) | Other |
| [R3-215056](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215056.zip) | Discussion on Standards Impact on Mobility (CATT) | Discussion |
| [R3-215130](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215130.zip) | Further discussion on use case of mobility optimization (Purple Mountain Laboratories) | Discussion |
| [R3-215270](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215270.zip) | AI/ML based mobility optimization (Intel Corporation) | Discussion |
| [R3-215332](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215332.zip) | Discussion on standard impact to support mobility optimization (Lenovo, Motorola Mobility) | Discussion |
| [R3-215479](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215479.zip) | (TP for TR 37.817) Further Discussion on Standard Impacts of AI/ML Mobility Optimization (Nokia, Nokia Shanghai Bell) | Other |
| [R3-215526](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215526.zip) | Further discussion on solution to AI-based mobility optimization (ZTE Corporation, China Unicom) | Other |
| [R3-215528](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215528.zip) | Input/output information for support of AI/ML enabled Mobility Optimization (LG Electronics) | Discussion |
| [R3-215563](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215563.zip) | Discussion on Standard Impact for AI/ML based Mobility Optimization (Samsung, Verizon Wireless) | Discussion |
| [R3-215699](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215699.zip) | Remaining issues for AI based Mobility and Energy Saving (CMCC) | Discussion |
| [R3-215666](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215666.zip) | (TP to TR 37.817) Remaining issues for AI based mobility enhancements and load balancing (Huawei) | other |
| [R3-215474](file:///D%3A%5C%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5C%5CTSGR3_114-e%5C%5CDocs%5C%5CR3-215474.zip) | AI/ML Load Balancing and Mobility Optimization use cases (Ericsson) | OtherMove to 18.4.2 |

# 5 Conclusion, Recommendations [if needed]

If needed