**3GPP TSG-RAN WG3 Meeting #112electronic R3-212689**

**Online, 17th – 27th May 2021**

**Agenda Item: 18.3**

**Source: CMCC (moderator)**

**Title: SoD Data Collection Use Cases**

**Document for: Discussion and Decision**

# 1 Introduction

**CB: # 46\_DataColl\_UseCases**

**- Chair: suggest to structure discussion around 5 areas, splitting work among companies for the resulting TPs:**

**1) Common parts / overview / general descriptions (merging any agreeable parts from e.g. 2301, 2313, 1683, 2190) (NEC?/E///?)**

**2) ES/EE (merging any agreeable parts from e.g. 2030, 2031, 2523, 2507, 1669, 2315) (ZTE,CU,Len,Moto?/CMCC?)**

**3) Load Balancing / Load Prediction (merging any agreeable parts from e.g. 2032, 2033, 2504, 2524) (CMCC?/HW?)**

**4) Mobility / Traffic Steering (merging any agreeable parts from e.g. 2028, 2029, 2191, 2271, 2269, 2316) (CATT?/ID?)**

**5) Other use cases (if any / if agreeable) (from e.g. 1969, 2179, 2389)**

(CMCC - moderator)

There are some overlaps between CB#46 and CB#47，we found it is sensible to discuss the standard impacts with the specific solutions together, so after coordination with the moderator of CB#47\_DataColl\_StdImpact, this CB#46 will only focus on use case description and potential benefits. The solutions for the identified use cases and potential standards impact will be discussed in CB#47.

Under the chair’s guidance, the offline discussion consists of 5 areas, the discussion will be structured as follows:

- In the first round of offline discussion, it is proposed to collect company views on the general question for each area;

- In the second round of offline discussion, it is proposed to focus on TPs for use cases, including ES/EE, Load balancing/ Load Prediction, Mobility / Traffic Steering, as well as common parts and other use cases if agreeable.

# 2 For the Chairman’s Notes

**To be added after email discussion.**

# 3 Discussion

## 3.1 Common

The proposals in this part (from [15] [16] [11]) are diverse and seems cannot to merge, TPs for prioritized three use cases are provided in [2] and could be discussed in following corresponding use case parts.

Companies are invited to provide views on whether following proposals are agreeable.

**Q1: Which following proposal(s) from [15] is agreeable for you?**

**Proposal 1: “Confidence Level” of a model inference output should be supported and provided to “Actor” node.**

**Proposal 2: “Validity Time” of model inference output should be supported and provided to “Actor” node.**

**Proposal 3: For ML enabled load balancing, “Model Training” can be located at CN/OAM or NG-RAN (CU). “Model Inference” can be located at NG-RAN (CU).**

**Proposal 4: For ML-enabled load balancing, input data of Model Training includes QoS requirement, traffic volume, cell capacity, cell resource status, and measurement data.**

**Proposal 5: For ML-enabled load balancing, output data of Model Inference includes prediction of traffic volume, cell capacity and cell resource status, action of UE (such as handover), etc.**

**Proposal 6: For ML-enabled load balancing, the prediction results of traffic, resource status, cell capacity, etc., should be exchanged between the source gNB CU and neighbouring gNB-CUs via Xn interface.**

**Proposal 7: For ML-enabled load balancing, handover decision at source cell can be decided by the prediction results of its own and neighbouring cells.**

**Proposal 8: NG-RAN can decide to switch off certain cells to lower energy consumption based on the prediction of cell load information.**

**Proposal 9: For ML-enabled energy saving, a gNB can send a message and avoid deactivating a needed cell of a neighbouring gNB, by utilizing the prediction result of cell load information exchanged between them.**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Proposal 1: No.  Proposal 2: Yes with clarification.  Proposal 3: No.  Proposal 4-5: Yes.  Proposal 6: Yes.  Proposal 7: No.  Proposal 8: No.  Proposal 9: No. | Proposal 1: Not all ML models provide confidence interval (CI). If we want CI to be provided, then first we need to define how CI should be calculated for those ML methods that don't directly generate such information. Before the definition is done, we don’t see CI is appropriate.  Proposal 2: need a clear definition of “Validity Time” if we want to use it. For example, in traffic prediction use case, the prediction result may be the traffic load for the next interval (which depends on the measurement interval in the input/output), thus, the prediction result is only good for the next interval naturally.  Proposal 3: this proposal is not necessary. Regardless of use cases, where the model training and model inference should be performed belong to vendor decision.  For proposal 4 and 5: while we agree to these two in principle, we have some comments.   1. Input data should be rich enough in order to generate output data. Proposal 4 does not cover all the needed measurements. For example, if the model suggests a UE handover, then the cell capacity of neighbouring cells need to be included as input data. It seems the relationship between Proposal 4 and 5 have not been carefully considered. 2. HO decision most likely does not based only on inference result as it will take into account other factors as well. It is cleaner to separate model inference and decision in any use case, while the 2 can reside on the same functional block.   Proposal 7: The decision of handover or not should be vendor-dependent, based on each vendor’s algorithm. We suggest rephrasing this proposal to something like : *“...the source cell can utilize the model inference results for itself and neighbouring cells together with other information to make HO decision...”*  Proposal 8: Again, the decision-making is vendor dependent. Can be rephased like in Proposal 7.  For proposal 9: two comments  1) not sure if this is necessary; if the target gNB needs to remain active, it does not need this request message; its own AI model should be able to make the decision (note the traffic information is exchanged between the source gNB and the target gNB so they know each other’s situation well).  2) while a gNB can send a message to neighbouring gNBs, whether to deactivate a particular cell on the gNB is up to the gNB's decision.  **In general, we suggest separating action/decision-making from inference results/prediction; we should not define how the decisions will be made.** |
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**Q2: Which following proposal(s) from [16] is agreeable for you?**

1. It is proposed to sufficiently progress the prioritized use cases on energy saving, load balancing, traffic steering/mobility optimization, i.e. at least by identifying their impact on the specifications, before considering any new use case.
2. It is proposed to investigate standard support to enable machine learning at the network side to reduce the energy consumption at the UE, such as the introduction of new UE feedback information reflecting the UE’s energy consumption.
3. It is proposed to investigate a RAN-based Energy Efficiency solutions to achieve better energy consumption at the RAN, for example by means of exchange of this information.
   * + **Exchanging information between RAN nodes, describing if a certain RAN action is taken due to energy efficiency**
     + **Exchanging of RAN node energy-related information between RAN nodes**
     + **Exchanging performance feedback related to a certain energy efficiency action taken in another RAN node**
     + **UE traffic prediction**
     + **UE mobility prediction**
     + **UE performance feedback**
4. RAN3 to discuss the following improvements related to Traffic Steering:
   * + Improved Mobility Load Balancing decisions using UE traffic related predictions and RAN load predictions.

**Proposal 5: It is proposed to consider the Link Adaptation use case as low priority.**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Proposal 1: Yes  Proposals 3 and 4: Yes, with clarification  Proposal 2 and 5: No | Proposal 2: The discussions so far were for RAN power saving, not for UE. So UE power saving should be considered a new use case. As a new use case, it should have lower priority and should be postponed.  Proposal 3:  1) Item 3: To clarify: what does "performance feedback” mean?  2) Item 4: To clarify: what does UE traffic prediction mean, per UE? If yes, this would require a new use case to predict UE traffic?  3) Item 5: similar as the above, UE mobility prediction is not included in the use cases being proposed so far.  In general, we believe ML-based RAN energy saving benefit can be evaluated at OAM or other-higher level entity instead of exchanging all the information between RAN nodes.  Proposal 5: This proposal is not necessary. If other use cases score higher based on agreement, then link adaptation use case becomes lower priority naturally. |
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**Q3: Which following proposal(s) from [11] is agreeable for you?**

Proposal 1: RAN3 is proposed to consider splitting the use cases into two parts: “AI-assisted decision” where the output is the decision itself (i.e. to turn on/off a cell, to hand over a UE from this cell toward that cell), and the “AI-assisted prediction” where the output is merely the prediction result used as an intermediate input for decision making.

Proposal 2: If proposal 1 is agreed, RAN3 is proposed to focus firstly on “Load prediction” “UE location prediction”, “Service data prediction” and “AI-assisted handover / data offloading decision”.

Proposal 3: If proposal 1 is agreed, RAN3 is proposed to confirm that “cell/carrier/symbol/etc turning on/off decision” and “radio resource configuration / scheduling” can be affected by the aforementioned predictions.

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Proposal 1-3: No | There is no need for these proposals. Whether to use ML output or inference to make decision directly or just as part of the decision-making is implementation dependent. |
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## 3.2 EE/ES

Several papers provide views and potential TPs on the use case of energy saving. Moderator would like to suggest companies to discuss the potential TP for EE/ES based on 2030[6], where detailed use case description, simulation results and potential benefits are provided, and merge agreeable parts in [1][2][17][21][22].

**Q4: Do you agree to work on the potential TP for use case description of EE/ES based on [6] and merge other TPs?**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Yes. |  |
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## 3.3 Load Balancing/ Load Prediction

Moderator would like to suggest companies to discuss the potential TP for load balancing based on 2524[23] and merge agreeable parts in [2][4][8][20].

**Q5: Do you agree to discuss the potential TP for use case description of load balancing based on [23] and merge other TPs?**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Yes. |  |
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## 3.4 Mobility/ Traffic Steering

Moderator would like to suggest companies to discuss the potential TP for mobility based on 2271[14] and merge agreeable parts in [2][12][18].

**Q6: Do you agree to discuss the potential TP for use case description of load balancing based on [14] and merge other TPs?**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | Yes. |  |
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## 3.5 Other use cases

Some new use cases are proposed to discuss, including

1. URLLC [3]
2. PSCell change [10]
3. Network slicing, QoE optimization [15]
4. L1/L2 Beam Management Configuration and Operation Optimization，Multi-user MIMO Configuration and Optimization， Scheduler Tuning and Parameter Optimization [19]

Companies are invited to provide views on whether to study above new use cases.

**Q7: Do you agree to study above new cases?**

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| **Company** | **Yes/No** | **Reasons/Comments/Suggestions** |
| Futurewei | No. | 1) Suggest we postpone these topics to later stages.  2) Some use cases under 4 belong to other RAN groups; should they be handled by RAN3? |
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# 4 Conclusion, Recommendations

To be edited, if needed**.**

# 5 Reference

1. R3-211669 Machine Learning Use Case for BS Power Saving Futurewei
2. R3-211683 TP to TR 37.817 Use case description NEC
3. R3-211969 Discussion on Use Cases for RAN Intelligence Samsung, Verizon Wireless
4. R3-212028 AI based UE Trajectory Prediction ZTE Corporation, China Unicom, Lenovo, Motorola Mobility, CMCC
5. R3-212029 Solution to AI based UE Trajectory Prediction ZTE Corporation, China Unicom, CMCC
6. R3-212030 AI based Energy Saving ZTE Corporation, China Unicom, Lenovo, Motorola Mobility
7. R3-212031 Solution to AI based Energy Saving ZTE Corporation, China Unicom
8. R3-212032 AI based Load Prediction ZTE Corporation, China Unicom, Lenovo, Motorola Mobility
9. R3-212033 Solution to AI based load prediction ZTE Corporation, China Unicom
10. R3-212179 AI based PSCell change Lenovo, Motorola Mobility
11. R3-212190 Discussion on use cases for AI in RAN CATT
12. R3-212191 Discussion on UE Location prediction CATT
13. R3-212269 Data Forwarding Optimization Use Case for AI InterDigital
14. R3-212271 Mobility Optimization Use Case for AI InterDigital
15. R3-212301 Use cases for AI/ML enabled NG-RAN Intel Corporation
16. R3-212313 Overview of AI/ML use cases Ericsson
17. R3-212315 AI/ML for energy efficiency use case discussion Ericsson
18. R3-212316 AI/ML traffic steering use case discussion Ericsson
19. R3-212389 Use Cases and Requirements for Artificial Intelligence in RAN AT&T
20. R3-212504 AI-based load balancing CMCC
21. R3-212507 AI-based energy saving CMCC
22. R3-212523 Further discussions on detailed procedure and potential spec impacts of energy saving Huawei
23. R3-212524 Further discussion on AI/ML assisted load balancing Huawei