3GPP TSG-RAN WG3 #117bis-e R3-225917

E-meeting, 10 – 18 October 2022

Agenda Item: 12.2.2.1

Source: Nokia (moderator)

Title: Summary of email Discussion on CB: # AIRAN2\_XnImpact

Document for: Discussion and Approval

# Introduction

**CB: # AIRAN2\_XnImpact**

**- Whether to define the new procedures for AI/ML input, AI/ML output, and AI/ML feedback information respectively. Coverage on design of the new procedure for AI/ML related information?**

**- How to transfer UE related information via UE associated procedure or non- UE associated procedure, via new procedure or existing procedure?**

**- Whether the AI/ML capability is needed, and its definition?**

**- Definition of predicted resource status, UE performance, energy efficiency metrics, et.?**

**- Discuss the start time, duration, end time for AI/ML related information, validity time, accuracy**

**- Capture agreements and open issues**

**- Provide TPs on stage2/3 if agreeable**

(Nok - moderator)

Summary of offline disc [R3-225917](file:///C:\Users\pantelid\Documents\workspace\3GPP\FTP\tsg_ran3\RAN3%20117bis-e\Inbox\Drafts\CB%20%23%20AIRAN2_XnImpact\Inbox\R3-225917.zip)

This email discussion will comprise two phases:

* Phase 1 Deadline: Thursday October 13th, 10pm UTC
* Phase 2 Deadline: Monday October 17th, 8am UTC

In the second phase, we will try to obtain TPs

# For the Chairman’s Notes

# Discussion

## Procedures for AI/ML related information

In the last meeting we agreed that a new procedure is needed for AI/ML related information:

*Define a new procedure over Xn which can be used for AI/ML related information, e.g., predicted information.*

*The new procedure for reporting of AI/ML related information, e.g., predicted information, should be based in a requested way, like resource status report procedure.*

Some companies propose to design the new procedure as a Class-1 procedure, initiating the predicted information reporting and with the predicted information response/failure to indicate successful/failure operation and a Class-2 procedure where the actual reporting takes place (e.g., [5509],[5516], [5779], [5702], [5588]). A lot of different names have been discussed for this procedure, but the actual name depends on the outcome of the discussion on AIRAN1\_General\_Stage2.

**Q1: Do companies agree that the new procedure for reporting AI/ML Related Information (e.g., predicted information) (with name FFS) shall contain a Class 1 procedure, for Reporting Initiation (with tentative name Prediction Data Reporting Initiation) and a Class 2 procedure for Data Reporting (with tentative name Prediction Data Reporting)?**

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| **Company** | **Agree /Disagree** | **Comments, if any** |
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The reporting of this new procedure can imitate Resource Status Procedure and therefore companies propose that reporting can also be at once ([5483], [5587]) or be periodic ([5483], [5587], [5702]). In [5587] an issue is brought up, namely that periodic reporting may be more suitable for initial training of an ML Model where more regular and a sufficient amount of data is needed. However, periodic reporting may provide unnecessary measurements when the only intention is to monitor events or updates in model inference, in which case event-based reporting could be introduced to capture changes or updates in the reported predictions. Event-based reporting could also detect when a prediction becomes invalid so that the next prediction is reported.

**Q2: Companies are invited to provide their views on whether the new procedure for reporting of AI/ML Related Information shall support reporting at a) once, b) periodic reporting and c) event-based reporting.**

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| **Company** | **Type of reporting to be supported (a) once, b) periodic, c) event-based). Indicate preference on a), b), c)** | **Comments, if any** |
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Another FFS from the previous meeting is the following:

*FFS on whether UE associated procedure is needed.*

Some companies propose that the new procedure for AI/ML information is non-UE associated, e.g., [5509], [5516] [5734], [5779], [5888].

**Q3: Companies are invited to provide their views on whether the new AI/ML procedure shall be non-UE associated or UE-associated.**

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| **Company** | **UE-associated, non UE-associated** | **Comments, if any** |
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Some companies propose that the response message, like in the case of Resource Status Procedure, confirms whether the node can do the requested prediction, e.g., [5702].

**Q4: Companies are invited to provide their views on whether the response message of the new procedure confirms whether a node can perform the requested prediction.**

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| **Company** | **Agree / Disagree** | **Comments, if any** |
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Some companies propose to consider timing information regarding when a prediction is requested since predicted information without knowing when the prediction will be calculated cannot be used at the receiving node, especially when this information is used as an input to another ML Model. Different timing options have been discussed: a start time and end time of a prediction ([5376]), time instant in future ([5483], [5588]), time duration ([5758]).

**Q5: Companies are invited to provide their views on whether timing indication shall be included when node subscribes to a prediction. If so, companies are invited to further provide their views on how this is exactly indicated, namely as a a) start time and end time, b) time instant, or c) time duration.**

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| **Company** | **Yes / No** | **If yes, how shall timing information be indicated, through a) start time and end time, b) time instant, or c) time duration.** |
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Some companies also bring up the issue of accuracy and discuss that a node receiving a prediction shall be able to understand the prediction accuracy (e.g., [5483], [5485])

**Q6: Do companies think that prediction accuracy shall be included together with prediction information?**

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| **Company** | **Yes / No** | **Comments, if any** |
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## UE Performance Information

UE performance has been discussed by several companies as part of feedback information (e.g., in [5514], [5516]). Several ways to evaluate UE performance have been proposed:

1. UE energy consumption
2. Average Packet Delay
3. Average UE Throughput DL
4. Average UE Throughput UL
5. Average packet delay
6. Average Packet Error Rate
7. UE performance in terms of RVQoE

**Q7. Companies are invited to provide their views on which of the above listed UE performance are useful for Feedback purposes for different use cases.**

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| **Company** | **UE performance/ Use Case** | **Comments, if any** |
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## Predicted Resource Status Definition

Various companies supported that Predicted Resource Status Information follows the granularity of existing resource status procedure (see e.g., [5376],[5483], [5514], [5516]). Some company also supported to consider predicted resource status over NR-U channel list ( [5483]). [5726] proposes to consider at least predicted per-cell CAC. Those are captured in the tabular below:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| IE/Group Name | Presence | Range | IE type and reference | Semantics description | Criticality | Assigned Criticality |
| **Predicted Resource status information** |  |  |  |  | – |  |
| >Predicted Radio Resource Status | O |  | 9.2.2.50 | Predicted value of the Radio Resource Status IE |  |  |
| >Predicted TNL Capacity Indicator | O |  | 9.2.2.49 | Predicted value of the TNL Capacity Indicator IE |  |  |
| >Predicted Composite Available Capacity Group | O |  | 9.2.2.51 | Predicted value of the Composite Available Capacity Group IE |  |  |
| >Predicted Slice Available Capacity | O |  | 9.2.2.55 | Predicted value of the Slice Available Capacity IE |  |  |
| >Predicted Number of Active UEs | O |  | 9.2.2.62 | Predicted value of the Number of Active UEs IE |  |  |
| >Predicted RRC Connections | O |  | 9.2.2.56 | Predicted value of the RRC Connections IE |  |  |

**Q8. Do companies agree with the entries of the tabular above? Is it agreeable that it is used in the reporting procedure of AI/ML related predicted information?**

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| **Company** | **Agree/Disagree** | **Comments, if any** |
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## Energy Efficiency metrics and Exchange

A lot of the discussions on energy efficiency focus on how to capture the EE metric. Some companies propose to consider a detailed Energy Efficiency metric, calculated based on DV over EC e.g., [5702], [5726], [5760], [5777], [5813], [5879]. Some other companies propose to reflect EE metric in an abstract way by using a quantitative encoding (e.g., through a number in 0 to 100) (see e.g., [5514], [5584]).

**Q9. Companies are invited to provide their views on the exact definition of the EE metric, namely shall it be a) a detailed metric based on DV over EC, or b) an abstract metric based on a qualitative encoding?**

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| **Company** | **What is the EE metric definition, a) or b) ?** | **Comments, if any** |
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In the last meeting we made the following agreement:

*Current Energy Efficiency metric can be exchanged between RAN nodes for the energy saving use case.*

A question that remains unanswered is in which procedure the current Energy Efficiency metric shall be transmitted. Some companies support to extend Resource Status procedure to carry Current Energy Efficiency metric (e.g., [5399],[5702], [5777]). Some other companies support to define a new procedure to capture Energy Efficiency information (e.g., [5484], [5584]) while a company proposes to introduce current Energy Efficiency in the new AI/ML procedure (e.g., [5514]).

**Q10. Companies are invited to provide their view on which procedure shall carry the Energy Efficiency metric, namely whether we shall a) extend Resource Status procedure, b) define a new procedure or c) use the new AI/ML procedure used to carry e.g., predictions.**

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| **Company** | **Companies are invited to choose among the a)-c) options above** | **Comments, if any** |
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Another relevant question is how to collect current Energy Efficiency information and whether it shall be collected on a per node or per cell granularity.

**Q11. Companies are invited to provide their views on whether current Energy Efficiency metric shall be collected on a per cell or a per NG-RAN node granularity.**

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| **Company** | **Per node or per cell granularity?** | **Comments, if any** |
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Finally, shall predicted Energy Efficiency metric be exchanged between neighbours? If so, which procedure shall be used for that?

**Q12. Companies are invited to provide their views on whether predicted Energy Efficiency metric shall be exchanged between neighbours and if so in which procedure?**

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| **Company** | **Exchange predicted Energy Efficiency metric (yes/no).** | **If yes, in which procedure shall this information be sent?** |
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## Validity Time

Even though the concept of validity time has been discussed since the SI phase, still there hasn’t been a common understanding among the companies related to how is the validity time defined. In this meeting, validity time has been defined as the time in future that prediction is calculated ([5483]) or the time duration in the future ([5758]) or the time in the future that prediction is valid [5781]. So the essence behind validity time is that it gives the time instant or the time duration during which a prediction is valid.

The question we would like to address here is whether validity time shall be sent together with “periodic” predictions.

Validity time for periodic prediction reporting can be indicated:

1. Implicitly with a new prediction when the previous prediction becomes invalid -no standards impacts from this solution ([5812], [5846])
2. Explicitly with every prediction in the AI/ML output – this solution has standards impacts ([5399], [5702], [5760])
3. By the subscription to the prediction, e.g., a node requests a prediction of 1 minute ([5513])

**Q13: Companies are invited to discuss whether validity time needs to be signaled explicitly or implicitly or whether it is indicated in the subscription procedure.**

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| **Company** | **Do companies agree that validity time can be indicated by the options a)-c) above?** | **If so, which one is the preferred option?** |
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## UE Trajectory Prediction

In the last meeting, it was agreed to transfer cell-based UE Trajectory information to neighbour NG-RAN nodes. During this meeting, a number of companies supported to use UE history information for as an input for UE Trajectory prediction (e.g., [5399], [5509], [5811], [5846]).

**Q14 Do companies agree that UE history information will be the basis of training an AI/ML Model for cell-based UE Trajectory prediction?**

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| **Company** | **Agree/Disagree** | **Comments, if any** |
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Another open point with respect to UE Trajectory prediction is to identify the exact representation of UE Trajectory Prediction. Some companies support that it may be given as a list of predicted cells (e.g., [5511], [5585], [5727], [5760]), a list of predicted beams (e.g., [5727], [5758], [5812], [5870]), or a list of predicted detailed location information (e.g., [5758], [5814], [5879]). Some companies propose that in addition the (expected) time when a UE has stayed at a given “hop” shall also be indicated (e.g., [5760], [5585]).

**Q15: Companies are invited to provide their views on whether cell-based UE Trajectory prediction is provided as a list of cells into the future, each of which is indicated together with an expected time of expected stay into the cell. Are any other granularities of UE Trajectory Prediction acceptable? (e.g., beam-based, location-based).**

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| **Company** | **Agree/Disagree** | **Are any other granularities of UE Trajectory Prediction acceptable? (E.g., beam-based, location-based, etc.)** |
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## Feedback Information

During the last meeting we made the following agreement related to sending UE performance as part of feedback information for each of the use cases:

* *UE performance (e.g, UL/DL throughput, packet delay, packet loss)*

In [5586] it is discussed that UE performance of handed over UEs needs to be calculated over a period of time to allow the average performance of throughput, delay, packet loss, etc. to converge. However, by that time the UE context at the source regarding the UEs for which feedback is requested is likely released. This is because UE context is typically more short-lived compared to the time needed for UE performance measurements to be calculated at a node. In the absence of an active UE context the source node cannot anymore correlate the received feedback information to the corresponding action that led to a certain UE performance.

Two methods were proposed for maintaining an active UE context in this meeting, i.e.,

a) Introduce a new UE context, surviving longer than handover so that UE performance information can be associated with the AI/ML action taken at the source NG-RAN node. [5586]

b) Maintain context after HO procedures are finished in an implementation specific way. [5846]

**Q16: Companies are invited to provide their views on how a UE can be identified for feedback purposes when UE context is released. Do companies think that either of the options a) or b) are agreeable?**

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| **Company** | **How to identify a UE when UE context is released** | **Comments, if any** |
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# References

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| --- | --- |
| [R3-225376](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225376.zip) | AI/ML Energy Saving (NEC) |
| [R3-225377](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225377.zip) | Predicated resource status information in AI/ML energy saving (NEC) |
| [R3-225399](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225399.zip) | XN enhancements for NG-RAN AI/ML (Qualcomm India Pvt Ltd) |
| [R3-225425](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225425.zip) | Discussion on exchange of AI/ML capability over Xn interface (China Telecommunication) |
| [R3-225482](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225482.zip) | Discussion on AIML capability exchange (Lenovo) |
| [R3-225483](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225483.zip) | Discussion on procedure used for prediction information exchange (Lenovo) |
| [R3-225484](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225484.zip) | Discussion on procedure for measurement information exchange (Lenovo) |
| [R3-225485](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225485.zip) | Discussion on prediction and feedback transfer during handover (Lenovo) |
| [R3-225502](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225502.zip) | AI/ML Radio Measurement Discussion (InterDigital) |
| [R3-225503](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225503.zip) | Discussion on Mobility Optimization Model Outputs (InterDigital) |
| [R3-225509](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225509.zip) | (TP for AI/ML BLCT to TS38.423) Procedures for exchanging AI/ML-related information (Ericsson, Inter Digital) |
| [R3-225511](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225511.zip) | Cell Trajectory Prediction exchange (Ericsson, Inter Digital, Version Wireless, Qualcomm) |
| [R3-225512](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225512.zip) | (TP for AI/ML BLCT to TS38.423) Cell trajectory prediction over Xn (Ericsson, Inter Digital, Verizon Wireless) |
| [R3-225513](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225513.zip) | Open points on capability exchange and validity time (Ericsson) |
| [R3-225514](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225514.zip) | AI/ML Network Energy Saving (Ericsson) |
| [R3-225516](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225516.zip) | AIML Load Balancing and Mobility Optimisation use cases (Ericsson) |
| [R3-225584](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225584.zip) | AI/ML Energy Saving: Energy Efficiency Metric and Procedures (Nokia, Nokia Shanghai Bell) |
| [R3-225585](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225585.zip) | AI/ML Mobility Optimization and Load Balancing Use Cases (Nokia, Nokia Shanghai Bell) |
| [R3-225586](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225586.zip) | Feedback Configuration after an AI/ML Action (Nokia, Nokia Shanghai Bell) |
| [R3-225587](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225587.zip) | Predictions Exchange between NG-RAN Nodes (Nokia, Nokia Shanghai Bell) |
| [R3-225588](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225588.zip) | (TP for TS 38.423) AI/ML Related Information and Procedures in Xn (Nokia, Nokia Shanghai Bell) |
| [R3-225702](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225702.zip) | Discussion on Xn impact of AI/ML for NG-RAN (Samsung) |
| [R3-225704](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225704.zip) | Correction of energy efficiency exchange for AI/ML for NG-RAN (Samsung) |
| [R3-225705](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225705.zip) | Correction of predicted resource status exchange for AI/ML for NG-RAN (Samsung) |
| [R3-225706](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225706.zip) | Correction of predicted UE trajectory exchange for AI/ML for NG-RAN (Samsung) |
| [R3-225726](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225726.zip) | Discussion on XnAP impacts of non-UE-associated metrics (CATT) |
| [R3-225727](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225727.zip) | Discussion on XnAP impacts of AI/ML for UE associated metrics (CATT) |
| [R3-225728](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225728.zip) | TP on TS 38.420 for AI/ML (CATT) |
| [R3-225729](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225729.zip) | TP on TS 38.423 for AI/ML (CATT) |
| [R3-225734](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225734.zip) | Open issues related to Xn interface for mobility optimization (LG Electronics Inc.) |
| [R3-225758](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225758.zip) | Signaling support for AI/ML information over Xn (AT&T) |
| [R3-225760](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225760.zip) | Further discussion on stage3 related issues for NG-RAN AI/ML (NTT DOCOMO, INC.) |
| [R3-225777](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225777.zip) | Discussion on AI/ML based network energy saving (including TP for TS 38.423) (Intel Corporation) |
| [R3-225778](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225778.zip) | Discussion on AI/ML based mobility optimization (including TP for TS 38.423) (Intel Corporation) |
| [R3-225779](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225779.zip) | Discussion on new procedures for AI/ML information exchange (including TP for TS 38.423) (Intel Corporation) |
| [R3-225780](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225780.zip) | Discussion on UE Performance and System KPI (including TP for TS 38.423) (Intel Corporation) |
| [R3-225781](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225781.zip) | Discussion on Validity Time of Predicted Information (Intel Corporation) |
| [R3-225811](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225811.zip) | Discussion on the procedure of AI/ML for NG-RAN (CMCC) |
| [R3-225812](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225812.zip) | Discussion on Open Issues for AI/ML for NG-RAN (CMCC) |
| [R3-225813](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225813.zip) | Open Issues on AI/ML for NG-RAN Energy Saving (CMCC) |
| [R3-225814](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225814.zip) | Open Issues on AI/ML for NG-RAN Mobility Optimization (CMCC) |
| [R3-225846](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225846.zip) | Further discussions on the support of mobility enhancements using AI/ML (Huawei) |
| [R3-225847](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225847.zip) | Further discussions on the support of load balancing using AI/ML (Huawei) |
| [R3-225848](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225848.zip) | Further discussions on the support of energy saving using AI&ML (Huawei) |
| [R3-225858](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225858.zip) | UE QoS Feedback (InterDigital) |
| [R3-225870](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225870.zip) | Consideration on AI/ML based mobility optimization (China Telecommunication) |
| [R3-225879](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225879.zip) | Discussion on the stage3 standard impacts of AIRAN (ZTE Corporation) |
| [R3-225880](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225880.zip) | TP to 38.423 and 38.420 for unified AI-ML procedures (ZTE Corporation) |
| [R3-225888](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225888.zip) | AI/ML Information via Xn Interface (China Telecom) |
| [R3-225891](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225891.zip) | On Energy Efficiency Metric over Xn Interface (China Telecom) |
| [R3-225501](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225501.zip) | AI/ML parameter Open Issue List Discussion (InterDigital) |
| [R3-225375](file:///D:\会议硬盘\TSGR3_117bis-e\Docs\R3-225375.zip) | AI/ML Load Balancing (NEC) |

# Conclusion, Recommendations [if needed]

If needed.