3GPP TSG-RAN Release 18 workshop Electronic Meeting **Tdoc RWS-210633**

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Title: Email discussion summary for [RAN-R18-WS-crossFunc-Nokia]

Source: Nokia, Nokia Shanghai Bell

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Agenda item 4.3 Cross-Functionalities for both eMBB and Non-eMBB Evolution

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1 Introduction

This document covers the questions and their answers for the following documents:

RWS-210082 RAN slicing enhancements for Rel-18

RWS-210083 AI/ML for NG-RAN in Rel-18

RWS-210118 Network energy efficiency in Rel-18

RWS-210119 On spectrum extension beyond 71 GHz

RWS-210120 NTN development path

RWS-210393 RF enhancements for Rel-18

Both the Phase 1 and Phase 2 discussion questions and answers are covered.

Figure 1. below shows overview of Release 18 package, in this contribution focus in on cross-functional items

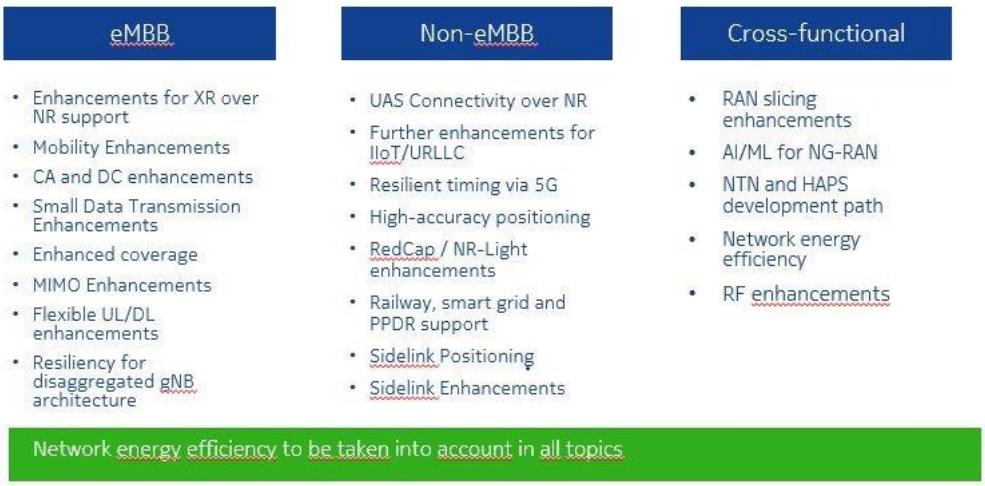

Figure 1: Nokia proposed Release 18 package

2 Comments and questions

2.1 Questions for RWS-210082 RAN slicing enhancements for Rel-18

Feedback Form 1: Phase 1. Questions about RAN slicing enhancements for Rel-18

1 – Intel Technology India Pvt Ltd

(1) Simultaneous slice support was discussed in SA2 and no conclusion was made in Rel-17. Should the work be first continue in SA2?

(2) Non-uniform Slice support in a RA was discussed in Rel-17 and SA2 confirmed that slice support within a RA needs to be uniform. If non-uniform slice support in a RA is to be discussed, should it be first discussed in SA2? (as it impacts PDU session maintenance and allowed slices concept in SA2)

2 – ZTE Corporation

Thanks for your proposal. We also see the need for further enhancement for RAN slicing to continue the work for slice remapping and evaluate the RAN impact of Rel-18 progress in other WG (SA1/SA2). Further enhancement on slice aware cell (re)selection can also be considered in addition to what we have in Rel-17.

In addition, we are interested in UE leverage different slice resource in MN and SN as mentioned in our paper RWS-210482.

-Regarding slice prioritization/preference in case the UE is associated with multiple slices, we understand there is ongoing discussion in Rel-17 on how UE would apply the slice specific reselection priority and having slice prioritization is one candidate solution when more than one set of slice specific reselection priority is configured. Could you please explain if there is any other use case for the slice prioritization?

-For support of network slices with small service area requirements, we understand each cell can support different slices and the broadcast system information can reflect the supported slice(s) of each cell per the Rel-17 discussion. Anything else is needed?

3 – Spreadtrum Communications

Thanks for your valuable contribution. We have questions about the deployment scenarios.

Q: A new deployment scenarios is proposed, i.e. support of network slices with small service area requirements. Could you provide more detailed interpretation about potential use cases? And the smaller area or even limited service time challenges the ability of slice deployment. Maybe the scenario needs to be confirmed by SA firstly.

4 – Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution

Can you clarify what you believe in your contribution is not a left over or requirement from other group and further clarify the requirements for such evolution

5 – CATT

Thanks for the contribution.We could not quite understand the intention of the bullet ”Support of network slices with small service area requirements”. Would the discussion focus on whether different slice is supported in the cells in one TA?

6 – Samsung Electronics Polska

Thanks for the contribution. We have few questions:
Q1) We acknowledge the issue that current uniform slice support within an TA/RA is not good for TA planning and configuration. Do you mean we should re-consider the support of non-uniformly slices within a TA/RA in R18?

Q2) Regarding ’slice prioritization/preference in case the UE is associated with multiple slices’, isn’t this objective under discussion in RAN2 for R17 RAN slicing WI (i.e., UE prioritisation of slice when there is more than one intended slice)?

7 – LG Electronics UK

Thanks for the proposal.

Could you explain the motivation of RAN Topology information awareness by AMF? Do you consider any requirement in SA or SA2?

Feedback Form 2: Phase 2 question on RAN slicing

1 – ZTE Corporation

Thanks for your answers to the round 1 questions.

For slice prioritization in Rel-18, you mentioned one potential use case is connected mode mobility where UE is connected to multiple slices and the target cell may not support all required slices of UEs. I understand it is also related to the slice re-mapping discussed in the RAN3 SI phase. Could you please elaborate how the slice prioritization helps in this case?

2.2 Questions for RWS-210083 AI/ML for NG-RAN in Rel-18

Feedback Form 3: Questions for AI/ML for NG-RAN in Rel-18

1 – Intel Technology India Pvt Ltd

What is Nokia’s views on a Rel-18 study item involving the air-interface?

2 – LG Electronics France

Q1) In slide 4, you mentioned that “while AI/ML WI focuses on SON/MDT use cases”. Can we understand that Nokia prefers that MDT with AI/ML will be included in the WI? How about QoE with AI/ML?

Q2) What do you think about having a study item for adoption of ML into radio interface?

3 – ROBERT BOSCH GmbH

[Bosch]: for AI-based UE-centric approaches:

- Q1: what enhancements do you see needed to enable this operation (i.e., if UE includes AI functionalities)
- Q2: do you agree to start with pilot topics: e.g., AI-based mobility (for UE-centric), AI-based positioning (for UE-centric or UE with AI-based sensor Fusion) ?
4 – CATT Thanks for the contribution. In general, we share the view that the Rel-18 work include both normative work and further study on more use cases. As to the last bullet for WI proposal, we think it depends on the conclusion of rel-17 SI. If no conclusion is made to transfer a trained ML model through the network interfaces, maybe it needs further study in Rel-18.
5 – Sony Corporation Thanks for the contribution. We have a question.
- About “Model Management and Transfer of a trained ML model through the network interfaces” does mean the model parameters are exchanged in RAN1 interface?
6 – Lenovo Information Technology As stated in our contribution RWS-210253, we also support to study air interface related part. Besides that, we also would like to study distributed AI among RAN nodes: v Study potential enhancements on **RAN interfaces** to support distributed intelligence, which may include intelligent task segmentation, data sharing, computing offloading and learning model sharing among devices and RAN nodes for a certain AI task; v Study potential enhancements on **air interface** to address the QoS related requirements regarding data sharing, computing offloading and learning model sharing between UE and RAN node.
7 – MediaTek Inc. Thanks for the contribution. A general question for clarification: 1) Does Nokia expect to standardize the data collection procedure for training and inference?
8 – Qualcomm Incorporated What additional use cases are preferred? is it restricted to RAN3 led topics or including PHY operation, e.g., RS design, CSF?
9 – Samsung Electronics Polska Does ”machine learning algorithm” means model training and inference, or inference only? Can UE power/computation to support ML model?

Feedback Form 4: Phase 2 questions for AI/ML for NG-RAN

1 – vivo Mobile Communication Co.

Thanks for sharing your understanding on AI over air interface. We notice the following reply in your first round answers.

Comparability and verification of AI/ML features for different use cases might be different. Do you think we should at least down-select the use cases first and then based on the selected use case we check comparability/verification of the AI/ML features? Or do you think down-selection of use cases should be conducted/studied to ensure common understanding on comparability/verification?

”Ensure comparability/verification of AI/ML features, which should be done first before investigating specific features”

2 – Intel Corporation (UK) Ltd

Q1: regardingto“WethinkthatifSON-MDTworkinRel-18issmall, itcouldbeaddedtoaWIonAI/ML”. Does it mean SON-MDT WI to extend with AI/ML? or a WI for AI/ML which supporting SON/MDT related use cases?

3 – MediaTek Inc.

Thanks for the answers.

AI traffic includes data collection & model transfer, the former may be done with existing procedure, how about the latter?

2.3 Questions for RWS-210118 Network energy efficiency in Rel-1

Feedback Form 5: Phase 1 questions for Network energy efficiency in Rel-18

1 – MediaTek Inc.

Thanks for the quality contribution.

The quoted figure in slide 2 shows existing NR parameter (SS burst periodicity) is near optimal, and NR gNB can achieve 15%-85% power consumption reduction compared with LTE eNB. On the other hand, operators still observe 3x power consumption with NR gNB. Is there any analysis that can explain such disagreement? Or will a systematic study still be necessary to investigate the issue and identify the solutions(s) to close the power consumption gap.

2 – CATT

Thanks for sharing the view of the importance of network energy efficiency. We kind of disagree with your assessment that UE power saving is detrimental to network energy efficiency. The DRX and DRX adaptation with WUS not only allow UE to have longer sleeping time and continuous sleeping when there is not data but also allow gNB to turn off DL Tx for network power saving on some slots when there is no data for any UE. One question to your contribution is whether network energy saving should be a standalone study item or incorporated in other feature.

3 – BBC

Sustainability

The BBC supports measures to improve the sustainability of the 5G RAN.

In particular we're keen to see a realistic and standardised methodology for the measurement and modelling of power consumption in networks to help operators to reduce their impact. In addition, as a content provider, the BBC would like the ability to better understand the impact of our content being consumed over these networks to also drive down our impact.

4 – KT Corp.

KT happy to see Nokia's suggestion of introducing base station sleep mode for network energy efficiency.

Hope to see this idea to be developed into SID in the future meetings.

5 – LG Electronics Polska

Could you explain why mobility enhancement or AI/ML SON items should include consideration of e.g., registration areas optimized for energy saving?

6 – HUAWEI TECHNOLOGIES Co. Ltd.

Thanks for the contribution. We have one question as below:

1. For longer periodicities, it is expected it will result in larger access delay, do you consider some other way to achieve both power saving and also avoid increasing access delay, e.g. on-demand SSB?

7 – Spreadtrum Communications

Thanks for the quality contribution. Regarding the proposal that "Network energy efficiency should be a criterion for selection of solutions across Rel-18 features", does it mean that Network energy efficiency can be specified in some other topics, i.e. no separate SI/WI for Network energy efficiency?

Feedback Form 6: Phase 2 questions on network energy efficiency

1 – VODAFONE Group Plc

We are supportive of work on energy savings and agree that all work items should take it into account. In that respect, are there any particular things that should be done to improve the base station energy consumption with regard to 'bounded low latency'/Guaranteed Bit Rate services, or, URLLC, or 'RAN slicing'?

2 – MediaTek Inc.

Thanks for the response to our 1st round question. While we think considering network energy efficiency in all R18 is important, it is easy for companies to argue their proposals will not impact network energy power saving if there is no quantitative evaluation methodology available for the judgement.

Also, scattered power saving features can cause trouble to handle feature interaction/compliance. For example, 2nd DRX is separately developed by R16 TEI and is still not compliant with other R16 power saving features so far.

By the above consideration, one R18 power saving item will be efficient and effective to develop power saving features with mutual compliance and wide supports.

2.4 Questions for RWS-210119 On spectrum extension beyond 71 GHz

Feedback Form 7: Phase 1 questions for spectrum extension beyond 71 GHz

1 – Motorola Mobility Germany GmbH

[Lenovo, Motorola Mobility]:

- What are your views on two parallel items in Rel-18 including further enhancements for B52.6-71 GHz and extension beyond 71GHz and corresponding timeline?

- Do you think the channel models in TR 38.901 are sufficient for FR between 100 – 114.25 GHz?

2 – Samsung Electronics Co.

Q1: Nokia mentioned beyond 71 GHz may be useful in the future, but it is too early for studying, then what's Nokia's expectation on the timing to start such work in 3GPP?

Q2: Becausecurrenly3GPPhaschannelmodelupto100GHz, doyouthinkRAN1canfirststudy71100GHz and after RAN1 finish channel model >100GHz, then, start the study >100GHz.

3 – InterDigital Communications

Q1. do you think existing channel model can be simply reused for beyond 71GHz without additional study although it was study based on the frequency up to 100GHz?

4 – CATT

We agree the key question is the appropriate timing for such work in 3GPP and Release 18 is too early for studies beyond 71 GHz.

5 – Beijing Lenovo Software Ltd.

We agree that waveform may the the first one important issue for beyond 71GHz, while other related issues including new modulation, new antenna models and larger number of beams should also be considered.

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6 – Sony Corporation

Thank you for this contribution. Do you consider DFT-s-OFDM still candidate waveform the spectrum in above 71 GHz?

Feedback Form 8: Phase 2 questions for spectrum extension beyond 71 GHz

1 – Spark NZ Ltd

Even up to 100 GHz the existing channel models are a stretch. a rather simple method to extend the frequency dependence of parameters was used to make the channel model valid up to 100 Ghz.

2 – Huawei Tech.(UK) Co.. Ltd

Thank you for the contribution. What is the upper bound of the frequency range you considered to be studied in the timeline of 5G-advanced? 100GHz, 114GHz or 275GHz?

2.5 Questions for RWS-21012 NTN development path

Feedback Form 9: Phase 1 questions for NTN development path

1 – THALES

Thanks for the triggering the e-mail discussion. We think that NTN related topics should be handled under

AI Non-eMBB-driven Functional Evolution

2 – Spreadtrum Communications

We are very interested in power saving in idle mode. What are Nokia's specific considerations on power optimization for NR-NTN IoT devices in idle mode?

3 – Intel Technology India Pvt Ltd

Enabling NR NTN without GNSS at the UE may lead to decreased system performance due to larger PRACH reception window (especially for GEO) and frequent PRACH transmission (especially for LEO). Do you expect that the significant part of connections will correspond to UEs without GNSS coverage?

4 – MediaTek Inc.

Q1: What are the use case, scenarios, and aspects specific to RedCap to support NTN?

Q2: Use case, scenarios, and needs for reduced-GNSS use to mitigate impact on power consumption with new RACH and signals and introduction of Closed Loop frequency control expected high impact on RAN1 specifications and workability to support long connection, high update rates for TA and frequency compensation indication, gains over simpler solutions based on Rel-17 NTN NR solutions with validity timer for UL synchronization?

5 – HUAWEI TECHNOLOGIES Co. Ltd.

Q1: Can you clarify the use cases and deployment scenarios for the support of RedCap in NTN in particular for indoor deployment? How much coverage extension do you expected to support RedCap NTN for indoor scenario?

Q2: Regarding the support of operation without GNSS, which one do you think should be prioritized in Rel-18 between smart phone and RedCap UEs?

Q3: For operation without GNSS, in addition to the enhancement to time and frequency synchronization, how to support CGI remapping in gNB?

6 – CATT

A few questions for clarification:

1. "Enhancements to support mobility/reselection optimizations for moving LEO satellites, minimizing battery consumption and ensuring good performance [RAN2/RAN3]", this bullet means to consider discontinous coverage for NR NTN in Rel-18?

2.About the interworking between TN and NTN, what kind of behavior are expected, handover/redirection/reselection, or DC like coordination? what do you think of the need of coordination between LEO/GEO/HAPS?

3.On support of RedCap devices,Rel-17 RedCap design is used as baseline? Or we could further combine the work between NR NTN and RedCap in the future release?

7 – Qualcomm Incorporated

1.- What are the use cases of Redcap devices in NTN? And in the context of NTN, will the RedCap devices have only 1 receive antenna, narrower bandwidth, or both? Also, what is the expected specification impact on top of Rel-17?

2.- On NTN IOT, could you further elaborate on the power optimization schemes? We agree this is an important topic, just would like to know more details.

8 – Samsung Electronics Polska

For mobility/interworking between TN and NTN, is it assumed that a single operator owns terrestrial and satellite based networks?

It is mentioned to focus on RedCap devices. Is this proposed as a priority for Rel-18? Is the non-GNSS operation assumed for RedCap?

9 – Lenovo (Beijing) Ltd

Thanks for the contribution, we have two comments

1) For UE w/o GNSS, new method for TA/frequency estimation, Is the estimation done by gNB or UE?

2) For IoT NTN, (uplink) power optimization for IDLE mode. Is this targeted for PUR tranmsision?

10 – Lenovo (Beijing) Ltd

We are interested in the proposed objectives for NTN and have the following questions:

(1) For UE without GNSS, you mentioned ”requires new methods for TA estimation”. Does it mean you would like to consider new methods to derive TA for UE without position info, or new methods for positioning so that UE can calculate TA?

(2) For minimizing power consumption, we agree that optimisation may be needed for PSM in sparse NTN deployment. We notice that PSM duration is controled by timers configurd by NAS. Do you consider optimisation only in RAN scope (e.g. RAN2) or there could be coordination with other TSGs?

11 – China Unicom

Thanks for this contribution.

Could you please provide more details on “improved mobility and interworking between TN and NTN in order to provide seamless connectivity [RAN2].” in page 3?

Feedback Form 10: Phase 2 questions on NTN development path

1 – ZTE Corporation

Thanks for your contribution and replies. W.r.t the redcap part, it seems that continuous enhancement is still expected for TN, e.g., bandwidth issue. It may be preferred to discuss it in later phase. Moreover, for redcap, it seems that directly linkage to satellite by wearable is not realistic with consideration on usage of mobile phone, so, any views on it. BTW, if the final requirement or capability for Redcap device in NTN is not same the TN case, do we prefer to define a new UE class?

2 – Samsung Electronics Polska

Q1: Do you consider the enhancement of DC to be applied to the case where two operators own each network?

3 – Omnispace

We support your proposals. We believe support for Redcap in NTN will open many new use-case.

4 – China Unicom

Thanks for your contribution and clarification. What's the potential solutions on handover/redirection/reselection, CA, or DC like coordination scenarios for NTN? Besides, since HAPS and TN may be deployed by the same operator, what's the potential solutions on mobility/interworking for HAPS and TN?

2.6 Questions for RWS-210393 RF enhancements for Rel-18

Feedback Form 11: Questions for RF enhancements for Rel-18

1 – Intel Technology India Pvt Ltd

(1) For MSD, does Nokia intend to study on feasible relaxation (improvement) for each band/BC? or simply to specify relaxation?

(2) Does Nokia prefer multiple level of relaxations? or a single value?

2 – Samsung Electronics Polska

Q1: For A-MPR optimization, what is the asusmption of scheme of mitigating the IMD products for further A-MPR optimizations?

Q2: We would like to confirm the MSD improvement is aimed for FR1 only or both FR1 and FR2? And how to determine which band combination whose MSD need be improved?

Feedback Form 12: Phase 2 questions for RF enhancements for Release 18

1 – VODAFONE Group Plc

Thank you for the contribution. We support studying and specifying A-MPR optimizations for UEs that are capable of a lower MSD.

2 – Huawei Technologies France

Thanks for the contribution.

A-MPR optimization:

Question 1: will the A-MPR optimization is limited to specific scenario or a general consideration?

Question 2: What's the methods in mind to optimize the A-MPR requirements?

MSD optimization:

Question 1: what's the assumptions for MSD optimization?

Question 2: How to utilize the MSD UE capability if only a small portion of UE have optimized MSD

Question 3: : How to handle a band combination with different MSD sources, e.g. IMD, harmonic, harmonic mixing, cross band isolation, etc.

Question 4: How to handle the combination with MSD in the spec but on MSD in real network for specific frequency configuration?

2.7 General comments

2.8 Answer to the questions Phase 1

2.8.1 Answers to questions on RWS-210082 RAN slicing enhancements for Rel-18

Table 1: Phase 1 answers for RAN slicing related questions

Deployment Scenario (Small Coverage Area Slices)	The main motivation for this objective is to enable efficient deployment of network slices with coverage restrictions, for example, restricted coverage area or duration. Although each cell can support different slices, as highlighted in the background slide of our contribution, currently, network operators would need to modify the TA configurations with slice support updates. The Rel-18 RAN work should study RAN features and procedures that can simplify deployment of such slices and minimizing the TA reconfigurations.
Slice Prioritization	Yes, this topic is partly also discussed in current Rel17 discussion on Slice specific cell re-selection and RACH configuration. Rel-18 can study any leftovers as well as any new aspects, for example, connected mode mobility where the UE is connected to multiple slices and the target cell may not support all required slices of UEs, etc.
RAN Topology Awareness by AMF	This is currently proposed in SA2 for Rel-18 Network Slicing Enhancements (S2-2104475). The main motivation is to enable the core network (AMF) to define optimized registration areas for different UEs by considering the actual deployed TA topology.

2.8.2 Answers to questions on RWS-210083 AI/ML for NG-RAN in Rel-18

Table 2: Phase 1 answers for the questions for AI/ML for NG-RAN

Rel-18 AI/ML study item involving the air-interface	We believe that there is a high number of highpriority studies that need to be undertaken in Rel-18 and it needs to be carefully decided what the scope of such a study item on AI/ML for air interface would be in order to have a conclusive and meaningful outcome. If there is going to a study item on AI/ML for air interface, we believe it must Ensurecomparability/verificationofAI/MLfeatures, which should be done first before investigating specific features Identify preferred application areas, benefits, complexity, potential std impact, and the trade-off between complexity and benefits must be evaluated Ensure that 3GPP RAN1 specification does not become dependent on AI/ML implementations but the 3GPP NG-RAN must be sufficiently agnostic to potential AI/ML implementations. The framework should cover both RAN interfaces and air interface. It would remain to be investigated if there is need for ML-specific procedures or new ML-specific parameters, but at least existing signaling capabilities over radio and between RAN nodes should transfer information useful for ML/AI. Also, it is important in the early phase of the study investigate how to ensure and verify predictable UE behavior with AI and also how to ensure that UE always meets the minimum requirements when AI is utilized by UE.
SON/MDT	Yes, we support to extend the MDT framework for AI/ML purpose; With respect to QoE in the WI, the topic has just moved into WI phase in RAN2 and RAN3. For this reason, we prefer to wait until the topic reaches the required maturity. We think that if SON-MDT work in Rel-18 is small, it could be added to a WI on AI/ML.

AI-based UE Centric approach	Further measurements made in UE may be relevant for use cases identified in the Rel-17 SI General architecture support for training and inference of Machine Learning algorithms located in the UE should be studied Before deciding to focus on UE-centric methods, we should investigate the use cases in general. UE-based methods for ML model shouldn't be primary goal in 3GPP Rel-18. Intentionally, first UE-RAN signaling capabilities should be in scope. AI-based mobility is already under study in Rel-17 and may be considered for further study in Rel-18.
If no conclusion is made to transfer a trained ML model through the network interfaces, maybe it needs further study in Rel-18.	We agree we need to see Release 17 SI conclusions before everything about Release 18 scope can fully concluded.
ML algorithm exposure	The intention is not to expose ML algorithms and implementations specific details on interfaces.
Data collection procedures	We would prefer to rather extend and re-use existing procedures in order to enable data collection for training and inference.

2.8.3 Answers to questions on RWS-210118 Network energy efficiency in Rel-18

Table 3: Phase 1 answers to the questions on energy efficiency

LTE vs 5G network energy efficiency	We have observed an example measurement from a real network which suggest 5G technology is up to 90% more efficient than 4G in terms of energy consumption per unit of traffic (W/Mbps). This is of course just a starting point, we need see in each change we do for specifications that we rather improve network energy further than cause degradation.
Network energy efficiency as standalone WI	Nokia view is that a standalone WI can have only limited impact on network energy efficiency, while it would be more important to consider in all changes we do what is the impact to the network side power consumption, be that for example related to UE energy efficiency, XR for NR or MIMO enhancements. Otherwise we risk introducing as part of the other work items changes which impact negatively network energy efficiency.

Registration areas optimized for energy saving	If you can optimally define a RA (registration area) for a UE based on the UE behaviour and slices sets it supports and awareness of the TA topology, one can strike an optimal balance Registration management/paging traffic, you can save energy (extend battery lifetime in UE and process less control plane messages). in rel-18 we propose to improve the topology awareness in the CN and this may impact the RAN in that the RAN can provide topology info to CN via NG. AI can be naturally used to help defining RA for a given UE.

2.8.4 Answer to questions on RWS-210119 On spectrum extension beyond 71 GHz

Table 4: Phase 1 question answer on above 71 GHz

Channel model in TR 38.901	We see the new channel model only needed when addressing frequencies above 114.25 GHz
Simultaneous handling of 52.6 and 71 GHz as well as above 71 GHz	We don't see urgency for further enhancements for 52.6 – 71 GHz
Above 71 GHz timing	From Nokia point of view we should revisit this after Release 18 when having more information about the spectrum availability in the frequency range as well
Candidate waveform for above 71 GHz	DFT-S-OFDM would be a natural starting point. But we should consider also PAPR reduction on top of DFT-S-OFDM (such as spectrum shaping) as well as other single carrier waveforms.

2.8.5 Answer to questions on RWS-210120 NTN development path

Table 5: Phase 1 answers for the questions on NTN development path

Power savings	We are mainly targeting NTN related UE power savings in idle mode, but are not excluding power savings in active mode. Features for small data transmission like PUR are within the scope. For idle mode savings can be achieved for both continuous and discontinuous coverage by for instance avoiding reading system information at every cell reselection and avoidance of cell search when there is no cell available. We believe the main work is in RAN scope.

GNSS less operation	We believe the solution where the NTN network is used for determining the UE position is preferred but we do not exclude other methods where the system can function without knowing the exact physical location of the device. Some overhead can be expected with the introduction of such concepts, but this will enable that UEs which are indoor, in deep forests or other places without GNSS reception can utilize NTN, plus will avoid that UEs provide a wrong GNSS position. This is targeting all types of NTN devices and may impact both UE and RAN.
RedCap	The use case of RedCap is both for low cost smartphones and enhanced NTN IoT devices (supporting larger throughput than eMTC/NB-IoT), enabling global usage of NTN. RAN should discuss what minimum capabilities need to be supported for these devices in NTN. These devices should also be supported indoor, which is covered under the GNSS less operation point above, which should be supported by these devices. The work can start using RedCap rel 17 capabilities.
Mobility / Interworking	Under mobility /interworking we believe the work should focus on seamless mobility between TN and NTN , considering features like DC. The starting assumption should be that these networks can be owned by different operators. Mobility/interworking between different 3gpp based satellite systems, like GEO and LEO, can wait to later releases.

2.8.6 Answer to questions on RWS-210393 RF enhancements for Rel-18

Table 6: Phase answers for question on RF enhancements

MSD: if study of MSD is conducted for each band/BC or not.	No, it is not. The original goal was not to study a way to improve MSD itself for each band/BC, but rather just define a way for UEs to tell gNB/eNB UEs' real ability in terms of MSD if they have smaller MSD than specified ones. So, actually, we don't have intention to pursue to study which BC can have less MSD or not. We are just saying if fortunately, a UE can have even less MSD maybe thanks to sufficient PCB isolation etc., we just want a way for the UE to share that information with gNB/eNB.
MSD: If capability of MSD level for each BC is introduced, does it have multiple levels or a single value?	It depends on BC. If a BC A has 10 dB MSD in the spec, it might be OK to have just have a single value. But if another BC B has 30 dB MSD in the spec, we may have multiple levels. For instance, we may have a capability to report 10, 20 or 30 dB better MSD than specified one for a BC. The BC A would use only 10 dB. If it is reported, the UE's BC A does not have any MSD(10-10=0). The BC B would use 10, 20 or 30 dB. If the UE's BC B MSD is 10 dB, 20 dB is reported(30-20=10dB), if it is 20dB, 10dB is reported or if it is 0 dB, 30 dB is reported.
MSD:DoesthisproposalapplyforbothFR1andFR2 ?	Only FR1
A-MPR optimization: What is an assumed scheme to mitigate the IMD products to reduce A-MPR?	One example. In LTE, we introduced a method to optimize MPR for intra band UL CA according to IMD5 region (see 6.2.3A in 36.101). That is the basis. In LTE, we fixed the LO position at the center of the UE CBW and if the UL RBs is close to the center, IM5 does not reach strigent SEM region so that smaller MPR can be seen. Now in NR, we can know where LO is (it can be reported) and where the UL RBs are. I mean the UL RBs at least confined within an UL BWP. Hence, if we know the distance the edge of UL BWP and the LO, we can identify more suitable A-MPR. Though we can produce more optimized AMPR but it requires evaluation, so we could find a way to refer to more suitable CBW for A-MPR. For instance, a UE uses 50 MHz CBW. If LO is close to the center of the BWP and if the BPW is 20 MHz, we don't need to apply A-MPR for 50 MHz CBW but rather we can apply A-MPR for 20MHz CBW.

2.9 Answer to the questions Phase 2

2.9.1 Answers to questions on RWS-210082 RAN slicing enhancements for Rel-18

Table 7: Phase 2. Answers for slicing related questions

Slice priorization	Slice prioritization could be applicable in both scenarios i.e. mobility with slice re-mapping as well as regular mobility without any slice re-mapping. For mobility events where slice re-mapping could be applicable, some slice prioritization information can help to identify, for example, the most critical slices/services. This could help to achieve optimized re-mapping decisions and efficient network resource utilization.

2.9.2 Answers to questions on RWS-210083 AI/ML for NG-RAN in Rel-18

Table 8: Phase 2 answers for AI/ML for NG-RAN related questions

SON-MDT	We believe that "traditional" SON/MDT should continue to evolve in Rel-18. A separate WI is preferable.
AI/ML for Air Interface	We think that we need to ensure comparability/verification of AI/ML features, which should be done first before investigating specific features.
Model Transfer	We agree that data collection for AI in NG-RAN may be done with existing procedures (or extensions of those). However, we think that current procedures would not suffice to enable model transfer but new procedures would be needed.

2.9.3 Answers to questions on RWS-210118 Network energy efficiency in Rel-18

Table 9: Phase 2 answer on network energy efficiency

Power saving as separate or dedicated item	Thank for your further questions on this area. The general worry for power saving especially from the network point of view is that if we have all network related discussion under a single network item, other work items tend easily to ignore what is impact of their design choices in the network side. Certainly having issues part of TEI is not helping the situation. Going forward the main thing of course will be that network power saving is taken into account systematically whether we are talking about actual power saving features or for example enhancing MIMO or coverage just to mention a few.

Power saving with services with bounded latency, **URLLC or network slicing**	Thank you for the question on network power consumption impact from various features. The key thing in bounded latency service and power saving is to ensure UE and network ”play well together” and have understanding e.g. what kind of DRX is suited and when. Network should not be forced sending stuff in connection with slicing for example on specific part of the carrier only as that will increase network power consumption, otherwise there is no strong dependency between slicing and network power consumption to our understanding (while of course one could develop proposals for slicing that would have negative impact on the power efficiency both for network and UEs). Due this reason we see important to highlight in all work items the need to consider impacts to power consumption, as it is harder to ensure when discussed totally separately.

2.9.4 Answer to questions on RWS-210119 On spectrum extension beyond 71 GHz

Table 10: Phase 2 answers on spectrum extension beyond 71 GHz

Extending the channel model to 114 GHz	Thank you for the questions on the channel model in 3GPP. Based on our investigations so far, we don’t expect major differences in channel characteristics between below 100 GHz and 100-114 GHz.
Upper range of frequency to be studied for 5GAdvanced, Extending the channel model beyond 100 GHz.	When considering work for higher frequency bands with 5G-Advanced, one needs to consider spectrum availability as well. Having first effort to enhance the channel model up to 300 GHz might the right approach, and then see when to address and how high in spectrum to go. When we have a channel model in place, then we can consider launching studies and specification development based spectrum availability and more better understanding of market needs.

2.9.5 Answer to questions on RWS-210120 NTN development path

Table 11: Phase 2 answer on NTN development path

RedCap	ZTE asked about Redcap. Thank you for your question. With Redcap we are targeting devices with reduced capability. Exactly how much capabilities can be reduced needs to be studied by the RAN WG and it may or may not be the same as Redcap for TN. The goal is to have power efficient, low-medium throughput devices which are affordable by a large part of the world population serving a wide range of use cases.

Mobility/Multiconnectivity	Samsung and China Unicom asked question about mobility/DC/Multiconnectivity. Thanks for your questions. With the enhancements for DC between a TN and NTN we are in the first phase thinking of DC between networks where the same operator owns both networks. In general all potential solutions needs to be studied in RAN and we do not want to exclude any scheme as long as both networks are owned by the same operator.

2.9.6 Answer to questions on RWS-210393 RF enhancements for Rel-18 **Table 12:**

Phase 2 answers on RF enhancements for Rel-18

Relation between A-MPR optimization and lower MSD	The MSD mentioned in the proposal was the MSD due to inter modulation due to dual uplink transmission between two different bands and/or harmonic from lower band. Hence, optimizing A-MPR does not help the MSD mentioned here. It is, however, optimization A-MRP has possibility to optimize MSD due to wider uplink transmission bandwidth for FDD bands. More specifically, the number of RBs captured in Table 7.3.2-3: Uplink configuration for reference sensitivity in TS38.101-1 may increase.
A-MPR: If the A-MPR optimization is limited to specific scenario or a general consideration.	A way to optimize A-MPR itself should be generic method. So far we think that applicability of this optimization is optional and per band/per band configuration. Please note also the phase 1 answers for AMPR.
MSD: How to utilize the MSD UE capability if only a small portion of UE have optimized MSD.	How to utilize the capability is the same regardless of how many UEs being able to have small MSD. And the question is not specific to this discussion. The question applies to all the features as specified as optional.
MSD: How to handle a band combination with different MSD sources, e.g. IMD, harmonic, harmonic mixing, cross band isolation, etc.	A good question. It depends. For instance, if a band configuration has MSD due to IMD5 from dual uplink and MSD due to 2nd harmonic from low band. If MSD due to IMD is 5 dB and MSD due to 2nd harmonic is 30 dB, RAN4 may specify lower MSD requirements for 2nd harmonic only. But if the MSD due to IMD is 30 dB, R4 may allow UE to signal lower MSD values for the respective MSDs.

MSD: How to handle MSD for specific frequency configuration not covered in the specification?	A good question and we understand the motivation of the question, but this is not specific to this MSD optimization. It depends on how aggressively or conservatively estimate possible not specified MSD for frequency configurations from the specified MSD and its side conditions. For instance, if there are UEs with MSD of 20 dB due to 2nd harmonic like CA_n1n77, but actual victim CBW is 20 MHz offset from the CBW where the 2nd harmonic directly hits, one would assume no MSD with 20 MHz offset since the current spec indicates 10 MHz offset will have great improvement of MSD for a certain scenario.

2.10 Summary for Phase 1

There seems to be in general wide interest to work on topics like network sharing, RF enhancements, AI/ML for NG-RAN (also interest on the air interface related considerations) or network energy efficiency in Release 18. NTN development is seen to continue to cover more than what Release 17 can accommodate, such as more on mobility or aspects related to RedCap. For above 17 GHz work there is in general interest but also sensing the understanding of lack of urgency at this point in time even if there is technical interest to understand the expected evolution on the waveform aspects (if OFDMA is still the way to go or not).

2.11 Summary for Phase 2

Additionally to phase 1 conclusions it could be recognized the need to consider the network energy efficiency impacts in different areas, like mentioned URLLC or network slicing. The above 71 GHz channel modelling (above 100 GHz) has interest to prepare for the future. There is also interest for RF enhancements in Release 18, including the example areas raised discussed here (MSD/A-MPR)