RAN-R18-WS-eMBB-Nokia - Version 0.0.4
RAN

3GPP TSG RAN Rel-18 workshop RWS-210536

Electronic Meeting, 28th June - 2nd July, 2021

Agenda Item: 4.1

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

1 Introduction

This discussion covers the following contributions:

RWS-210070 Enhancements for XR over NR support Nokia, Nokia Shanghai Bell

RWS-210075 MIMO Enhancements for Rel-18? Nokia, Nokia Shanghai Bell

RWS-210076 Enhanced coverage for Rel-18 Nokia, Nokia Shanghai Bell

RWS-210078 Mobility Enhancements for Rel-18 Nokia, Nokia Shanghai Bell

RWS-210079 CA and DC enhancements for Rel-18 Nokia, Nokia Shanghai Bell

RWS-210080 Small Data Transmission Enhancements for Rel-18 Nokia, Nokia Shanghai Bell

RWS-210081 Flexible UL/DL enhancements for Rel-18 Nokia, Nokia Shanghai Bell

RWS-210084 Resiliency for disaggregated gNB architecture in Rel-18 Nokia, Nokia Shanghai Bell

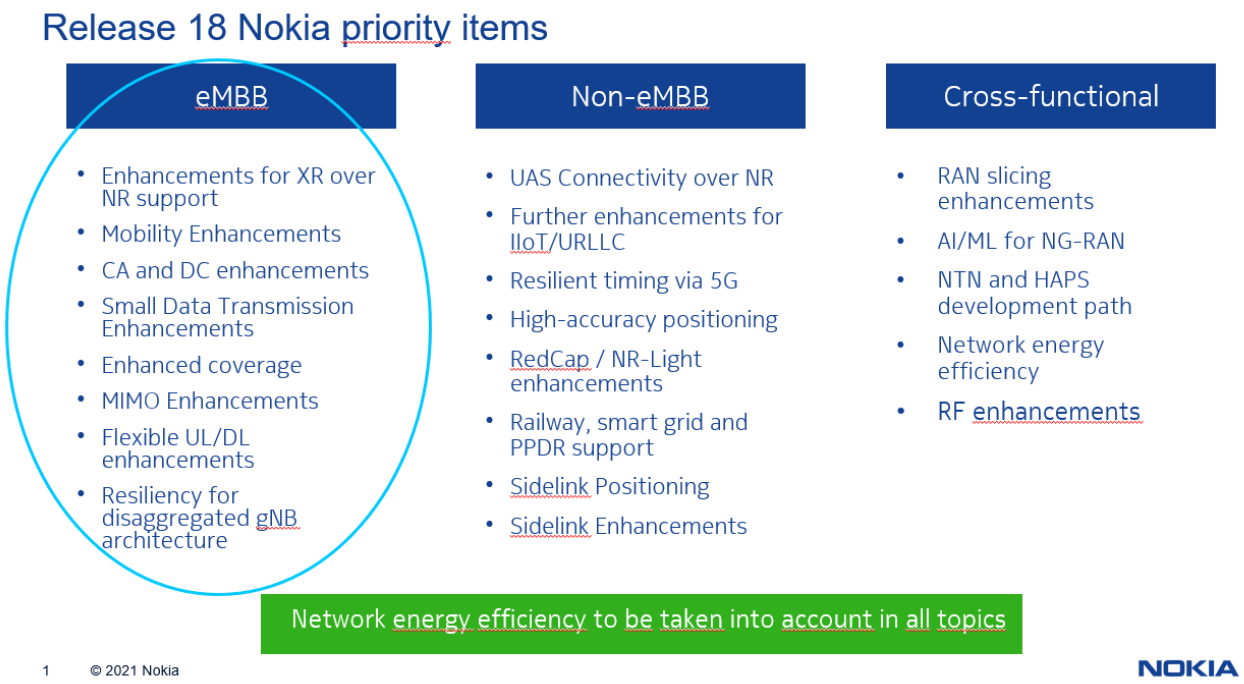

Figure 1: Release 18 Nokia eMBB priority items

2 Comments and questions

2.1 RWS-210070 Enhancements for XR over NR support

Feedback Form 1: Comments and questions on RWS-210070

1 – Spreadtrum Communications For handover, what other measurement report shall be considered except for the timing?
2 – CATT Thanks for sharing the idea of NR enhancement for XR. The proposed area of capacity enhancement of eSPS and eCG, mobility enhancement with MAC-based beam switching, UE power saving with dynamic DRX adaptation, and higher layer QoE enhancement are quite interesting. However, we believe the aspects of NR enhancements should be discussed and concluded in the working groups first during the XR study before further discussion of the scope of XR work item.
3 – HuaWei Technologies Co. Q1. We also see some value on QoS differentiation of the multiple streams. Do you have any specific consideration on what enhancements can be done in RAN and how SA4/SA2 is involved to better support this as in our understanding such differentiation rather requires an E2E mechanism in 3GPP? Q2: some of the listed aspects seem not specific to XR, could you please clarify which aspects you see specific to XR?

4 – Guangdong OPPO Mobile Telecom.

Thanks for the contribution. One question for clarification:

Q: what's the difference between "adaptive discontinuous reception" and "dynamic configuration of DRX"

5 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

1. On the prioritization of XR decoding in SMTC window, is it expected that the quality of measurement degradation due to such prioritization is acceptable or can be controlled by gNB?

2. On the prioritization of decoding for XR critical PDCCH/PDSCH (even if collides with SMTC windows where UE may performs measurements), do you have any views on whether this could be addressed via multiple gap configuration (that may be defined in Rel-17) or a more dynamic operation is preferable as XR critical data?

3. For "a) Synchronous MAC-based gNB beam switch (to avoid critical XR transmission/window", could you clarify the motivation/benefit for this deterministic switch of beam?

4. Could you clarify how can 3GPP have any visibility/trustability to "View per identifier (VPI) and pose information accuracy" in relation to ongoing XR traffic?

6 – ZTE Corporation

Thank you for the contribution. Can you further calrify the RAN3 impacts of higer layer QoE?

7 – Samsung Research America

Slide 4: "(…) iii) dynamic on-the-fly change of eSPS and Configured Grant configuration" -

Given that R17 can dynamically (de-)activate individual SPS/CG configurations, what additional functionality is intended by dynamic change to eSPS/CG configurations? And what would be its comparative benefit? Could you provide some more background on the motivation of this part of the proposal?

Slide 4: "FR2 prioritized decoding during SSB based measurement timing configuration" -

What is the expected / estimated achievable gain in the XR KPIs with the proposal? Is it right to assume that prioritization by the UE of PDCCH decoding when scheduling XR in SMTCs implies that SMTC measurement behavior cannot be left to UE implementation any more, e.g. for the proposed scheme to work, the gNB must rely on the assumption that the UE will decode PDCCH on the serving cell during SMTC? What impact do you expect and to what extend do you foresee the need to relax BF/RRM measurement requirements (when skipping some/many/majority of SMTC)?

Slide 5 & Mobility for XR: Could you provide more background as to why it would be critical to include XR mobility enhancements right away into the R18 SI/WI (as opposed to consider this an optimization for a later Release)? For example, is there anything XR-specific about mobility handling (incl. interruption times during HO) which wouldn't also apply to generic URLCC? For example, do you anticipate that he likelihood of mobility events for XR applications would be higher than typically expected for URLCC/factory-floor IIOT services such that there would be a scaled benefit of considering XR related mobility enhancements through (e)DAPS in a SI? It is not obvious to us to include XR mobility in a SI, so any insight you could provide here would be greatly appreciated.

8 – MediaTek Inc.

Thanks for the good contribution. We have some questions below to know more about the enhancements.

- For enhanced SPS and CG to match XR DL/UL periodicity, dynamic grant should be sufficient for DL (low overhead and high efficiency). UL traffic can also utilize flexible CG type-2. What are the expected additional enhancement and benefit?
- For Enhanced CDRX to match XR frame rate, DCI-based power saving is able to achieve the best dynamic and fine-granularity power saving. What is expected addition enhancement w.r.t. R17 PDCCH monitoring reduction and benefit, considering very dense UL (Ex. 4ms) in XR assumed in SA4?
- For cross-layer enhancement, RAN1 can first conclude the benefit of RAN awareness of application and application awareness of RAN first (Ex. packet dropping, packet prioritization), and then the work can be led by SA4 since QoS requirements are currently under study in SA4. How is it planned to progress the work in SA4 and RAN for RAN awareness of application and application awareness of RAN?
- For the 5QI enhancement, how is it planned to progress the work in SA and RAN for QoS perspective?
- For FR2 prioritized data decoding during SMTC, what's the expected amount of impact to RRM performance and the capacity gain?
- For UE informing gNB intra-frequency measurements and synchronous MAC-based gNB beam switching, would the impact to UE implementation and the capacity gain be studied first?
- For eCHO and FR2 DAPS-HO, whether these mobility enhancements can be used for other use cases other than XR?

9 – Apple Europe Limited

could you provide more details on "dynamic on-the-fly change of ePSPS and configured grant configuration"?

Could you provide a minimum set of critical mobility related features for XR? ECHO vs DAPS?

10 – Qualcomm Incorporated

1) What is the difference of "Adaptive DRX" and "Dynamic configration of DRX" under power saving?

2) Please provide additional explanation for pose info accuracy for UAI? How can it be used by network?

3) Typically, beam management should be performed as quick as possible to avoid beam loss so how could this beam switching be timed to avoid overlap with XR? Some clarifications would be useful. Is there a specific usecase in mind?

11 – Samsung Electronics Co.

Additional questions:

1. Given that Rel-17 can dynamically activate/deactivate individual SPS/CG configurations, what additional functionality is intended by dynamic change to eSPS/CG configurations and what would be its comparative benefit?

2. What is the tradeoff of a UE skipping SMTC windows to decode PDCCH in FR2? What is the expected average gain in the XR KPIs?

3. What is the likelihood of mobility events for XR applications and what would be the scaled benefit of enhanced DAPS vs. no eDAPS in such scenarios? What about mobility is XR-specific and was not e.g. URLLC-specific?

12 – LG Electronics Inc.

Thanks for the contribution.

Q1) In your paper (RWS-210070), WI objectives are proposed. For the objective on mobility and beam management enhancements, is it your intention to work on the mobility and beam management in XR WI rather than in MIMO WI? For the sub-bullet on Enhanced Dual-Active Protocol Stack (DAPS), you redirected readers to the mobility WI for details. Then could you explain which part of the mobility and beam management is intended for XR WI, if any?

13 – China Unicom

Thanks for the contribution.

We share the same view for supporting higher layer QoE. What is the potential solutions for higher layer QoE?

For Synchronous MAC-based gNB beam switching, what is the potential impact on XR service, i.e. packet jitter?

2.2 RWS-210075 MIMO Enhancements for Rel-18?

Feedback Form 2: Comments and questions on RWS-210075

1 – LG Electronics Inc.

Could you elaborate more on the scope of proposed enhancement of interference indication?

2 – Samsung Research America

- (p5-p6) Just to clarify, is Doppler-domain compression for Type-II codebook what you have in mind? Or any other enhancement, e.g. on CSI-RS?

- (p7) Re multi-layer PUSCH transmission with DFTS-OFDM, could you elaborate more on how to obtain coverage gain based on higher rank with DFTS-OFDM (knowing from LTE that DFTS-OFDM-based MIMO incurs difficulties in designing advanced receivers at the gNB side)?

- (p7) How much PAPR reduction is expected for multi-layer PUSCH with DFT-S-OFDM have over that with OFDMA?

3 – Beijing Xiaomi Mobile Software

- Q1: for ‘CSI acquisition enhancement for higher mobility UEs/ High Speed Trains’, from your material, we find that your possible solution is to consider the relation in time domain and to report wideband CSI only. From our point of view, there is no spec impact of reporting wideband CSI only. While for the relation in time domain, is it possible that the overhead will be not reduced since it is not sure which parameters will be changed and the range of the parameters may be large.

- Q2: for ‘Enhanced TCI framework: enablers for dynamic configuration of separate TCIs’, we want to clarify the difference between this point and Rel-17, does it mean that the dynamic configuration is not concluded in RAN1-105 e-meeting, thus it need to be enhanced in Rel-18?

- Q3: The dynamic indication of interference is worth studying. More explanation is appreciated.

- Q4: for ‘Enable dynamic TCI state switching for periodic RSs’, we want to know the motivation of this point. From our understanding, if the TCI states need to be dynamically changed, it can be configured as semi-persistent or aperiodic RSs.

- Q5: for ‘Unified TCI framework is a redundant signalling framework, which is not necessary for multi-TRP operation’, we are wondering what is the meaning of this sentence.

4 – Guangdong OPPO Mobile Telecom.

Thanks for the contribution. The scope seems too large for Rel-18. Down selection is inevitable. Is there any preference on priority in the mind?

5 – ZTE Corporation

Thanks so much for sharing this contribution.

- On multi-codeword encoding for mTRP, we are interested in more than one codeword for UL transmission. Then, some clarification of combining the introduction of multi-codeword and mTRP together is highly appreciated. From our perspective, multi-codeword for UL is general issues for supporting imbalance of channel quality corresponding to different layers even in the sTRP. Combining these two issues together seems not to be needed in our initial views.

6 – MediaTek Inc.

Q1. MB: If NW would like switch the beam for CSIRS/SRS more dynamically, why doesn’t configure RS in semi-persistent or aperiodic?

Q2. MB: For reduction of TCI activation latency, to our understanding, panel switching latency is not the only reason why the 3ms delay is needed. Moreover, according to RAN4 requirement of TCI activation, latency is dominated by SSB measurement instead of the 3ms.

Q3. For UE-assisted UL Tx beam selection, what's the difference between Rel-17 SSBRI/CRI reporting for MPE mitigation (if supported)? Why only focus on beam selection for UL rather than both DL & UL?

Q4: CSI tracking is performed by UE or gNB? Please could you explain the basic approach?

7 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

1. If unified TCI is not supported for mTRP, we should continue using spatialRelationInfo for UL. Why do we need two frameworks?

2. What kind of assistance and reference UE receivers are considered for "Support interference handling enhancements"?

8 – Futurewei Technologies

Thank you for your contribution. FUTUREWEI also support work on high mobility MU-MIMO enhancement, multi-TA related extention of mTRP scenarios. In addition, we proposed to work on cooperative MIMO schemes to improve system capacity for XR, FWA and other challenging services. Please take a look at our contribution RWS-210036 (https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_AHs/2021_06_RAN_Rel18_WS/210036.zip) and feel free to comment at: https://nwm-trial.etsi.org/#/documents/4580 . BTW, we are not sure we understand your statemenet that "unified TCI framework is a redundant signaling framework". Can you please clarify?

9 – Motorola Mobility UK Ltd.

Thank you for the interesting contribution. My question is related to your proposal in the ***"CSI acquisition enhancements"*** section, which reads *"Study the use of DMRS for CSI acquisition, to reduce the measurement delay, CSI calculation delay (e.g., fewer ports to measure)"*. Does that imply using DMRS for CSI acquisition in conjunction with CSI-RS? How do you envision the specification impact of using DMRS-based channel acquisition, which ties CSI measurement with PDSCH transmission?

10 – Spreadtrum Communications

Thanks for the contribution. In our views, DFT-s-OFDM is only configured to achieve low PAPR for cell edge UEs. For multi layer PUSCH with DFT-s-OFDM, is it configured for cell edge UEs or cell center UEs? If it's for cell center UEs, what's the benefit on configuring DFT-s-OFDM comparing with CP-OFDM? If it's for cell edge UEs, how to ensure the coverage?

11 – Beijing Lenovo Software Ltd.

Q1: On MB enhancements, what do you mean on the sentence "assist dynamically UE to determine its RX according to indicated interference situation"? Does it means that the gNB shall additionally indication the 'interference beam(s)' for a scheduled PDSCH in addition to the TCI state?

Q2: On mTRP enhancement, we are also interested in the simultaneous multi-panel UL transmission with multi-codeword, but the power control or the power allocation batween different TX panels may be a important issue. More explanations on this issue are appiciated.

12 – Qualcomm communications-France

On P3, could you elaborate a bit more on P3 narrow beam alignment? For UE assisted UL beam switching, any difference from R17 MPE UL beam report? Could you elaborate a bit more on enhanced interference indication?

13 – HuaWei Technologies Co.

Thanks for the contribution, we have the following questions:

1. CSI enhancements are proposed for high mobility scenarios, whether the enhancements are for both TDD and FDD, where TDD CSI acquisition is generally based on SRS? There are high mobility cases for both TDD and FDD systems.

2. On Page 6, why the performance of R16 degrades as the overhead increases?

3. On Page 3: ”P3 narrow beam alignment procedures” was not elaborated in follow-up slides. As P3 procedure has been supported with CSI-RS resource set with repetition set to ON, what is being proposed here?

14 – NTT DOCOMO INC.

Could you elaborate more on interference handling enhancements in your mind?

15 – Qualcomm communications-France

Regarding ”reduce max latency b/w CSI-RS and CSI”, could you please elaborate the potential spec impact? Change the rules related to DRX?

16 – CATT

On CSI calculation delay reduction (e.g. using fewer CSI-RS ports), what is the general flow of procedure?

17 – Ericsson LM

· On UL MIMO, what is the underlying antenna array assumption for the 8 TX codebook for UL?

· Regarding simultaneous UL transmission towards multiple TRPs, we understand that simultaneous transmission of two PUSCHs or two PUCCHs will be in scope. Do you also propose to consider simultaneous transmission of one PUCCH and one PUSCH from two different UE panels?

· Regarding the proposal “Unified TCI framework is a redundant signalling framework, which is not necessary for multi TRP operation.”, wouldn’t it be beneficial if unified TCI framework is extended to multi-TRP also? For instance, multi-TRP operation may have benefits such as fast TCI state switching if unified TCI framework is extended to multi-TRP operation, or?

2.3 RWS-210076 Enhanced coverage for Rel-18

Feedback Form 3: Comments and questions on RWS-210076

1 – BBC

Coverage Enhancement

The BBC supports measures to enhance cell coverage in order to improve the delivery of media services over 5G networks, especially in rural areas.

2 – EURECOM

In general, we support to continue the work on coverage enhancements in Rel-18. Many enhancements identified in the SI have not been treated in the Rel-17 WI and should be addressed in Rel-18. In particular, we are interested in further PUCCH enhancements.

3 – MediaTek Inc.

For RACH msg-1 repetition with same beam, what's gNB behavior on receiving the multiple msg-1 repetition? Is it simply selection diversity?

4 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

1. There were extensive discussions for PRACH enhancement during CovEnh SI phase. For multiple msg1 transmission with same or different beams, can you please clarify whether this is generally applied for both FR1 and FR2?

2. There was no sufficient study for power domain based solution for CovEnh. Some solutions were discussed briefly in SI phase. For the proposed spectrum extension, can you clarify whether there is any RAN1 spec impact?

5 – ZTE Corporation

We also interested in improving UL performance in Rel-18. Most of the proposed enhancements are the left overs of Rel-17, and we are open to further discuss. One clarification from our side: except for RAN4 impacts on performance requirements, are there any RAN1 impacts for the proposed FDSS with spectrum extension in your mind? We have a similar question regarding the proposed tone reservation.

6 – Samsung Electronics Co.

Q1. How the UE chooses the beam for Msg3 in FR2 proposal?

2.4 RWS-210078 Mobility Enhancements for Rel-18

Feedback Form 4: Comments and questions on RWS-210078

1 – MediaTek Inc.

Q1. DAPS for FR2: What are the requirements for UEs to enable DAPS HO for FR2 to FR2 mobility?

Q2. RACH-less: We agree that interruption can be largely reduced if RACH can be skipped. But what are the assumptions for allowing RACH-less handover? Is this applicable only for certain cases (e.g. TA 0 or the same TA), or it should work for general mobility scenario?

Q3. CHO+DAPS: If we find solutions to support general RACH-less handover, do we still need DAPS?

Q4. CHO enhancements: We share the same view that fast selection among pre-configured candidates helps FR2 mobility. Does this imply that the candidates are kept after handover? Can this be a RACH-less execution?

2 – Ericsson LM

1) In objective 2 and 3, make-before-break handover is mentioned. Do you have in mind the Rel-14 LTE version of make before break or do you expect that we should do something more enhanced for NR Rel-18?

2) For objective 1, it says that end-2-end UL latency should be improved. Does end-2-end here cover also CN-delays? Would there be CN impact of this objective?

3 – HuaWei Technologies Co.

Regarding the fast cell selection, can you clarify what is the exact meaning of fast cell selection. Do you think preconfiguration is needed to allow such fast cell selection, is it a fast cell switch?

4 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

1) For E2E UL latency in DAPS HO objective, can you please clarify how to avoid 2 Xn signalling?

2) For the robustness of PSCell access objective (e.g. Allow conditional PSCell access for conditional inter-MN handover with (MR)-DC configuration), is it part of CPAC + CHO? For example, does UE perform CPAC when CHO is performed?

5 – Apple Hungary Kft.

For DAPS FR2+FR2 intra-band, is there any additional requirement at the UE in terms of supporting additional Tx for eg.? We are wondering on the requirment impact from the UE that would be different from FR1-FR2 for eg.

6 – Verizon UK Ltd

We are very interested in mobility enhancement for FR2. And agree that we shouldn't just consider 0-ms interruption as the goal, instead, we should look for ways to shorten the interruption to a more tolerable range.

7 – Lenovo (Beijing) Ltd

Thanks for your paper.

For the UE with a single transceiver, why need to enhance the Make before break for almost 0 interruption since DAPS is kind of MBB mobility. What is the main different between enhanced MBB you proposed and current DAPS?

8 – NTT DOCOMO INC.

Could you elaborate more on interference handling enhancements in your mind?

9 – NTT DOCOMO INC.

Sorry, I input into a wrong place for previous comment. Please ignore it.

10 – Qualcomm CDMA Technologies

Even though most of these solutions have been discussed in the past, the list of objectives is still quite long. Based on the history, not all of them can be done in one Release. Do you have any prioritization among these objectives, also considering the market traction and interest?

11 – Samsung Electronics Co.

We are positive for further mobility enhancements. Please see our questions below:

Q1: In Rel-16, FR2-to-FR2 DAPS HO was discussed, but not specified, because RAN1 and RAN4 then failed to reach a conclusion on feasibility. Thus, it's still questionable on feasibility while considering UE complexity and capability.

Q2: Make-before-break already introduced in LTE is so beneficial, especially for UEs with low capabilities, e.g. with single transceiver. This contribution has just indicated that it can be introduced in FR1 and FR2. We wonder whether to target FR2-to-FR2 case also.

Q3: In Rel-16, RAN2 considered, but didn't introduce RACHless because the gain due to RACHless can be replaced by 2-step RA. However, we have assumed RACHless is still beneficial because 2-step RA would be initiated only with good link quality. Since LTE RACHless would be a baseline, in high-level, we wonder what we should improve RACHless for NR.

Q4: The combination of DAPS HO and CHO could mean two different intentions as follows:

Intention 1 - DAPS HO is triggered upon a certain condition is met, or

Intention 2 - DAPS HO can be commanded (unconditionally) to the UE with CHO configuration

Thus, we wonder the exact intention on DAPS HO + CHO, i.e. intention 1, intention 2 or both.

Q5: We wonder what expected gain is with DAPS HO + CHO.

2.5 RWS-210079 CA and DC enhancements for Rel-18

Feedback Form 5: Comments and questions on RWS-210079

1 – MediaTek Inc.

Thanks for the quality contribution. In general, we are supportive to further CA and DC enhancements in Rel-18. Below please find our comments/questions:

- General comment:
  - For FR2, there is strong demand in aggregating larger number of carriers to exploit the wide spectrum resource. There is a fundamental conflict between UE blind decoding complexity and network multi-carrier scheduling flexibility, which also requires further investigation and resolving.
- Specific comments:
  - On RAN2 procedure enhancement, which part in current procedure of early measurement is suggested to be further optimized/reduced?
  - On RAN4 requirements, which part(s) of UE processing timeline is expected to be reduced? Any impact to existing RAN2/RAN1 design (e.g. more RS)?

2 – Beijing Xiaomi Mobile Software

Thanks for the proposals.

Not clear how to achieve enhanced EMR procedures for FR2? Thanks for the clarification. Any impact to existing RAN2/RAN1 design or only on RAN4?

3 – ZTE Corporation

We are generally supportive of any solutions to reduce the activation time for dormant cells (as also mentioned in our tdoc RWS-210464.

One question we have is whether the CSI-RS reporting is also to be supported for the proposed EMR scheme?

4 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

[UE Requirements for measurement procedures with FR2]

1. We also recognize the potential gain in enhancements in RAN2 mobility. Can you share your views on what are the expected solutions for fast measurement on FR2 (i.e. how could the delay be decreased)?

2. From our point of view one possible way to reduce delays is to consider high-capable UE implementations with multi-beam simultaneous processing. Is it considered as a candidate enhancement?

[Enhanced EMR]

3. What additional improvements are considered for early measurement report for FR2??

5 – Apple Hungary Kft.

We do agree that FR2 needs improvement and need to decide between how much of UE's EMR efforts (which consume) power can justify the usefulness of faster SCell setup. In current release, the UE can report beam meas for the potential SCell using EMR. Could you let us know what additional enh are you thinking, as we have to evaluate this against the UE efforts in providing this info.

6 – Verizon UK Ltd

We think this is a very important area to improve in Rel-18. Thanks for putting the proposals together. One question we have is if it has considered all the likely UE implementations.

2.6 RWS-210080 Small Data Transmission Enhancements for Rel-18

Feedback Form 6: Comments and questions on RWS-210080

1 – LG Electronics Inc.

We are interested in MT-triggered SDT. We also propose to support DL SDT in our paper RWS-210231.

In your paper, it is not clear how the network triggers DL SDT for a UE. We assume paging needs to be enhanced for this purpose, but do you have any other idea on this? Please elaborate more on the mechanism to trigger DL SDT.

2 – Beijing Xiaomi Mobile Software

Thanks for the proposals.

Not clear how to achieve enhanced EMR procedures for FR2? Thanks for the clarification. Any impact to existing RAN2/RAN1 design or only on RAN4?

3 – Beijing Xiaomi Mobile Software

sorry, it is for RWS-210079

4 – ZTE Corporation

We are supportive of the general views expressed in this paper. We also think that MT-triggered SDT which will be missing from Rel-17 would be a low-effort-high-return topic to pursue. As LG mentioned above, we also think enhancing paging could be one way to achieve this, but any other options can be considered too as part of the work.

It has been proposed that this will be useful for network-initiated positioning (which we agree), however, we also think the general MT-triggered SDT scheme could be applicable to any other application too. At the end, our understanding is that we could develop a mechanism that is independent of the application (as is the case with SDT currently). Do you share this view in general?

5 – Sony Europe B.V.

Sony also think MT SDT should be supported as there are many applications that transmit small packets where a UE is the receiver, not only positioning

6 – EURECOM

We are supportive of the proposals in this contribution. Concerning PDCCH monitoring reduction (DRX), do you think further power reduction can be achieved by supporting ”wake-up signal” -based schemes currently specified in RAN1 Rel-17 ”Power Saving Enhancements” for RRC_IDLE ?

7 – HUAWEI TECHNOLOGIES Co. Ltd.

[Huawei, HiSilicon] We also think that MT-SDT would be useful to be enhanced. We have the following questions for the remaining proposed enhancements:

a. PDCCH monitoring improvements: this topic has been discussed in Rel-17 and it was decided that it is not required to address this issue. The reason behind is that an SDT-specific search space can be utilized where PDCCH monitoring occasions are sparser than normally (e.g. in RRC Connected mode). Did your power consumption gains evaluations consider this? Why should this be addressed in Rel-18 considering it was not seen as an issue in Rel-17?

b. SDT without anchor relocation: We agree this would be useful. What kind of enhancements do you have in mind, e.g. using a pre-configured/default RLC context as discussed in Rel-17 or something else?

UE context fetch from outside RNA: We think this issue is not specific to SDT in our understanding and it may occur already in the existing specifications. Do you agree with this understanding? Furthermore, Xn tunnels do not have to be restricted to any specific RNA, it seems that this issue can be addressed with proper network implementation/configuration where neighboring gNBs have Xn connectivity established. Do you agree with this or you see some specific issues that cannot be solved by network configuration/implementation?

8 – Beijing Lenovo Software Ltd.

Thanks for this interesting paper on MT-triggered SDT. Our question is, since R17 MO-EDT is discussed only based on UE inactive mode, do you have any consideration on the priority or preference to the MT-SDT procedure in UE inactive mode or in UE idle mode? If MT-SDT is introduced, it could be apply to other use case besides the positioning.

9 – Qualcomm CDMA Technologies

What types of optimizations are you considering from small data perspective on UE context fetch failure case?

10 – ITRI

Thanks for the proposals. We see the necessity of supporting MT-triggered SDT. This could further reduce the signalling overhead for small DL data arrival. We would like to know whether the paging scheme will be the only solution for informing the incoming small DL data in the proposal.

2.7 RWS-210081 Flexible UL/DL enhancements for Rel-18

Feedback Form 7: Comments and questions on RWS-210081

1 – MediaTek Inc.

Q1: From the objectives, the study seems to focus on dynamic TDD only. Do you also consider fullduplex (FD) TDD at gNB side only or both gNB & UE sides?

Q2: Does the gNB-2-gNB CLI mitigation enhancement require new UE behavior or is transparent to a UE?

Q3: If FD TDD is considered, what is the Impact to legacy UEs? How can these legacy UEs be protected from CLI without any noticeable degradation?

Q4: How substantial is the expected power consumption impact on gNB to implement NR flexible duplex?

2 – Intel Corporation (UK) Ltd

Thank you for the contribution. Please see our questions below:

1. What is meant by ”Conduct the study in line with Rel-16 TDD adjacent channel coexistence conclusions, where dynamic TDD was primarily found feasible for low power gNBs”? Is the idea to restrict to ”sub-band-based FD @ gNB only”?

2. What is your view on relative order of studies on feasibility between RAN4 and RAN1? What type of assumptions on feasibility on self-/adjacent channel/sub-band emissions/interfernce (that need RAN4 studies) be assumed by RAN1?

3 – Samsung Electronics Co.

- Regarding CLI enhancement, do you think L2 based CLI reporting with periodic resource is enough for handling flexible TDD or expect to enhance CLI further in Rel-18 not only UE-to-UE but also gNB-to-gNB (over RIM)?

- Page 3: For scenarios, what’s your view of scenarios other than that studied in Rel-16 TDD in TR 38.828? It seems you only mentioned gNB-2-gNB CLI mitigation, what do you think of self-interference at gNB, and UE-2-UE CLI ?

4 – Ericsson LM

It is stated that “Cases with uplink heavy configurations and solutions for gNB-2-gNB CLI mitigation was not covered in Rel-16.” However, Rel-16 did include “network coordination mechanism(s) including at least exchange of intended DL/UL configuration” as part of the objectives which was specified. Can these mechanisms not be used for UL-heavy configurations? Does the Rel-16 work preclude applicability to such configurations?

2.8 RWS-210084 Resiliency for disaggregated gNB architecture in Rel-18

Feedback Form 8: Comments and questions on RWS-210084

1 – Ericsson LM Thanks for the paper. We have two questions: Question 1: Will a logical gNB consisting of the multiple gNB-CUs be perceived differently than a logical gNB consisting of one gNB-CU (current)? i.e. do we see changes on NG and Xn interface? Question 2: Will the multiple gNB-CUs have a hierarchy structure?
2 – Intel Corporation (UK) Ltd Thank you for the contribution. Please see our question below: 1. Is the failure of gNB-CU-CP caused by RAN overload? If it's connection failure, or wireline failure, which cannot be predicted, are those events also under the scope for resiliency enhancement?
3 – Samsung Electronics Co. Q) What does geo-redundant resiliency solution for gNB-CU-CP mean?"
4 – DOCOMO Communications Lab. Thank you very much for your contribution in this topic. We share the same motivation to help reliably operate e.g. highly-centralized CUs. Do you also assume serving the same cell by multiple CUs at the same time in the scope? This would provide increased redundancy and load distribution, and might enable DECOR-like use cases as in RWS-210022 and RWS-210140.

2.9 General comments and questions

Feedback Form 9: General comments and questions

3 Answers to the First Round Questions

3.1 Answers to RWS-210070 Enhancements for XR over NR support

Answers related to eSPS and Conf. Grant: eSPS and Conf. Grant:

As compared to the currently standardized SPS solution, we see a need for enhancements to make it better fit the purpose of serving XR traffic. Due to jitter and timing drifts for XR applications, it is e.g. desirable to extended current SPS solutions to the timing of the SPS allocation could be changed on-the-fly without having to release an existing SPS configuration, followed by configuration and activation of a new one that fits an XR traffic flow that have experienced a shift in its timing.

It is correct that dynamic scheduling could also be used for XR. But, SPS have some advantages that should be applicable also for XR. Those include less control channel overhead, and also simple scheduling as the new

scheduling does not need to be evaluated for every TTI where there is buffered XR data.

Answers related to SMTC:

In R1-2102830 we presented the problem of XR decoding during SMTC windows for FR2. According to 3GPP TS 38.133 *"The UE is not expected to transmit PUCCH/PUSCH/SRS or receive PDCCH/PDSCH/CSI-RS....."* during SMTC windows when it performs L1-RSRP measurements on SSB. This may mean that scheduling e.g. is excluded for a 5ms periods every 20 ms (if having SSB every 20 ms with 5 ms SMTC windows). This is in our view a critical aspect for efficiently serving XR traffic on NR. We hope that possible solutions for how to smartly prioritize XR decoding in SMTC windows could be further discussed during the ongoing Rel-17 XR SI. In the pursue of such solutions, a priori knowledge of the semi-deterministic arrival of XR frames could be utilized, potentially linked with configured SPS patterns for the XR traffic (if such this scheduling method is used. As expressed by Intel, one has to be careful that such new solutions do not degrade the quality and availability of RRM measurements too much as this may cause other problems. We expect some impact in RAN1 and/or RAN2 depending on the type of signalling as well as RAN4 to include further conditions and restrictions for gNB and UE behaviour (scheduling, when to prioritize PDCCH/PDSCH reception, etc.). Depending on the level of coordination and signalling that would be specified, the measurement behaviour could still be left to UE implementation with the addition of some pre-configured restrictions.

Answers related to General mobility-related questions:

The requirements for mobility interruption times in 3GPP TS 38.133 are so large that there is a risk of violating the PDB for one or several XR frames whenever a handover happens. We therefore recommend that solutions to overcome or minimize the effects of this are considered in Rel-18.

As commented by several companies, DAPS is attractive for XR use cases as having the lowest values for mobility interruption times. But, DAPS is currently not standardized for FR2, and it is only applicable for PCell (not for CA). We therefore suggest this to be addressed in Rel-18 as well.

Related to MAC-based gNB beam management, there is hardly any interruption when beam switching happens. It would, however, be desirable if one could control the exact timing of gNB beam switching so it does not happen during the TTIs where time critical XR transmission takes place.

Regarding the question on which SI/WI should study the XR-related mobility enhancements, we prefer these activities to be carried out with the XR SIs/WIs. Here, the URLLC-level restrictions may be too stringent leading to severe overprovisioning. At the same time, we are open to other suggestions (e.g., study the mobility enhancements with the Mobility WI), as long as the features related to the XR devices and services are taken into account.

Answers related to Synchronized MAC-based beam switching:

During gNB beam switching the performance of link adaptation and HARQ may experience slight degradations that could cause reception errors and undesirable retransmission (i.e. larger delays). Given the XR traffic semi-deterministic (e.g. with XR frames every 16 ms), it is therefore desirable to be able to more accurately control the timing gNB beam changes so those occur at time periods where no critical XR transmission are taking place. Delaying a beam switching with e.g. few milliseconds is deemed acceptable as compared having it collide with critical XR transmissions.

Here, indeed, as pointed by Qualcomm, an optimization task could arise as there might be cases, where beam switching must be performed now to keep the beam (e.g., for narrow beams), while there may be also conditions, where beam switching can be delayed just a bit to finalize a critical XR transmission/reception

(e.g., for wide beams).

Answers related to eCHO:

We agree that eCHO and the directions for XR improved mobility are not strictly limited to XR use cases. But the proposed type of enhancements is motivated by the XR KPIs and the characteristics of the XR traffic which calls for possible enhancements. Related to "other UE measurements reports", we are open for suggestions that offer attractive benefits. For example, some traffic awareness like a-priori knowledge of the semi-deterministic arrival of XR frames could be utilized to guide CHO decisions.

Answers related to DAPS:

SA concluded that AR services will be used in mobile scenarios. Enhanced DAPs help to meet PDB and PER of XR services during handover procedure.

Regarding the question on which SI/WI should study the XR-related mobility enhancements, we prefer these activities to be carried out with the XR SIs/WIs. Here, the URLLC-level restrictions may be too stringent leading to severe overprovisioning. At the same time, we are open to other suggestions (e.g., study the mobility enhancements with the Mobility WI), as long as the features related to the XR devices and services are considered.

Answers related to Difference between dynamic and adaptive DRX:

These are two groups of mechanisms aiming for similar goal – tailor the DRX configuration to suit the best XR devices and services. Hence, the difference between these two bullet points is not drastic. We still divide the possible enhancements into two categories:

First, due to non-integer inter-arrival time of XR traffic (e.g., 16.6 ms) the DRX configuration should be adapted, e.g., shifted. That what is referred in our slides as "adaptive DRX".

Second, the XR traffic may also change in time (e.g., switch of a frame rate from 30fps to 60fps, etc.) Hence, the dynamic configuration of DRX is also needed to dynamically change the DRX cycle in case of such an update case. This one is referred in our contribution as "dynamic DRX".

Answers related to General higher-layer questions:

We agree with MTK on the need to better understand the benefits of application awareness at RAN first before starting normative work on SA. However, coordination with SA2 and SA4 and preliminary study to assess the impact in the current QoS framework would be beneficial to understand its feasibility.

5QI enhancements require coordination with SA2, but these enhancements enable the optimization of radio resources (Please refer to our answer in 4.2 VPI and pose information).

Regarding higher layer QoE, our idea is to enable a certain level of traffic awareness at RAN as discussed by other companies (here, we refer to 5QI as an example of higher-layer QoE). We are open for suggestions that offer attractive benefits.

Answer related to VPI and pose information accuracy:

As indicated by other companies, we think that traffic awareness at RAN would be beneficial to optimize RAN operation and meet QoS requirements of XR services. For example, pose information accuracy can provide some guidance for reserving radio resources (the higher the error, the higher the data rate to cover

such error). VPI, which corresponds to an additional QFI (QoS flow) identifier, can help to implement traffic differentiation/prioritization and optimize use of radio resources. For instance, when VPI corresponds to a QoS flow carrying a low-quality portion of the 3D video, PDB and PER can be relaxed and met with less resources. Coordination with SA2 and SA4 for the evaluating the impact on the QoS framework is needed.

Answers related to General XR questions:

XR applications and services bring a novel set of traffic/device characteristics and requirements. Hence, indeed, a detailed study on XR support in NR is needed. Here, we do believe that i.e., the ongoing 3GPP SI for XR in Rel. 17 can be used to perform some preliminary studies on the suitability of possible enhancements (including their feasibility, complexity, and potential performance gains). The work performed later for XR in Rel. 18 and beyond should be carried in coordination with other SIs/WIs related i.e. to MIMO, mobility enhancements.

3.2 Answers to RWS-210075 MIMO Enhancements for Rel-18

Answers related to CSI acquisition enhancements:

Re Samsung (2, p5-p6): time-domain compression and/or successive refinement of PMI are the approaches we have in mind, and a few different candidate techniques can be studied. The objective of this new form of time-compression for medium-high mobility is to improve the ability of the gNB to extrapolate the precoder based on tracked channel variations

Re Xiaomi (3, Q1): our results show that subband reporting degrades more than wideband reporting with speed, because, in general, the higher the CSI resolution, the more sensitive it is to channel variations in time. However, our proposal is to improve subband reporting at high speed rather than using wideband reporting only. For the time-domain CSI compression, any solution we study will need to improve the performance-overhead tradeoff for a given CSI reporting periodicity and CSI-RS periodicity

Re Mediatek (6, Q4): we think a UE needs to measure multiple CSI-RS occasions and compress CSI in time-domain. On the other hand, gNB needs to extrapolate the precoders for future DL transmission from the time-compressed CSI reporting, so in this sense it's the gNB that tracks the channel. Extrapolation at the gNB, however, is implementation-specific and it is unlikely to have specification impact but it is important to harness the gain from CSI tracking.

Re Motorola (9): we think DMRS can be used in conjunction to CSI-RS for updating certain CSI quantities. For example, after initial CSI reporting based on CSI-RS measurement, subsequent updates can be measured on DMRS. Updated quantities may include CQI but also PMI, which is measured on the effective precoded channel, which includes possible interference from co-scheduled UEs. The specs impact may be limited to how the reporting setting for DMRS-based reporting is obtained from a corresponding CSI-RS-based configuration and how the DMRS-based reporting is triggered.

Re Huawei (13, Q1): we think CSI enhancement for high mobility is relevant for both FDD and TDD, as DL channel tracking in time and time-compressed reporting by a UE can improve the gNB's own tracking of UL channel variations

(13, Q2) as overhead increases, more and weaker beams/FD components are added to the report which tend to age more quickly than stronger components, especially in LOS propagation, and thus can hurt the performance as speed increases.

Re Qualcomm (15): the specs impact could be minimal, e.g. by allowing a UE to reset a CSI report to a

predetermined value if the latency between measurement and reporting exceeds the maximum. But other solutions with higher spec impact are not precluded.

Re CATT (16): the reason why CSI calculation delay may be reduced by measuring DMRS is that the measurement occasions are more frequent than CSI-RS and the number of ports to measure (layers) is much smaller than for CSI-RS

Answers related to UL MIMO enhancements:

To Samsung[2]

Considering LTE SU-MIMO as a reference, by applying CM preserving codebooks, PAPR/CM gain of DFT-s-OFDM over CP-OFDM is preserved.

CP-OFDM with advanced receiver can be an alternative solution while DFT-s-OFDM provides comparable performance gain with simple gNB receiver.

To Samsung[2] and Spreadtrum[10]

For DFT-s-OFDM, applying higher-order modulation requires higher SNR than low order modulation. This is because PA output power back-off increases significantly when increasing modulation order. Furthermore, use of higher modulation order is more limited by phase noise, further reducing the coverage. Thus, the best way to provide larger throughput with reasonable coverage is to increase transmission rank and use SU-MIMO.

To Ericsson[17]

We assume x-pol 1x4, and/or 2x2 antenna array for possible CPE UEs or IAB node, which may use UL for backhaul Tx.

Answers related to Multi TRP operation:

To Ericsson, Futurewei, Xiaomi:

Regarding relationship between Rel-17 unified TCI framework and multi-TRP, we just wanted to highlight the fact that there is already a functioning framework supporting mTRP operation. We are not against extending Rel-17 TCI framework to mTRP, but such extension and potential enhancements need to be justified by the expected benefits in doing so.

To ZTE [5] and Beijing Lenovo Software [11, Q2]

Our motivation is to optimize multi-TRP transmission with single DCI when there is some imbalance in the links between the UE and multiple TRPs. By supporting mapping of layers transmitted from each TRP to a separate codeword, each codeword can be optimally encoded based on link adaptation for each TRP. For UL, particularly with multiple panel, we agree that power control issues should also be considered.

Answers related to Multi beam enhancements:

To Xiaomi [3, Q4], MediaTek [6, Q1]

CSI-RS for tracking, i.e. TRS, is the main QCL source RS and the UE needs to be configured always periodic TRS (aperiodic TRS cannot be standalone but it can only be provided together with P-TRS). For P-TRS only RRC level TCI state switch is possible currently.

To MediaTek [6, Q2]

Agree in case of unknown TCI state. In case of known TCI states, it could be studied whether it would be possible to reduce MAC latency e.g. in case the TCI activation comprises TCI states not requiring UE panel switching.

To MediaTek [6, Q3], Qualcomm [12]

Regarding UE assisted UL beam switching, we are thinking this in general for overhead reduction in beam switching while also accounting MPE. It could also apply both DL and UL. Intention is to consider approaches where UE's beam report or UL signal triggers UL (or DL/UL) beam switch confirmed by the gNB (as partly captured in Issue 6 in Rel17 Multi-beam enhancements). It could be applied to both dynamic grant and configured grant UL signals. Rel-17 SSBRI/CRI reporting for MPE mitigation will enhance UL Beam management and reduce unnecessary P-MPR. Rel-18 could further enhance UL beam management to mitigate MPE and reduce beam switch latency by enabling the UE to pro-actively switch UL TCI in such scenario. Regarding UL & DL beam management, DL is reported thus known at the gNB, however UL degradation due to UE condition (e.g. MPE) may not be detected on DL RS yielding unpredictable failures.

To Qualcomm [12]

UE reporting on DL RS depends on UE beam used for measuring DL RS. Depending on UE beam gain used in Rx, the reporting may be boosted without gNB knowledge. Furthermore, even if reporting is performed with comparable Rx beam gain but the UE has panels of different sizes, P3 may not be usable on all panels and gNB is not informed of potential gain from P3 on candidate beams. Hence, beam management decision may be sub-optimal. This P3 capability may vary dynamically.

To LG[1], Xiaomi [3, Q3], Qualcomm [12], DOCOMO [14]:

Regarding to the proposed interference indication enhancements, the intension of our proposal is to extend Rel-16 L1-SINR framework by considering dynamic assistance information indication regarding to inter-beam-interference. As a result of this, UE can determine its RX according to indicated assistance information related to interference situation leading to enhanced system performance with respect to existing releases, especially in M-TRP/inter-cell framework. Since current specification does not provide support this, the potential merits of Rel-16 L1-SINR framework can not be utilized as efficiently as possible from the perspective of system performance.

To Intel [7, Q2]:

Assistance can cover information about inter-beam-interference e.g. in M-TRP/inter-cell framework. Regarding to reference UE receivers, for example, advanced MMSE-IRC receiver or non-linear receiver (e.g. reduced complexity ML) can be considered.

To Lenovo [11, Q1]:

Yes, gNB can provide assistance information about interfering DL beams associated with the reception of e.g. PDSCH or PDCCH, in M-TRP/inter-cell framework.

To Huawei [13, Q3]:

CSI repetition may cause too much overhead. The intention is to identify the cases where the UE cannot align

its narrow beam without support from network.

Other Answers:

Regarding the comment on potential down-scoping of objectives, we understand this is something that needs to be further elaborated after the workshop, also taking into account the proposals from other companies. But in general we agree that the scope of WIs need to remain reasonable.

3.3 Answers to RWS-210076 Enhanced coverage for Rel-18

Answers related to FDSS with spectrum extension:

We assume that FDSS w/ spectrum extension has only limited RAN1 impacts. The supported extension size(s) and the related resource allocation is expected to have RAN1 impacts. Another possible impact is in DMRS.

Answers related to Multiple Msg1 repetitions with the same or different beams

For Msg1 repetition with the same beam in FR1, the gNB uses the same Rx beam for receiving the Msg1.

Selection diversity is a simple and robust scheme that can already increase performance. More advanced implementations can be based on coherent and non-coherent combination of the received sequence(s). Other intermediate solutions are possible (e.g., selection diversity based on detected sequences).Multiple Msg1 transmissions with the same or different beams may be appliable in both FR1 and FR2 in general. However, the more relevant scenarios would be to apply multiple Msg1 transmission with the same beam for FR1 and with different beams for FR2. In FR1 it seems more important to increase the energy at the receiver, while in FR2 it seems more important to find the “correct” beam and repetition on a “wrong” beam struggles to improve performance significantly.

Answers related to how the UE chooses the beam for Msg3 in FR2:

If each Msg1 transmission/RO combination is unique then gNB can distinguish between them. During RACH, the DCI used to schedule the RAR related to a correctly decoded preamble over the PDSCH, is scrambled by gNB using an RA-RNTI value associated with the PRACH occasion in which the preamble has been transmitted. Hence the gNB can indicate the best UE beam to be used for msg3, via indication of the corresponding RO, using the RA-RNTI.

3.4 RWS-210078 Mobility Enhancements for Rel-18

Answers related to Interruption time reduction in FR2-FR2 (objective 1 in slide 5 of RWS-210078):

The aim of the first objective (slide 5 in RWS-210078) is to specify a solution that reduces the interruption time close to 0 ms for FR2-FR2 handover. We are not restricted to specify DAPS for FR2-FR2 as done for FR1-FR1 and FR1-FR2 (and vice-versa).

One option is indeed to adapt DAPS for FR2-FR2 by using TDM patterns in case the UE cannot receive simultaneously from source and target nodes (to be decided and specified by RAN1/4).

Other solution would be to specify Single-Active Protocol Stack (SAPS) that was discussed in Rel. 16 as alternative for DAPS and which has much less implementation complexity (only a single PDCP is maintained

by the UE). Herein, the UE will receive and transmit data to source cell until RACH response from the target cell is received. The UE will detach from the source cell before it sends RRC Reconfiguration Complete to the target cell. The solution has some additional interruption time for sending RRC Reconfiguration Complete compared to DAPS but has less much implementation complexity.

Answers related to RACH-less Handover (objective 2 in slide 5 of RWS-210078):

RACH-less handover (i.e. LTE-like, without any NR enhancements) would work in the scenario where the same timing advance of source node can be used for target cell or the timing advance of the target cell can be set to 0 (in case of small cells).

In case of inter-cell mTRP, RACH-less handover can be extended to allow a slimmer handover if the target cell of handover is one cell involved in mTRP. In this case, RACH-access is not needed and the timing advance of the target cell can be continued to be used, i.e., RACH-less can be enhanced to allow the UE to continue using the acquired timing advance for the target cell.

Moreover, RACH-less handover would be useful in scenario where the UE might switch fast between (CHO) prepared cells as described in slide 13 of RWS-210078, i.e., the random access is not needed as long as the previously acquired timing advance is still valid.

RACH-less handover works in some specific scenarios and cannot reduce the interruption time close to 0ms in all cases. As a first step, the same principles as in LTE can be adopted (i.e. TA=0 or TA_src = TA_tgt), but obviously NR extensions to this LTE scheme can be worked out.

Answers related to Fast Cell Selection (Objective 4 in slide 6 of RWS-210078, slide 13):

In this proposal, the UE needs to keep the CHO configuration for a set of cells. RACH-less can be performed when switching between the cells as long as the acquired timing advance is still valid at the UE side.

Answers related to Make-before-Break (Objective 2 in slide 6 of RWS-210078):

For NR, MBB solution of LTE Rel. 14 can be enabled by enhancing conditional handover of Rel. 16. MBB works with a single transceiver (less complex than DAPS where the UE is temporarily simultaneously connected to source and target, at least in DL) and reduce the interruption time by RRC procedure delay and UE processing time, i.e. UE detaches from source cell when sending the PRACH preamble to target cell. The interruption time of MBB handover will be reduced further if RACH-less access is performed to the target cell. MBB can be specified for FR1-FR1, FR2-FR2 and FR1-FR2 (and vice-versa).

Enhancing MBB beyond the one defined in LTE Rel. 14 may require the UE to keep two radio links with source and target cells (receive from source cell while performing random access) and in this case we fall into the first objective of specifying a solution that reduces the interruption time close to 0ms in FR2-FR2 scenario (like SAPS – Single Active Protocol Stack or DAPS with TDM pattern)

Answers related to End-2-end UL latency reduction for DAPS:

In DAPS, the target gNB receives the UL packets from the UE but it cannot forward them to UPF before it receives the final SN Status Transfer message from the source node. This leads to an end-2-end delay of 2 Xn message which can be harmful for latency-critical services. In this objective, we are after studying/specifying solutions that can minimize the UL end-2-end latency, preferably without involving CN.

Answers related to Robustness of PSCell access:

If during CHO, the target MN prepares a target SCG, it is proposed that the UE performs access to the target SCG only when a condition for PSCell (e.g., CPAC condition) is met upon/after CHO execution. This is to ensure that the quality of the target PSCell is sufficient as there is a gap between the CHO preparation and execution).

Answers related to Inter-working of CHO and DAPS:

In this objective, a UE can perform DAPS handover execution when the CHO execution is performed. Namely, the UE is configured with Conditional DAPS HO. When the execution condition is met, DAPS HO is performed. By using both CHO and DAPS, the UE can have the benefits of CHO (improved mobility robustness) and DAPS (interruption time reduction during the handover). This can help to achieve a higher reliability (less outage) as shown in the simulation results of slide 11 in our RWS-210078.

Regarding RACH-less + CHO (instead of DAPS + CHO) – we want to initially prioritize what is already in the NR specification (i.e. DAPS and CHO). We do not think it is justified to conclude already now that RACH-less (which does not exist in NR) can be used with CHO, instead of DAPS.

Answers related to Prioritization of the Objectives:

The amount of work needed for each objective varies and we are open to discuss and prioritize some objectives for Rel. 18, also considering which area/objective has the highest number of companies supporting related work.

3.5 RWS-210079 CA and DC enhancements for Rel-18

Answers related to Main scope (RAN2 objectives):

We see that this would be a RAN2-led WI, with also large impact to (at least) RAN4 (since measurement requirements would be needed, see below).

Our main proposal is to extend EMR procedures to CONNECTED: We can shorten CA/DC setup time by having UE do measurements during PCell connection setup time, thus enabling the measurements to be ready earlier, and the measurements can then continue also in CONNECTED mode.

We considered that the work should focus on FR2 (where the main issues are) but of course need not be restricted only to it (as beam management is possible also in FR1).

To avoid the same uncertainty that caused Rel-15 FR2 requirements to be very loose (i.e. companies not being certain what was possible to be required for FR2 to allow implementing workable FR2), we think it's important that any mechanisms introduced should also allow to balance UE power consumption and CA/DC setup delay (especially in FR2) and consider different UE implementations.

Answers related to RAN4 Objectives:

We would aim at defining measurement requirements for performing measurements during connection setup. The work should also consider and build on top of Rel-17 baseline for beam management requirements. Focus should be on FR2 requirements.

Answers related to RAN1 objectives:

We consider very few or no impacts to RAN1 from the above RAN2/4 objectives. The less we impact physical

layer, the easier it would be for practical UE implementations.

However, we are open to consider other proposals for CA/DC enhancements that are RAN1-specific and help to make CA/DC setup more efficient.

3.6 RWS-210080 Small Data Transmission Enhancements for Rel-18

Answers related to PDCCH monitoring reduction:

[Answer to Question 7a. from Huawei]

We confirm that the SDT-specific search space has been considered in our evaluation. Indeed in Rel-17 it was assumed that such SDT dedicated Search Space may be sufficient for short SDT durations, and thus, the benefits of further schemes for PDCCH monitoring reduction may be limited. First, we note that the SDT-specific search space will be common for all UEs performing RA-SDT (rather than UE-specific), which limits the network flexibility to adapt to different UE needs. Secondly, the assumption of short DRX duration is not valid in many scenarios. As shown in our results, the UE power consumption increases significantly, as compared to a single-shot SDT, particularly in scenarios with subsequent UL/ DL transmissions, with UE context fetch, and under high(er) NW load, which lead to longer SDT duration, and in turn consume additional power for PDCCH monitoring periods, mentioned earlier. Further, we have also identified the following scenarios, which will lead to a rather long SDT procedure duration:

If the network decides to wait to collect for DL data before ending the SDT procedure (to avoid the high cost of beam-swept paging and switch to RRC Connected to transmit the DL data)

SDT with failure scenarios (note: T319 timer may be set up to seconds)

Hence, we see room for PDCCH monitoring improvements in Rel-18 to support “longer” SDT procedures in a more energy-efficient manner.

[Answer to Question 6 (EURECOM)]

It could be considered as part of the work if the Rel-17 enhancements currently defined for RRC Idle/Inactive should be applied/extended for SDT.

Answers related to MT-triggered SDT:

[Answer to Question 1 (LG), 4 (ZTE), 5 (Sony), 8 (Lenovo), 10 (ITRI)]

The MT-triggered EDT approach could be considered as baseline for SDT. This entails that paging could be enhanced with an MT-SDT indication. But we agree that other options can be considered as part of the work.

We also agree that MT-triggered SDT can be beneficial for any DL-centric applications with infrequent and small data packet. The network-initiated positioning is provided just as an example of relevant use-case.

[Further Answer to Question 8 (Lenovo)]

We see the need to complete the SDT support in Inactive, by introducing MT-triggered SDT in Inactive, to support efficiently both DL- and UL-initiated use cases from Inactive. In addition, Idle mode could be considered if relevant use cases are identified.

Answers related to Backhaul signalling optimization for UE context fetch failure case:

[Answer to Question 9 (QC)]

Extension of Xn-based context fetch procedure could be considered to avoid/limit context fetch failure scenarios. This would allow to continue using SDT smoothly also in scenarios of mobility outside the RNA. The exact solution(s) can be discussed as part of the work.

[Answer to Question 7b (Huawei)]

We confirm that the problem is not specific to SDT, but it is carried-forward from Rel 15 RRC Inactive functionality.

We acknowledge a theoretical implementation solution to address the issue, by having a mesh Xn connectivity between gNBs i.e every gNB is Xn connected to every other gNB, but it is very complex and expensive.

Xn connectivity between neighbouring gNBs is insufficient to address the issue, since a UE may resume in a target gNB which is not a neighbour of the serving gNB.

Xn connectivity between every pair of gNB of the RAN is hugely expensive and unrealistic solution.

A default solution of the UE's RNA being composed of only one gNB cells may prevent the issue as the context retrieval is performed at every gNB border. But this is sub-optimal as a universal solution and will defeat the benefits of tracking a UE at RNA level in RRC INACTIVE mode.

Answers related to Backhaul signalling optimization for SDT without anchor:

[Answer to Question 7b (Huawei)]

The solutions could be considered as part of the work. Using a pre-configured/default RLC context is indeed a potential solution

3.7 RWS-210081 Flexible UL/DL enhancements for Rel-18

Answers to Mediatek Inc.:

Answer for Q1: It is correct that our proposal is to first focus on dynamic TDD to have developed solution for UL-heavy configurations, including related gNB-2-gNB CLI mitigation solutions. We see this as an important topic for the short to mid-term, while potential support for FD is on the longer time horizon and likely also much more complex with larger implications.

Answer to Q2: As you indicate, it would be desirable to have developed the gNB-2-gNB CLI mitigation methods so the full gains of those are available also for legacy UE.

Answer to Q3: As you indicate with this question, there are many aspects to consider for FD, and among those is impact and support for legacy UEs. In our proposal, we first suggest focusing on dynamic TDD to build more efficient support for UL-heavy configurations, addressing gNB-2-gNB CLI mitigation.

Answer to Q4: The gNB-2-gNB CLI mitigation solutions should be designed without sacrificing gNB energy consumption.

Answers to Intel Corporation (UK) Ltd:

Answer to Q1: What we mean by *"Conduct the study in line with Rel-16 TDD adjacent channel coexistence conclusions, where dynamic TDD was primarily found feasible for low power gNBs"* is to respect these earlier conclusions, and e.g. not start to assume fast dynamic TDD for FR1 Macro cells as this would not be allowed from a coexistence p.o.v.

Answer to Q2: For our proposal on "Flexible UL/DL enhancements for Rel-18", RAN1 could take the lead, but RAN4 would need to be included and consulted when it comes to gNB requirements, potential coexistence aspects, etc. And potentially also involved in agreeing on assumptions for system-level simulations.

Answers to Samsung Electronics Co.:

From our point of view, the most critical problem to have addressed is better support for UL-heavy configurations. E.g. enabling a co-channel deployed low gNB to operate with UL heavy config while the Macro layer may be using DL heavy configuration. This calls for gNB-2-gNB CLI mitigation solutions. Those may come in the form of coordinated resource muting, coordinated beamforming, etc., that we propose to assess as part of a Rel-18 SI. We are open to also consider enhancements addressing UE-2-UE CLI if a need for those can be justified as compared to solutions in Rel-16. Aspects of self-interference mitigation at gNB is not a priority in the short- to mid-term.

Answers to Ericsson LM:

It is correct that Xn/F1 signalling of Intended UL-DL configuration was introduced in Rel-16. This is basically just announcing which radio frame configuration a gNB is using to a neighbouring gNB. However, no solutions were included in Rel-16 to have gNB-2-gNB CLI mitigation. We agree that Rel-16 CLI findings shall be the starting point for a new Rel-18 SI on Flexible UL/DL enhancements.

3.8 RWS-210084 Resiliency for disaggregated gNB architecture in Rel-18

Answers related to NG-RAN architecture impacts:

Only one CU-CP is "active" at any given time, while the standby CU-CP is "inactive".

From the perspective of e.g. a neighbour gNB, we envision that there would be separate Xn interface instances to the active CU-CP and standby CU-CP. The application level configuration data associated with the two Xn interface instances would be identical, but only one of them would be "active" at any given time. From the perspective of the AMF, similar logic holds for the NG interface.

The standby CU-CP must be prepared for a potential failure of the active CU-CP. The intention is to adhere to the existing cardinality rules of the NG-RAN architecture, which implies that a DU has one active F1AP connection to a single CU-CP.

Answers related to Reasons for failure:

CU-CP failure can occur due to multiple different reasons (e.g. hardware failure or natural disaster), and the resiliency solution should be robust to be able to handle different cases.

However, it is not our intention to cover e.g. "connection/wireline" (interface) failures since there are existing mechanisms to ensure reliability of transport network.

Answers related to Meaning of geo-redundancy:

A geo-redundant resiliency solution for gNB-CU-CP is one which supports a standby CU-CP located outside the IP network of the active CU-CP and hence can be geographically separated. This is essential to provide a resiliency solution that is functional even during natural disasters.

3.9 General comments and questions

4 Second Round Questions and Comments

4.1 RWS-210070 Enhancements for XR over NR support

Feedback Form 10: Second Round Questions and Comments

1 – Samsung Electronics Co. Q1: How is changing the timing of an SPS configuration fundamentally different than deactivating/activating a first/second SPS configuration? Why can't Rel-17 specifications support a jitter in XR traffic arrivals? How is that different than TSN traffic? Q2: Do you consider that a possible XR WI, based on the considerations of the SI, should be optimized for/focused on FR2 operation? Q3: What is a quantified likelihood of a mobility event for a given XR application? Could you quantify the impact that a mobility event would have on the overall experience for that XR application compared to error events during "regular" operation? And, similar to Q2, do you consider FR2 to be the focus of a possible WI on XR?
2 – China Unicom Thanks for your detailed answers. For general mobility-related part, we share the same view that DAPS is important for FR2 especially considering FR2 may be the common frequency band for XR and IIoT services. DAPS for FR2 should be in the scope of mobility enhancement for R18. And for synchronized MAC-based beam switching, is this mechanism on the basis of current beam management scheme or parallel scheme? And is this used under intra-gNB scenario or also applicable for inter-gNB mobility?
3 – MediaTek Inc. Thanks for the detailed reply. For SMTC related enhancement, is it correct understanding that both RAN1/RAN4 would be involved in this Rel-18 XR WI?

4.2 RWS-210075 MIMO Enhancements for Rel-18

Feedback Form 11: Second Round Questions and Comments

1 – Beijing Xiaomi Mobile Software

Thanks for your answers. One more question, for "Study the use of DMRS for CSI acquisition, to reduce the measurement delay, CSI calculation delay (e.g., fewer ports to measure)", here you mean the measurement delay and calculation delay can be reduced since only a subset of ports are measured. But it is possible that the best port is not included in the subset of ports being measured. So do you have any solution to select the suitable subset?

2 – Samsung Research America

'- (p8): For UE-assisted UL beam switching can you comment on how the beam alignment is kept between UE and gNB? Without alignment, the gNB misses the beam switch from the UE. This would need gNB confirmation before beam switching can occur (which is similar to beam indication).

- (p8): 3ms latency for MAC CE activation is related to the L2 processing and interaction between L2 and L1. Do you think that latency can be less if beams belong to the same panel?

- (p9): We assume the statement: "Unified TCI framework is a redundant signaling framework" is in the context of some schemes from Rel-16 multi-TRP. Could you elaborate which schemes (done based on Rel-16 framework in Rel-17)? Clearly beam indication (M,N>1) is needed. Is it, e.g. the repetition scheme for PUCCH

3 – Guangdong OPPO Mobile Telecom.

Some further qeustions as below

1) For simultaneous transmission from two UE panels, will the two panels transmits the same data or different data or both are supported?

2) With dynamic TCI state switching for periodic RSs, How to ensure the measurement, e.g. within a CSI-RS resource set, or for case timeRestrictionForChannelMeasurements is not enabled?

4 – ZTE Corporation

Thank you so much for your reply. Regarding multiple codeword, the general solution for both mTRP and sTRP may be more essential in our views, although we share the same views with you that some motivation for sDCI-mTRP is clear. Some field tests for sTRP, e.g., NR Rel-15, to prove the necessity of introducing multiple codewords for UL can be found in our contribution R1-2104596 which was supported by many operators.

Then we have the further comments as follows.

- Regarding CSI acquisition, we are open to further study DMRS-based CSI reporting. In our initial views, this CSI reporting is much relevant to CQI-only reporting. But, after reviews some discussion from your replies to other companies, it seems that you also support PMI-based reporting? If so, does it mean that we need to introduce a new DMRS transmission procedure without DL precoding?

- Regarding mTRP, we are also glad to have some enhancement on more realistic assumption for mTRP. But, in general, for a given DL/UL transmission, the delay spread of OFDM symbol should be assumed within a CP (e.g., for async TRPs) in a receiver, right? Then, we may only need to study whether/how to enhance TA indication signaling (e.g., multiple TAGs in a CC/BWP).

-

Besides, we also identify the necessity of enhancing interference-aware reporting/indication. There are a large restriction for RS configuration, e.g., CMR to IMR mapping, for Rel-16 L1-SINR reporting.

5 – HuaWei Technologies Co.

Thanks for confirming both FDD and TDD are need to be enhanced for high speed case CSI. For TDD, the CSI is generally obtained from SRS measurement, not rely on CSI reporting. Do you any consideration on the SRS enhancements to address the CSI acquisition issues for TDD, e.g., CSI aging due to long periodicity of SRS, interference for SRS, etc?

6 – LG Electronics Inc.

Thanks for the answer. We are still not crystal clear on which assistance information for L1-SINR would be helpful to improve system performance. Could you explain a bit further?

7 – CATT

Thanks for the answer, and apologies that we din't quite comprehend the answer in the first round. For CSI delay reduction it was mentioned that partial CSI-RS ports can be used for measurement. Assuming in the first measurement instance the UE measured the full CSI-RS resources (all ports) and reported RI/PMI/CQI. In the second measurement instance, if a subset of CSI-RS ports are measured, (1) how are the subset of CSI-RS ports determined? (2) What is the feedback metric on the subset of CSI-RS ports (3) are there any dependencies between the 2nd CSI report content/format to the 1st CSI report?

8 – Intel Corporation (UK) Ltd

Thank you for the responses. We have additional questions below:

Q1. Could you please explain how CSI tracking works in the scenarios with dynamic interference where the CQI and RI might change over the time?

Q2. What is the urgency of specifying 8Tx in RAN1 considering that RAN4 doesn't have performance requirements for 4Tx even for 1 MIMO layer? Does it make more sense to specify requirements for 4Tx first and then work on 8Tx enhancements?

4.3 RWS-210076 Enhanced coverage for Rel-18

Feedback Form 12: Second Round Questions and Comments

1 – MediaTek Inc.

Thanks for your answer to our question on the gNB behaviour for msg-1 repetition with same beam. In our view, the assumption needed for coherent/non-coherent detection and for selection diversity may be very different. For example, whether the preamble/RO for the multiple msg-1 transmissions need to be associated for a common RAR. Please could you give Nokia's view on this?

4.4 RWS-210078 Mobility Enhancements for Rel-18

Feedback Form 13: Second Round Questions and Comments

1 – ZTE Corporation

Thank you for providing your answers in first round!

We have the following further questions:

For the Fast Cell Selection (Objective 4 in slide 6 of RWS-210078, slide 13), "UE needs to keep the CHO configuration for a set of cells" we want to clarify whether the "CHO configuration" refers to the CHO container? If yes, how to handle the delta configuration within the container? In addition, we also want to clarify whether the radio bearer level (e.g. IEs in RadioBearerConfig) reconfiguration is allowed in the fast cell selection, or only the cell group level (e.g. IEs in CellGroupConfig) reconfiguration is allowed?

Regarding UE beam alignment before or during HO (Page#19), could you please clarify the motivation of this enhancement. In general, after HO, the gNB can trigger CSI-RS based beam training immediately, but based on the recommended solution (that is to perform some more RS measurement between Msg2 and Msg3), it seems that NW has to experience a long latency for Msg3/4. This cost may also need to be evaluated.

2 – HuaWei Technologies Co.

Q1: Thanks for your answer. Can you please clarify whether RACH-less has extra benefits compared with L1/L2 mobility?

Q2: Regarding your comment on E2E latency reduction, you mentioned "There is inherent end-2-end UL latency (of at least 2 Xn signaling messages, > 10 ms) in DAPS handover as data forwarding to UPF cannot start immediately" which is similiar as our understanding, could you please clarify which technique you are considering to minimize Xn latency?

3 – MediaTek Inc.

Thanks for your clarifications, we have some further questions.

Q1. SAPS and TDMed DAPS: We share similar view that if DAPS with 0ms interruption is not possible, these method can be consider since they do help reduce the interruption. Regarding SAPS, can the UE perform Tx/Rx with source cell when it is receiving MIB from target cell, transmitting preamble to target cell, or receiving RAR from target cell? Maybe this depends on UE hardware architecture?

Q2. Fast cell switch: We share similar view that UE might switch fast between (CHO) prepared cell, and random access is not needed as long as the previously acquired timing advance is still valid. Is the proposed fast cell switch triggered by UE (as in Rel-16 CHO), or by the network (i.e. there is a handover command but UE needs not to perform RACH)?

4.5 RWS-210079 CA and DC enhancements for Rel-18

Feedback Form 14: Second Round Questions and Comments

1 – China Unicom

Thanks for your contributions and clarification. When considering to extend the EMR procedures to CONNECTED, what's the percentage reduction in CA/DC setup time and percentage increase in UE power consumption (such as based on simulation outcomes)?

2 – MediaTek Inc.

Thanks for the response and clarification. On extended EMR, the focus looks to enable the early measurement during connection setup. From our understanding, specification doesn't preclude such UE behavior. No specific requirement may be due to UE limitation during performing connection setup, and study the feasibility in UE will be needed.

Since connection setup time is not expected long (may be shorter than SS burst period), do you expect UE can perform effective measurement during connection setup time? Or the intention is to advance the measurements after a connection setup to be performed at the start of the connection setup?

4.6 RWS-210080 Small Data Transmission Enhancements for Rel-18

Feedback Form 15: Second Round Questions and Comments

4.7 RWS-210081 Flexible UL/DL enhancements for Rel-18

Feedback Form 16: Second Round Questions and Comments

1 – Intel Corporation (UK) Ltd

Follow-up to round #1:

To confirm, is it correct understanding that, for Rel-18, Nokia would like to limit the study to inter-cell CLI enhancements to better realize dynamic TDD (e.g., defining spec support for gNB-gNB CLI), and NOT include support of FD operation at gNB or UE ("sub-band-based" or "spectrum sharing-based")?

2 – Samsung Electronics Co.

Thanks for clarification. From Nokia point of view, your proposal includes both gNB-to-gNB and/or UE-to-UE CLI handling for dynamic TDD having different DL to UL configuration between cells in same operartor. If our understanding is correct, we have question for this can be also used for having difference TDD configuration between oprators. In current deployment (for example, macro cell), we are stuck into the fixed TDD ratio due to inter-operator interference and we are quite questionable whether CLI enhancement can solve this problem.

4.8 RWS-210084 Resiliency for disaggregated gNB architecture in Rel-18

Feedback Form 17: Second Round Questions and Comments

4.9 General comments and questions

5 Answers to the Second Round Questions

5.1 RWS-210070 Enhancements for XR over NR support

1 – Samsung Electronics Co.

Q1: How is changing the timing of an SPS configuration fundamentally different than deactivating/activating a first/second SPS configuration? Why can't Rel-17 specifications support a jitter in XR traffic arrivals? How is that different than TSN traffic?

Thank you for your question. From our understanding, there are fundamental differences between XR and TSN traffic that cannot be fully solved using multiple SPS configurations. For example, interarrival variability due to jitter and variable burst size of XR traffic. Here, the first/second SPS configuration can provide some help (when comparing to a single static SPS configuration) but may still not be flexible enough to fully capture the XR traffic the most efficient way. While jitter is a problem that can be solved with Rel-17 features, several other problems are introduced by XR traffic, which have not been considered for TSN, as discussed during the Rel-17 SI.

It is also correct that current SPS solution includes options having up to 8 SPS configurations that can be activates/deactivated as needed. However, each of those required RRC signaling for configuration, and, in addition, separate signaling for activation/deactivation, hence, resulting in signaling overhead. As an alternative, it would be advantageous to have only one SPS config per XR flow and introduce enhancements that allows to adjust the timing of this one, without having to maintain many different SPS configurations and activate/deactivate those as the timing characteristics are changes.

Q2: Do you consider that a possible XR WI, based on the considerations of the SI, should be optimized for/focused on FR2 operation?

Current Rel.17 SI just concluded on the baseline traffic model and its parameters for XR as well as the evaluation methodology for capacity and power. We expect extensive simulation results coming for the next RAN1 meeting from companies. This will help to identify the further focus of XR in Rel.18. At this moment, we tentatively see FR2 enhancements as an important part of Rel. 18 work on XR, but it should not be limited to FR2, so FR1 should also be in the scope of Rel-18 XR.

Q3: What is a quantified likelihood of a mobility event for a given XR application? Could you quantify the impact that a mobility event would have on the overall experience for that XR application compared to error events during "regular" operation? And, like Q2, do you consider FR2 to be the focus of a possible WI on XR?

The large-scale mobility of the XR devices is likely to be like mobility of state-of-the-art smartphone-type UEs in many applications. At the same time, in case of FR2, the small-scale mobility (minor shifts and rotations) start playing an important role (especially, for XR devices simulating gaming/etc. activities with many unpredictable shifts and rotations of the devices, such as AR/VR glasses). Hence, yes, for FR2, mobility issues may be even more challenging in some configurations, so tentatively it looks important to cover those in Rel. 18. The latest TS 22.261 Section 7 indicates that XR uses cases include both stationary and pedestrian

UE mobility, while selected Gaming services can also be played in vehicles and trains. However, as mentioned above, more results are to be collected within Rel. 17 SI on XR in the following meetings.

2 – China Unicom

Thanks for your detailed answers. For general mobility-related part, we share the same view that DAPS is important for FR2 especially considering FR2 may be the common frequency band for XR and IIoT services. DAPS for FR2 should be in the scope of mobility enhancement for R18.

And for synchronized MAC-based beam switching, is this mechanism on the basis of current beam management scheme or parallel scheme? And is this used under intra-gNB scenario or also applicable for inter-gNB mobility?

Thanks for your remarks and question. The synchronous MAC-based beam switching could be envisioned as an enhancement of the current beam management scheme for intra-gNB beam management. Furthermore, considering alike methods inter-gNB handovers would also be relevant. All such potential enhancements should of course be justified by performance benefits.

3 – MediaTek Inc.

Thanks for the detailed reply.

For SMTC related enhancement, is it correct understanding that both RAN1/RAN4 would be involved in this Rel-18 XR WI?

Thank you for your question. For SMTC enhancements we see the main impact on RAN2: RRC and MAC and RAN4: RRM requirements. RAN4 shall revisit its RRM requirements to include additional conditions where scheduling restrictions does not apply for the UE.

5.2 RWS-210075 MIMO Enhancements for Rel-18

CSI acquisition enhancements

Re Xiaomi (1): CSI measurement on DMRS is limited to the ports precoded by the same precoders used for data. However, every so often feedback can be provided on a larger selection of ports, e.g. by CSI-RS based measurement

Re ZTE (4): we are open to consider other CSI quantities, besides CQI, as part of the CSI reporting based on DMRS, but we don't think we need a new DMRS transmission procedure without DL precoding.

Re Huawei (5): for the TDD scenario in high speed, because of the SRS limitations (coverage, transmit power, tx antenna switching etc.) solutions based on CSI feedback should be considered, besides possible SRS enhancement.

Re CATT (7): in our previous reply we did not mention a restriction on CSI-RS port measurement, but we referred to the fact that DMRS ports, which correspond to PDSCH layers, are fewer in number than CSI-RS. (1) when measuring DMRS ports, there is no need to determine a subset of CSI-RS ports. (2) and (3) both feedback quantities and dependencies between CSI-RS and DMRS-based reports are FFS

Re Intel (Q1, 8): scenarios with high mobility and dynamic interference are challenging for CSI tracking. This is one of the reasons why we think Rel-18 should explore other solutions in addition to time

compression-based methods

UL MIMO enhancements

Re Intel (Q2, 8): indeed it would be ideal to have requirements work proceeding together with the RAN1 developments, and this is something to take into account in prioritization of the work across the working groups.

Multi TRP operation

Re ZTE (4): indeed TA enhancement is a potential mechanism, however we understand it is important to support more advanced UE architectures that can deal with timing differences beyond CP, especially for FR2.

5.3 RWS-210076 Enhanced coverage for Rel-18

To Mediatek

Our view is that (1) how received signals are processed/combined at gNB and (2) how RA-RNTI/RAR signaling is performed, are two separate aspects:

If Msg1 repetition is performed by UE using the same Tx beam for each Msg1 repetition, how received signals are processed/combined is very likely an implementation detail which each gNB could handle differently (several options are possible, as discussed already). In principle, the same holds when Msg1 repetition is performed by UE using a different Tx beam for each Msg1 repetition. However, in this case some evident options may exist, e.g., selecting the Msg1 whose measured RSRP is the highest, and could be considered for the feature design, if applicable. According to R15/R16/R17, any pair [RA-RNTI, RAPID] identifies one pair [RO, preamble ID] with no ambiguity. In this context, gNB can always identify a pair [RO, Msg1 repetition] by using the corresponding [RA-RNTI, RAPID]. When Msg1 is repeated, only one RAR is sent by gNB in any case. Assume N Msg1 repetitions. Upon reception, gNB can identify N pairs [RO, preamble ID], i.e., one per Msg1 repetition. This results in N possible pairs [RA-RNTI, RAPID]. What gNB does at this stage is to select one of the N pairs, according to a criterion/metric, which could be an implementation detail or a rule to be agreed on. The CRC of the DCI used to schedule the RAR would then be scrambled using the RA-RNTI of the RO over which the selected Msg1 repetitions has been received, and the RAPID included in the RAR would be the preamble ID of the selected preamble. In summary, RA-RNTI/RAR signaling would not require any modifications as compared to R15/R16/R17, i.e., existing R15/R16/R17 framework is used. The only change is related to gNB behavior/implementation.

5.4 RWS-210078 Mobility Enhancements for Rel-18

Reply to ZTE Corporation

Answer Q1:

In fast cell selection operation, full CHO configuration might be the first choice as the delta configuration might become invalid if the reference configuration is changed when toggling between the cells. However, we are definitely open to consider what would be the best solution to accomplish this as the same dilemma seems to be present in many proposals that involve retaining CHO configurations after HO execution.

As for which reconfiguration are allowed during fast cell selection, this can be discussed during the normative work.

Answer Q2:

The CSI-RS based beam training can be triggered after the handover execution is completed at the expense of additional signalling overhead (RRC Reconfiguration to configure the CSI-RS index to be repeated, RRC Reconfiguration Complete and DCI to trigger the activation of CSI-RS) and delay (the refined UE beam cannot be achieved before the handover execution is completed). The transmission of the RRC Reconfiguration Complete shall not be necessarily delayed (and shall still be prioritized) as the scheduling of the CSI-RS repetition can be performed while the UE is waiting for the UL grant to send RRC Reconfiguration Complete or immediately after sending RRC Reconfiguration Complete (or in parallel to the transmission of the RRC Reconfiguration Complete message). By integrating the procedure of CSI-RS based beam training into the handover, the additional signalling overhead and latency are reduced.

Response to Huawei

Answer for Q1:

RACH-less is an enhancement that can apply for L3 mobility procedures and is independent from L1/L2 mobility feature discussion (where the use of RACH has also not been discussed yet). The main aim of RACH-less is to reduce the interruption time caused by random access during the handover, and can even work together with the L1/L2 mobility.

As for L1 centric mobility, it is still not clear what is the advantage of this feature compared to L3 mobility procedures. Based on our simulation results contributed to Rel. 17 feMIMO WI (see R2-2104988), triggering the handover based on L1 measurements can lead to unreliable handover decisions (=increase in handover failures) and ping-pongs (=unnecessary handovers causing extra processing for both UEs and networks). Moreover, it is already possible for the network to disable TTT and L3 filtering to have L1 measurements trigger the handover.

If the goal is to replace the RRC Reconfiguration by MAC CE to trigger the handover, we are open for studying this if it can save some procedure delay contributing to the interruption of the handover (it needs to be studied and may require confirmation from RAN4). Note that in CHO Rel. 16, the UE can always decode the RRC Reconfiguration before the CHO execution and as such save the procedure delay of processing the RRC Reconfiguration.

Answer Q2:

We would like to study and specify enhancements that reduces the UL latency in DAPS, preferably without impacting the core network functions. In particular, we are after adapting the RAN2/3 signaling to reduce the UL latency by enabling UL forwarding without delay in some cases.

Response to Mediatek

Answer 1:

In SAPS, the UE will continue to transmit and receive with the source cell until the RAR response is received. Upon receiving RAR, the UE detaches from the source cell and sends RRC Reconfiguration Complete to the target cell. A UE with two receivers might be able to receive from both source and target node during the

PRACH preamble transmission and RAR. Otherwise, if not possible, a TDM pattern might be needed. And as always, different UE hardware capabilities and architecture can be considered during the work.

Answer 2:

Both options are possible and could be considered during the work.

5.5 RWS-210079 CA and DC enhancements for Rel-18

Reduction in CA/DC setup time

The exact percentage of delay reduction and power consumption can vary but the aim would be to achieve similar benefits as with FR1: That is, reduce the CA/DC setup time to 50-100ms ballpark (which is also roughly the same time it takes to setup the connection). UE power consumption is also crucial to ensure practical feasibility: As we have seen in the Rel-15/16 work on EMR, when the additional measurements allow higher data rates to be used earlier, the overall UE power consumption can even go down as the total active time for the UE is reduced.

For both FR1 and FR2, the CA/DC setup time is dominated by the measurement time: The FR1, this time was >500ms, and EMR was able to lower it to 50-60ms on average. For FR2 CA/DC setup, the measurement requirements indicate that, as per 38.133 table 4.2.2.2-1 (excerpted below).

TS38.133, Table 4.2.2.4-1: T_{detect,NR_Inter}, $T_{measure,NR_Inter}$ and $T_{evaluate,NR_Inter}$

Table 1:

DRX cycle length [s]	*Scaling Factor (N1)*		*T_{detect,NR_Inter} [s] (number of DRX cycles)*	*$T_{measure,NR_Inter}$ [s] (number of DRX cycles)*	*$T_{evaluate,NR_Inter}$ [s] (number of DRX cycles)*
	FR1	*FR2[Note1]*			
0.32	*1*	*8*	*11.52 x N1 x 1.5 (36 x N1 x 1.5)*	*1.28 x N1 x 1.5 (4 x N1 x 1.5)*	*5.12 x N1 x 1.5 (16 x N1 x 1.5)*
0.64		*5*	*17.92x N1 (28 x N1)*	*1.28 x N1 (2 x N1)*	*5.12 x N1 (8 x N1)*
1.28		*4*	*32 x N1 (25 x N1)*	*1.28 x N1 (1 x N1)*	*6.4 x N1 (5 x N1)*
2.56		*3*	*58.88 x N1 (23 x N1)*	*2.56 x N1 (1 x N1)*	*7.68 x N1 (3 x N1)*

Note 1: Applies for UE supporting power class 2&3&4. For UE supporting power class 1, N1 = 8 for all DRX cycle length.					

$T_{detect,\ NR_Inter}$: *UE cell detection time.*

$T_{measure,NR_Inter}$: *UE measurement period.*

$T_{evaluate,NT_Inter}$: *UE evaluation period.*

In general the UE will need to initially detect the cell, measure the detected cell followed by evaluation (for evaluating if reselection is needed). Looking at the requirements, the measurement delay is *DRX cycle * (36 x N1 x 1.5)+ (4 x N1 x 1.5) = DRX cycle * (40 x N1 x 1.5)* = 320*40*8*1.5 = 153600ms = 153.6 s = 2.5 minutes (with the smallest DRX cycle (= 320ms) defined in the requirements) to measure just a single FR2 carrier. This is mostly due to the N1 scaling factor in the requirements, and would still naturally scale up linearly if more carriers would be measured.

Therefore, we think the procedures should allow UE to perform measurements as early and fast as possible. The aim should be to consider any enhancements that allow FR2 measurements with reduced latency.

Measurements during connection setup

The connection setup from IDLE takes some time even in normal conditions: We already studied this during Rel-16, and as per R2-1900352, the connection setup procedure (considering both AS and NAS messages) takes 50-100ms time in total. As pointed out by the previous answer, the measurement delays are significant in FR2 and this is a challenging goal: But setting the goal to 50-100ms CA/DC setup delay is a good aim and is at the right ballpark

And while UE is allowed to already do measurements during connection setup, there is no real incentive for UE to do that as there is no knowledge if such measurements would be useful. Since UE doesn't know which carriers network wants to use, it should be ensured that if UE does such measurements, these are targeted to the right carriers and network knows which measurements UE is carrying out. Target is that performed measurements become beneficial from system point of view.

6 Summary

The Phase 1 and Phase 2 discussion indicate strong interest in developing solutions and further enhancements for the eMBB topics proposed in the Nokia WS contributions discussed in this contribution.

The discussions in Phase 1 and Phase 2 provide good input how to formulate objectives for studies and work on these areas. We welcome further WS discussion for aligning views between companies even further and

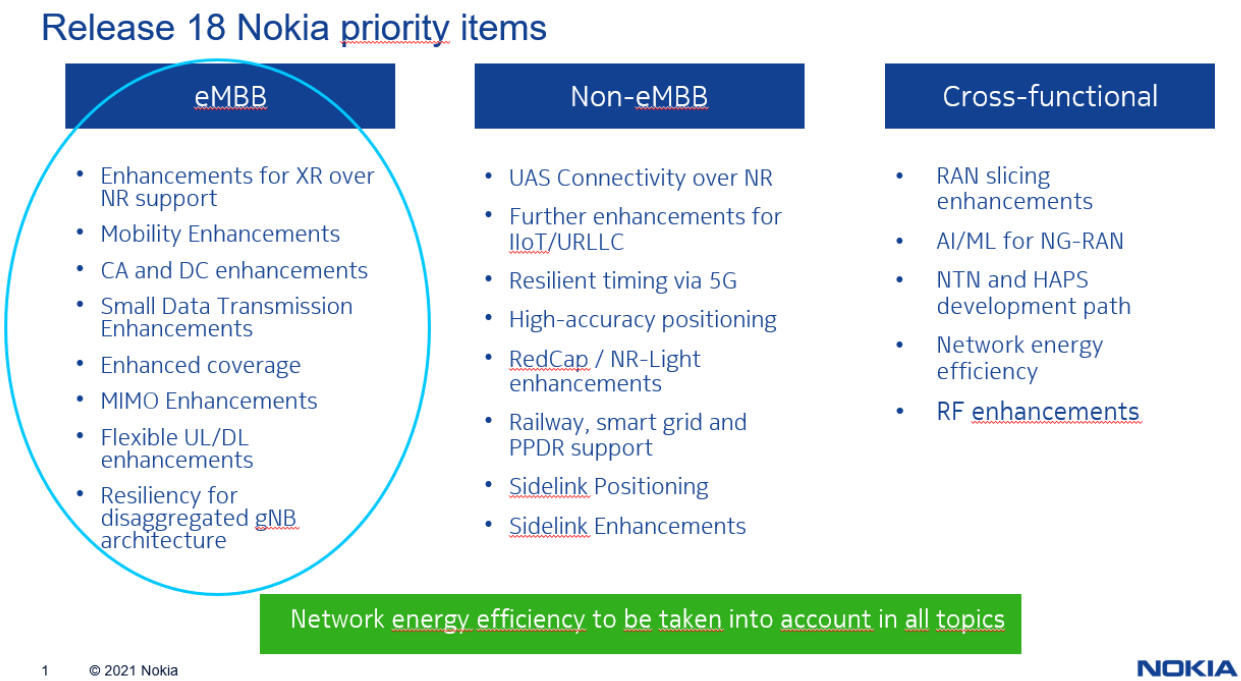

Figure 2: Nokia's eMBB proposals to Rel-18 RAN Workshop

developing detailed objectives for these items.