[98e-05-R18-NES] Rel-18 network energy savings - initial round - Version 0.0.7

RAN

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3GPP TSG RAN Meeting #98e Attachment for RP-223445

Electronic Meeting, December 12 - 16, 2022

Source: RAN1 Chair (Samsung)

Title: Moderator's summary for discussion [98e-05-R18-NES]

Document for: Discussion and Decision

1 Introduction

The purpose of [98e-05-R18-NES] is to converge on a way forward with regards to the follow up work on *Rel-18 Network Energy Savings*. The following relevant tdocs were submitted to RAN1#98e under agenda items 9.1.1 and 9.2.5:

- *RP-222902, RP-222919, RP-222974, RP-222990, RP-223003, RP-223004, RP-223021, RP-223031, RP-223043, RP-223131, RP-223162, RP-223182, RP-223188, RP-223200, RP-223224, RP-223241, RP-223335, RP-223340, RP-222914, RP-222988, RP-223084, RP-223094, RP-223152, RP-223261*

Over the last 9 months, the study on network energy savings for NR was done in RAN1, RAN2, RAN3. Outcome of the study can be summarized as

- Definition of a base station energy consumption model
- Definition of an evaluation methodology and KPIs
- Study and identification of techniques to improve network energy savings

Relevant details including evaluation methodology, evaluation results, and conclusions are captured in TR 38.864 (RP-222821).

2 Initial round discussions

2.1 General direction moving forward

Two contributions (RP-222988 from DT and RP-223188 from Ericsson) explicitly mention the need for additional study on some of the network energy savings techniques. On the other hand, most of the companies

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who have submitted contributions on Rel-18 network energy savings focused their discussions on the work scope of the normative work.

From moderator point of view, there are three possible alternatives with regards to the issue of whether/how to handle additional study on network energy savings:

1. **Alternative 1**: Postpone the start of normative work to 2023.Q2 and focus on the additional study of network energy savings techniques in Q1.
    - Note: Under the current RAN schedule, only 2 quarters will be left for normative work in RAN1.
2. **Alternative 2**: Start the normative work on network energy savings in 2023.Q1. In addition to the normative work, extend the study of network energy savings techniques until end of 2023.Q1. The scope of the Rel-18 normative work will be revisited and finalized in RAN#99.
3. **Alternative 3**: Start the normative work on network energy savings in 2023.Q1. There is no extension on the study of network energy savings techniques.

Interested companies are requested to share their views.

Feedback Form 1:

1 – KT Corp. KT supports Alt 3 starting normative work from 2023.Q1.
2 – Rakuten Mobile Our preference is Alt.3 or Alt.2, since 2 quarters discussion would not be enough to complete necessary aspects.
3 – Samsung Electronics Co. Alternative 3.
4 – VODAFONE Group Plc We support Alternative 2, as we share similar views as DT's contribution where a complete package of network energy saving techniques is beneficial as the outcome of R18, thus avoiding offloading some of the techniques for further releases. Power Domain techniques tackling the power amplifier efficiency, in particular, may benefit from the extension of the study item.
5 – Futurewei Technologies Our preference is either Alt 2 or Alt 3, depending on how much downselection we approve for the WID. We find the current draft of the WID is not consistent in terms if the items to be selected to proceed to the WI. Specifically, the scope of the time and frequency domain techniques would be one candidate for further study as per Alt 2.

6 – LG Electronics Inc.

We support Alt 3 since it has been declared that NES SI was completed according to status report from RAN1/RAN2/RAN3.

7 – HUAWEI TECHNOLOGIES Co. Ltd.

We prefer Alt.3. In our understanding, the current outputs from different working groups are able to justify converting the SI to work item phase. The techniques we included in the WID RP-223432 all got evaluated at least from more than 2 companies, which should be able to cross-verify the network energy saving gain. The key concept of the techniques are well defined in the TR also, and the corresponding details should be subject to discussions in the work item phase.

Overall we think RAN WGs have done good study, in addition to the large amount of evaluations, analysis on the performance impact, legacy UE impact as well as specification impact were also discussed and captured in the TR.

8 – ZTE Corporation

ZTE, Sanechips

The techniques in different domains has been well evaluated in SI, the NES gain and the potential impact have been capture in TR. We think this SI can be converted to WI as it is planned. Therefore, Alternative 3 is preferred.

9 – Fraunhofer IIS

In our view Alt 1 is the best choice, as several companies noticed that the outcome of the SI is inconclusive. As noted by Ericsson in RP-223188, there were ”Limited opportunity for discussion and cross-verification of evaluation results for many techniques” in RAN-1. In RAN-2 only a subset of the techniques could be evaluated, as RAN-2 was waiting for input from RAN-1 until the last meeting. RAN-4 was not involved so far, but one important technique (SSB-less) depends completely on RAN-4 feasibility. Adaptation/reduction/elimination of common channels/signals is essential to achieve the NES objectives, but no specific technique was recommended because RAN-1 did not have enough time to down-select.

Alt 2 would still be acceptable, but would leave much normative work for Rel-19. This may cause market fragmentation (see RP-222988). That is why Alt 1 would be preferred.

Alt 3 would mean ignoring that the study is neither complete nor conclusive.

10 – AT&T

Agree with Vodafone. Power domain enhancements without any UPT/latency impact have a lot of utility to operators but were not simulated by many companies during the SID. An extended study solely focusing on power domain enhancements (other than D-1 which was also shown to have UPT/latency impacts) would be highly desirable to reduce network energy consumption during high loads as well, as stated by Vodafone, AT&T and others during the GTW call.

11 – CATT

We support Alt3. RAN1/RAN2/RAN3 had done tremendous works to complete the NES study items in defining the power model, and provided clear descriptions, power saving gain, and system impact analysis of the network energy saving techniques in time/frequency/spatial/power domain in short period of time. Some aspects during the study might not be perfect, e.g., assumptions were made in optimistic or ideal condition. However, the study have provided good references matrices from the evaluation results and system analysis. The NES study should be completed and move to work item.

12 – TELECOM ITALIA S.p.A.

Support the view expressed by Fraunhofer (option 1 is the preferred solution). Also support the view stated by Vodafone and At&T

13 – InterDigital

We prefer Alt 3. Alts 1 and 2 leave less time for completing the WI, and further discussion in SI may not be so fruitful given the number of solutions studied.

14 – Apple Italia S.R.L.

We are fine with either Alt 3 or Alt 2. No matter which alternative is taken, the ultimate goal is to perform proper down-selection and have a well-defined scope for the work item. If Alt 3 is taken, it is very important to have a reasonable scope for the WI, instead of including most of the techniques that RAN1 was not able to provide conclusive recommendation.

15 – Intel K.K.

Support Alt3. It is important to have a manageable scope of WI and any potential schemes/direction that cannot be included this time can be pursued in future releases. As of now, results for schemes and corresponding impacts across different domains are documented in TR and seem to be sufficient for recommendation purposes.

16 – Verizon UK Ltd

Very much agree with the view expressed by Vodafone, AT&T, Telecom Italia etc. including their view on power domain techniques.

17 – SoftBank Corp.

After endorsing the time plan for REL-18 and taking quality concerns expressed in the GTW (last night in Asia) into consideration, Alt-3 sounds rational/practical and we also have sympathy to RAN1 chair's view in general, only 4 meetings left.

18 – NTT DOCOMO INC.

Alternative 2 or 3. Our first preference is Alt.3. We share similar view with other companies that RAN WGs have done good study with evaluation results and analysis. However, we would be fine with Alt.2 if companies think further study is needed to converge for the time domain enhancements.

19 – Qualcomm Incorporated

We prefer Alternative 3. We think there has been sufficient evaluation during the SI. This should no preclude including power domain objectives, and including those would be our preference.

20 – CAICT

We support Alternative 3.

21 – LG Uplus

Considering the Rel-18 schedule, we prefer Alt.3

22 – vivo Mobile Communication (H)

Considering the time left for Rel-18, we prefer Alt. 3 since only 4 meetings left for RAN1. On the other hand, the detailed necessary enhancement beyond existing mechanism for some particular techniques may need further study in Work Item phase.

23 – Telstra Limited

Preference is Alternative 2 with same view as DT, Vodafone, etc where SI extension may benefit improved power domain energy savings techniques.

24 – Nokia Corporation

We have concerns on how alt. 2 could work in practice unless there is a very clear division between which techniques would be further studied and which ones would be standardized. Given the large number of techniques that have been proposed, and which would continue to be evaluated, in practice Alt. 2 means that time for normative work will be very limited. Please note also that some of the proposed techniques would require study over several quarters to evaluate their feasibility and determine potential benefits, including significant allocation by RAN4, which has not been involved in the studies at all so far.

Hence, we prefer alt3, i.e. start the normative work with a limited set of objectives already in 2023 Q1, so that there is a concrete outcome of the WI in Rel-18.

25 – CTSI

First, consider the limited time left for Rel-18, the WI should be started as soon as possible. Besides, great work has been done on the evaluation of NES techniques in the SI, we don't see there will be more meaningful process be made with one more meeting. So, we prefer Alt.3.

26 – CTSI

China Telecom:

First, consider the limited time left for Rel-18, the WI should be started as soon as possible. Besides, great work has been done on the evaluation of NES techniques in the SI, we don't see there will be more meaningful process be made with one more meeting. So, we prefer Alt.3

27 – KDDI Corporation

We understand the study time was short, however, we are not sure whether there will be a better conclusion or not with anther 3 months extention. With the current Study, considering the limited time left for Rel-18, we think we can start normative work with a limited items.

28 – Fujitsu Limited

Our preference is Alt. 3. Considering the WG situation during the SI phase, we are not sure if the extention of SI phase will change the companies' attitude. Starting WI now will give us more time for constructive discussion in WGs.

29 – Guangdong OPPO Mobile Telecom.

we support alt3. we think RAN1 has evaluate alternatives carefully and further study for one more quarter is not so helpful.

30 – Spreadtrum Communications

Alternative 2 or 3.

We may understand some operators' concerns, e.g. try best to get "on-shot R18 NES" and avoid the paper standard due to rush-into. NES is very important from operators' view. However, unfortunately more discussions in WGs may not so helpful in our mind.

The paper standard cannot be avoided completely, but there are still many parts or features in the standard being robust in real deployment.

To avoid the endless enhancement/patches, we can try to let the hardware enhancements be specified in R18 and leave the software enhancments to the following release. The software update is smooth for network evolutions.

31 – NEC Corporation

Our preference is Alt.3.

32 – Telia Company AB

We prefer alternative 3. It would be important that 3GPP can actually deliver practical solutions in Rel-18. Normative work should start as planned in Q1-23. NES improvement study item and work item proposal should still continue in Rel-19 and future releases.

33 – Ericsson LM

Alternative 2

34 – MediaTek Inc.

We support Alt3.

The most valuable part of R18 NES SI is the evaluation methodology and BS power consumption model, which, in our view, is stable and complete. Further discussion in the techniques with only one meeting is not likely to bring consensus on scheme(s) with insufficient support, and consolidating the WID scope in this RP meeting would be the most practical way forward. Proceeding with R18 specification will effectively

raise the bar for additional enhancement(s) that should justify their benefit(s) w.r.t. R18 baseline, which is also useful to ensure better solutions for NR networks.

On PA-related NES schemes, we see the main issue is the implementation dependency. From the TR, it is captured for D-3 and D-5 that ”PA scaling values used for this NW ES scheme are not covered by RAN1 power consumption scaling model.”, which implies other RAN1 companies’ cannot check/reproduce the evaluation results by the proponent company. In this regard, additional time for studying PA-related NES schemes will not be helpful.

35 – Orange

We would prefer alternative 2.

36 – TURKCELL

We support Alternative 2.

37 – China Mobile Com. Corporation

CMCC support alt 3.

38 – Deutsche Telekom AG

Obviously, Alternative 1 is our choice inline with our proposal in 988.

Given the surprising outcome of the discussion on Rel-18 timeline yesterday, we can accept Alternative 2 but we think this is not good practice from project management point of view. What is more important is what also VF and other indicated that a very good NES solution is found as a overall solution in Rel-18 in order to have the benfits asap in our networks to help achievining the goal of mimimising the carbon footprint as much as possible, Especially functions which require UE involvement like WUS to trigger a basestation to provide coverage are needed asap as operator can only activate such features if the population of UEs is sufficiently high (which takes some time).

It is of no doubt that any UE feature to support NES shall be mandatory for the UE.

39 – Panasonic Holdings Corporation

Our preference is Alternative 3. As said by Apple, the importance is down selection further as guided by FL in this NWM discussion.

40 – LG Uplus

Alternative 2 is preferred.

41 – Tejas Networks Ltd.

We support Alternative 2.

42 – Sony Europe B.V.

We support alternative 3 ie start WI from Q1 23 and no further study in Rel-18

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43 – Motorola Mobility UK Ltd. [Lenovo] We prefer Alternative 3 with a well-defined and manageable scope for the WI including only techniques that have shown to have considerable gain and easily compatible with legacy in the SI.
44 – BT plc Alternative 3. RP-223002 declares SI phase concluded and TR 38.864 captures the results. Extending the SI is at the cost to reduce the WI will impact the final quality of the work.

2.2 Potential work item objectives

This subsection will be used for discussing the work item objectives assuming there is a work item approved in RAN#98e. According to the previously agreed plan on Rel-18 Network Energy Savings, the work item will start in 2023.Q1 with target completion date of 2023.Q3 in RAN1 and 2023.Q4 in other WGs. RAN1, the leading WG, will have four meetings (1 TU per meeting in Q1 and 2 TUs per meeting in Q2/Q3) to complete the work item. To complete the normative on time, it is critical that the work scope be compact with very well defined objectives. Furthermore, it is recommended to avoid 'study and specify if beneficial' type of approach as much as possible for all objectives.

2.2.1 RAN1-led objectives

RAN1 evaluated and discussed network energy savings techniques in time, frequency, spatial, and power domain. Conclusion of the study can be summarized as the following:

- Beneficial and recommended
  - Adaptation of spatial elements (C-1) [RAN1]
- Beneficial
  - Adaptation of TRPs in mTRP operation (C-2) [RAN1]
    - RAN1 observed that there is potential to provide large gain
  - Adaptation of DTX/DRX (A-4), including the alignment of Cell DTX/DRX with UE DRX [RAN2, RAN3 and possibly RAN1]
  - Time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4]
  - Adaptation of transmission power of signals and channels (D-1) [RAN1]

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Considering the limited number of meetings and TUs, it is obvious that only a subset of the potential enhancements can be accommodated in RAN1. From RAN1 chair's point of view, it is strongly recommended not to have more than two different types of enhancements in RAN1 to avoid the risk of not completing this work item on time.

Adaptation of spatial elements (C-1) was concluded in the TR to be beneficial and also recommended. Based on this conclusion, the following proposal is made.

Proposal1*: For network energy savings, specify the enhancement of spatial element adaptation such as the number of active transceiver chains or the number of active antenna panels at gNB in transmitting and/or receiving channels and signals*

Please note that the objective in the WID will be further discussed once Proposal1 is agreed. Interested companies are requested to share their views on Proposal1.

Feedback Form 2:

1 – KT Corp. KT supports moderator proposal to include C-1 in the objective for the normative work.
2 – Samsung Electronics Co. We support proposal 1.
3 – VODAFONE Group Plc Support
4 – Futurewei Technologies Support
5 – LG Electronics Inc. We support Proposal 1 with the following modification, considering substantial impacts on legacy UEs if spatial elements for broadcast channels/signals can be dynamically adapted. ***Proposal1****: For network energy savings, specify the enhancement of spatial element adaptation such as the number of active transceiver chains or the number of active antenna panels at gNB in transmitting and/or receiving* ***UE-specific*** *channels and signals*
6 – HUAWEI TECHNOLOGIES Co. Ltd. We support proposal 1 to include the adaptation of spatial elements (C-1) to the WID.

7 – ZTE Corporation

ZTE, Sanechips

Based on TR conclusion and recommendation, we also think the spatial domain adaptation can be included in the WI objectives.

Furthermore, we think the evaluated NES gain in TR is based on the adaptation of number of active transceiver chains, instead of active antenna panels. Therefore, the following is suggested:

For network energy savings, specify the enhancement of spatial element adaptation such as the number of active transceiver chains ~~or the number of active antenna panels~~ at gNB in transmitting and/or receiving channels and signals

8 – Fraunhofer IIS

We support the inclusion of C-1

9 – AT&T

Ok

10 – Intel K.K.

Support C-1

11 – CATT

We support Proposal 1.

12 – InterDigital

Support the proposal

13 – Apple Italia S.R.L.

Support

14 – Verizon UK Ltd

Support the proposal to include C-1.

15 – SoftBank Corp.

Support C-1.

16 – Rakuten Mobile

Agree

17 – NTT DOCOMO INC.

We support Proposal 1. At least the enhancement of CSI resource, CSI report and TCI configuration is needed for antenna/spatial adaptation.

18 – Qualcomm Incorporated

We share same views with both LGE and ZTE. In particular, we suggest the following update to the proposal:

"Proposal 1: For network energy savings, specify the enhancement of spatial element adaptation such as the number of active transceiver chains ~~***or the number of active antenna panels***~~ *at gNB in transmitting and/or receiving* ***UE-specific*** *channels and signals."*

19 – CAICT

We support proposal 1.

20 – China Mobile Group Device Co.

CMCC

21 – China Mobile Group Device Co.

CMCC

22 – China Mobile Group Device Co.

Support Proposal 1

23 – LG Uplus

We support proposal 1

24 – vivo Mobile Communication (H)

Support the proposal. As proposed below, we suggest to combine D-1 into this proposal.

25 – Telstra Limited

We support the proposal

26 – Nokia Corporation

We support the proposal, with the understanding that detailed formulation will be done in subsequent iterations.

27 – CTSI

We support the proposal.

28 – KDDI Corporation

We are OK with the proposal

29 – CTSI

On behalf of China Telecom

30 – Fujitsu Limited

We support Proposal 1.

31 – Guangdong OPPO Mobile Telecom.

we support proposal1

32 – NEC Corporation

We support Proposal 1. It is only recommendation from the study.

33 – Spreadtrum Communications

Support

34 – Telia Company AB

We support proposal 1.

35 – Ericsson LM

Support

36 – CEWiT

We support the proposal to include the technique C1

37 – Orange

we support

38 – TURKCELL

We support Proposal 1.

39 – Deutsche Telekom AG

Support

40 – Panasonic Holdings Corporation

We support the proposal.

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41 – LG Uplus Support
42 – MediaTek Inc. We support proposal 1 and the revisions from LGE, ZTE and Qualcomm.
43 – Tejas Networks Ltd. We support Proposal 1.
44 – Sony Europe B.V. OK with P1
45 – Motorola Mobility UK Ltd. [Lenovo] We support proposal 1.
46 – BT plc Support C-1
47 – CHTTL we support

For the remaining possible enhancements relevant to RAN1, it is recommended that **only one** additional enhancement is agreed for normative work in consideration of the limited Rel-18 time.

Proposal2: *Select one of the following possible enhancements for Rel-18*

- *Adaptation of TRPs in mTRP operation (C-2) [RAN1]*
- *Adaptation of transmission power of signals and channels (D-1) [RAN1]*
- *Time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4]*

Please note that the objective in the WID will be further discussed once RAN can converge on which possible enhancement to support in Rel-18. Interested companies are requested to share their views on Proposal2.

Feedback Form 3:

1 – KT Corp. KT believes that the study result of D-1 showed strong benefits for operators needs on reducing power

consumption of gNB. This feature needs to be supported in Release-18.

2 – Samsung Electronics Co.

D-1.

3 – VODAFONE Group Plc

Support to de-prioritizing C-2 over the other two techniques. Time/frequency domain techniques need further discussion in order to converge which technique should be included in the normative work. Technique D-1 is OK to include it in the WI.

4 – Futurewei Technologies

Time and Frequency approached have the greatest potential energy savings benefits, among all the possible approaches studied in the SI. Therefore, our view is that Time/Freq domain approaches are very promising, We should proceed with some approaches within this category (Time/Freq Domain) and if needed, additional quarter of studies (Alt 2) can be a good compromise to achieve this.

5 – LG Electronics Inc.

We are OK with D-1, considering expected specification impact from D-1 seems similar to that from C-1. However, we have a concern if the third bullet will be selected, as new NES-UEs can have significant specification/implementation impact to support those techniques and legacy UEs cannot access the network implementing them.

6 – HUAWEI TECHNOLOGIES Co. Ltd.

We think more than one direction can be included to the WID under this proposal 2, the reasons are as given below:

● We do agree with the moderator that the RAN1 TU should be taken into account in order to complete the WID on time. However, as shown in the endorsed TU planning RP-213697 in RAN#94-e, the RAN1 TUs for the 4 meetings are 1 2 2 2. With this TU allocation, more than 1 RAN1 item can be taken in addition to C-1, especially considering that D-1 can share common framework with C-1 as described below.

● Under time and frequency domain, actually the main standard work for some of candidate solutions are mainly for other working groups instead of RAN1. For example, for SSB-less SCell operation, RAN4 will be the leading group with the involvement of RAN2, actually at this stage we don't identify RAN1 work for this technique. For this kind of techniques, it is not good to be precluded due to RAN1 TU. To make the overall workload manageable, we can consider to take the techniques with main work spread among working groups for time and frequency domain, and with some potential restriction on the potential specification impact. It is noted that RAN1 show that the below techniques are all beneficial for network energy saving.

Follow the above thinking, as shown below, we propose to take D-1 for power domain, and also some candidate solutions under time and frequency domain:

● Adaptation of transmission power of signals and channels (D-1) [RAN1]

Note: Strive for a common framework on multiple CSIs enhancements for the adaptation of spatial elements and adaptation of DL transmission power

● Time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation

o SSB-less SCell operation [RAN4, RAN2]

o SIB1-less operation with or without SSB [RAN2, RAN1, RAN4]

o On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]

o Longer SSB transmission periodicity [RAN2, RAN4]

Note: No new type of UL channel/signal to be introduced

From the above list for time and frequency domain, actually only on-demand SSB/SIB1 is RAN1-led items, and we can put the restriction as the note that there is no new type of UL channel/signal to be introduced to further restrict the potential RAN1 impact.

In addition, in order to further minimize the RAN1 standard work, we can put the restriction to strive for a common framework for the adaptation of spatial elements (C-1) and adaptation of DL transmission power (D-1) on multiple CSIs enhancements.

7 – ZTE Corporation

ZTE, Sanechips

For the enhancement listed in proposal 2, our comments are as below.

(1) C-2: the spatial domain solution of C-1 is recommended, technique C-2 can be de-prioritized in Rel-18.

(2) D-1: It is concluded as beneficial to NES. However, the enhancement directions of technique C-1 and technique D-1 are the same(i.e., more dynamic indication, enhanced CSI measurement/reporting). Therefore, same framework should be applied for both technique C-1 and technique D-1 if technique D-1 is considered on top of technique C-1. In this sense, even technique D-1 is included, it is not reasonable to count them as two separate items.

(3) For time/frequency domain solutions: the mandatory transmission of common signal/channel reduces network's opportunities of entering into sleep mode, which is the major contributor of network energy consumption. Therefore, elimination of common signal/channel is critical for network energy savings, especially in the empty/low load cases. Based on the results in TR, the NES gain from SSB-less/SIB-less can be up to 98.4% in empty load. Hence, it should be considered in the WI scope.

To be more specific, there are two promising scenarios about SSB/SIB-less scheme.

1) SSB-less for inter-band CA(led by RAN4): it is an extension of intra-band SSB-less SCell. It can provide up to 80.4%~97.4% energy saving gain at empty load, up to 72.7% energy saving gain at low load. The SCell activation procedure can be also enhanced by removing temporary TRS introduced in Rel-17. It is also observed that SSB-less SCell with UL only traffic has more NES gain, where there should be no/less implementation challenge e.g. no DL AGC adjustment is needed. Network should be able to adapt to traffic need per band and save energy by avoiding any DL transmission when there is no DL traffic in that band. Therefore, the enhanced SCell activation procedure should be considered at least for UL only traffic. We believe the overall workload is low for this technique as this is just an extension of the existing technique. We can focus more on RAN4 work for this objective.

2) NES cell without SIB and SSB (led by RAN2): it can achieve the most energy saving gain compared with NES without SIB (but with SSB)., i.e. it can have meaningful gain only if we support both SIB-less and SSB-less together.

Besides, we think WUS (led by RAN1) can be additionally supported in combination of NES cell to achieve a tradeoff between network energy saving and UE performance.

For the common signal/channel with long periodicity, our concerns are that it has negative impact on UE access and less energy saving gain than SSB-less/SIB-less. Therefore, it can be de-prioritized in Rel-18.

To this end, we suggest to have more concrete objectives for time/frequency domains.

Specify solutions to supporting SSB-less/SIB-less cell:

- SCell without SSB in inter-band CA, including SCell activation process at least for UL only traffic(RAN4, RAN2, [RAN1])

- NES Cell without SIB and SSB (RAN2, RAN4, RAN1)

Including System information transmitted by anchor cell, the system information update, RACH procedure

- WUS for NES cell without SSB and SIB (RAN1, RAN2, RAN4)

Note with the above suggested objectives, we still believe the workload of different WGs are manageable within the assigned TU, i.e., SSB-less inter-band CA is led by RAN4, NES Cell without SIB and SSB is led by RAN2, WUS (if supported) is led by RAN1.

8 – Fraunhofer IIS

The inclusion of time/frequency domain adaptation/reduction/elimination of common channel signals is of utmost importance to achieve high energy saving gains, especially at low loads - that is the WI priority. Those were the only techniques to save more than 80% energy at zero load. These techniques also would complement C-1, as C-1 reduces the power during active time whereas the common channel adaptation techniques simply reduce the active time or frequencies (the energy saving gains of C-1 and e.g. A-3/A1-3 or B1 would be cumulative). In contrast combining C-1 with C2 or D1 is likely to provide less joint benefits.

Therefore, we fully support time/frequency domain as most promising enhancement for NES.

9 – AT&T

if at most one other enhancement can be specified in RAN1, we prefer inclusion of D-5, possibly after an extended study phase.

10 – CATT

The network energy saving techniques in time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4] would have the clear network energy saving gain and less system impacts when the scope is further down selected.

The network energy saving technique *Adaptation of TRPs in mTRP operation (C-2)* would provide the power saving gain. However, mTRP is not a generic deployment scenario and could wait for future release.

The network energy saving techniques of power adaptation could be done by gNB implementation for UE-specific PDSCH/PUSCH channels with DMRS. Some proposed power adaptation techniques would

have the impact of the coverage and UE implementation in channel tracking, measurement and estimation. These techniques should be further analyzed and could be included in the work of future release.

11 – InterDigital

Support time domain adaptation, given techniques bring the most energy savings gains. To avoid legacy UE impacts and not affect UE experience, focus can be made on adaptation of UE specific signals and channels, and UE WUS can also be considered.

D1 can be merged with C1 into a single objective in RAN1, given both deal with the same enhancement on CSI-reporting

Frequency domain solutions (such as SSB/SIB-less inter band operation) can be deprioritized, given feasibility was not concluded. C2 can also be deprioritized.

12 – Intel K.K.

We support D-1. It can also benefit from consideration of C-1 and D-1 under a common framework and thus may be completed efficiently.

13 – Verizon UK Ltd

Same view with AT&T - like D-5 a lot, if it is manageable.

14 – Apple Italia S.R.L.

We support chairman's proposal of adding at most one additional RAN1 objective in general, to make the work load manageable and maintain good quality work. Originally our proposal is to include cell DTX/DRX adaptation as the 2nd objective, as we believe it has a lot of RAN1 impact. Even though it is proposed as RAN2-led objective now, it does not change the amount of RAN1 work needed. No matter which other objective is to be included, the RAN1 work load from cell DTX/DRX should be jointly considered.

Regarding the 3 items being proposed, we think C-2 can be de-prioritized. There was not strong interest from companies in RAN1 based on the number of companies that provided the evaluation results. More importantly, M-TRP is not a typical deployment scenario, so it is not so important to provide enhancements for M-TRP at this stage.

For the other two items, we are open to discuss further. However, for adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation, it is actually an umbrella for a large number of proposals. We need to be specific on which technique(s) we are targeting here. If inter-band SSB-less SCell is to be considered, this should be led by RAN4 and feasibility study should be performed first (because no study was done during the SI phase in RAN4). For the other techniques, each of them may have different impact on legacy UEs, specs and UE implementation. We do not think it is necessary to include multiple of them as they are all targeting at harvesting the same energy saving. Down-selection is necessary.

15 – SoftBank Corp.

Support D-1 if we have to select one of these.

Comment on D-5 (UE post distortion, we guess): Allowing gNB distortion also imply increasing unwanted emission, even if degraded wanted signal can be compensated by REL-18 NES conscious UE. We need to address to what extent a gain is feasible while not to violate the regulations.

16 – Rakuten Mobile

C-2 could be deprioritized. Between D-1 and Time/frequency domain technique, we observe both techniques have clear benefit for network energy saving. If we select one from time budget perspective, D-1 is preferred as smaller spec. impact is expected.

17 – NTT DOCOMO INC.

We think more than one techniques can be included the WID in addition to C-1. As commented by Huawei, RAN1 workload for time and frequency domain techniques are not expected to be large according to the draft WID in RP-223432. Besides, C-1/D-1 may strive a common framework for CSI enhancement. Therefore, we don't think it is appropriate to limit only one technique due to RAN1 TU limitation. We think it is essential to include time domain enhancements to achieve high energy saving gains especially zero/low load scenario.

Regarding C-2, it can be de-prioritized because m-TRP is not a generic deployment. It can be considered in later release, if needed.

18 – Qualcomm Incorporated

We are interested in power domain enhancements. Our main preference among those is D-5. If there is no consensus to include D-5 in Rel-18 due to limited time, then it should be targeted for the next release in our view. If D-5 will not be in Rel-18, then it can be discussed whether at least D-1 should be included. We agree that both C-1 and D-1 may need CSI procedure enhancement in principle. However, the detailed enhancements could be different. Hence, we do not support adding a note (as some companies suggested) on common CSI enhancement framework in WI at this stage. We can discuss in RAN1 whether a common CSI enhancement frame should be pursued.

For time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) includes a list of techniques discussed in TR 38.864. To facilitate the discussion, we should explicitly discuss which RAN1-led technique in this domain we should down-select to. From our perspective, we are open to discuss whether on-demand SSB/SIB1 should be included in WI. Although we note that on-demand SSB/SIB1 is only applicable to deployments without legacy UEs.

19 – CAICT

We have the similar view from HW and propose to have both power domain and time/frequency domain enhancemeents. we have slightly preference on time/frequency domain enhacements first.

20 – vivo Mobile Communication (H)

Here are our views on the above listed techniques:

1. C-2: it could be deprioritized if RAN1 time is limited.

2. D-1: we prefer to deprioritize it since it can be done by implementation as we explain in SI discussion. If majority wants to have such enhancement, we think D-1 can be combined with C-1. This is because both C-1 and D-1 involve CSI related enhancement, e.g., CSI resource and/or CSI report (re)configurations/adaptations /(de)activation via L1/L2 signaling, for the adaptation of spatial elements and/or PDSCH power. So, the same framework can be designed and only the involved parameter is different. Based on this, we suggest the following change in proposal 1:

For network energy savings, specify the CSI related enhancement for adaptation of spatial and/or power domain.

3. For adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation, the following can be included:

1) SSB-less operation for inter-band CA

2) SIB1 offloading from one cell to another cell

3) On-demand SSB/SIB1 triggered by UEs in RRC_idle/inactive/connected

For bullet 1, RAN4 will be the lead group and there is no work in RAN1;

For bullet 2, RAN2 will be the lead group and there is little work in RAN1;

For bullet 3, RAN1 will be the lead group. The WUS can reuse existing channel/signals so the design work in RAN1 will be alleviated a lot.

Based on the above discussion, we propose to include the following:

CSI related enhancement for adaptation of spatial element and/or PDSCH power (RAN1, RAN2)

On-demand SSB/SIB1 triggered by UEs in RRC_idle/inactive/connected state (RAN1, RAN2, RAN4)

SIB1 offloading from one cell to another cell (RAN2, RAN1, RAN4)

SSB-less operation for inter-band CA (RAN4, RAN2)

21 – Telstra Limited

We support D-1, although note that C-2 may also be developed under a common framework.

22 – Nokia Corporation

We support D-1 as highest priority for inclusion in the WI, as it provides benefits and it matches the desire from operators to see power-domain techniques included in the work.

Given that there are synergies between D-1 and C-1, we could consider also on-demand SSB/SIB transmission triggered by UE using a legacy signal/channel as WUS, which is a subset of the time/frequency techniques. Please note that the formulation from the moderator on time/frequency techniques is way too broad, as that includes several of the techniques studied so far.

Finally, we also consider C-2 is an important enhancement and we would be fine to include it if time allows.

23 – CTSI

China Telecom:

1. For the C-2, we prefer to deprioritize it.

2. For the D-1, we have the similar as ZTE that we do think it is useful but can be combined with C-1 with similar enhancement on the CSI reporting and other aspects.

3. For time/frequency domain techniques, it is no doubt it has the second strongest benefits besides the C-1. But the current version should be clarified which techniques are included. From our prospective, the SSB-less operation for inter-band CA should be considered, and it can be led by RAN4 as moderator proposed in the WID, so there will be no more work for RAN1. Besides, the on-demand SSB/SIB1 triggered can be supported. With the techniques be supported, the longer SSB transmission periodicity can also be supported at the same time.

24 – China Mobile Group Device Co.

CMCC

Regarding D-1, we also agree to have a common framework for spatial and power domain techniques, then work load to add D-1 in WI objective will not increase too much RAN1 work load.

Regarding time and frequency domain, we have observed greatest energy saving gains during the study phase, some are more promising than spatial and power domain, so, techniques in time and frequency domains should be captured in WI objectives. To consider the limited TUs, we could further discuss and down-select or add restrictions on the listed potential enhancements to reduce the work load for RAN1. For further down-selection, from operator's view, the transmission of common signal/channel restricts network to enter into sleep modes and leads to large network energy consumption, then, the elimination of common signal/channel could be considered during the WI phase. So we propose to capture SSB-less/SIB1-less (RAN2-lead), and capture the on-demand SSB/SIB1 transmission triggered requested by UE (RAN1-lead) into the WID objective, where these two schemes may be work together to ensure network energy saving and UE performance.

Regarding C-2, it can be deprioritized to consider the TU in RAN1.

25 – Fujitsu Limited

D-1 can be included in the WID as this is the consensus in during SI phase.

As for time/frequency domain, we believe the potential for network energy saving gain. However it would not be so easy to come up with an explicit list of techniques in this week. We are OK to prioritize D-1, and time/frquency domain techniques can be considered in later release.

We don't see any urgent need for C-2, so it can be deprioritzed.

26 – Guangdong OPPO Mobile Telecom.

if we support solution C-1, solution C-2 serves quite similar purpose hence it can be deprioritized.

the assumption for solution D-1 is that gNB will adapt its transmission power dynamically, which we think is not reasonable assumption in field.

we support inter-band SSB-less SCell operation. Without transmit SSB (and also SIB since it is scell), the energy saving gain is clear. Nevertheless it seems also clear that it can't be applied for all inter-band combination. So to identify feasible inter-band combination in RAN4 is necessary first step. And for identified band combination, further evaluation on impact on RRM performance is helpful to understand potential impact on implementation, especially in UE side.

27 – NEC Corporation

We are fine to down-select among these options. D-1 should be promising and prioritized.

28 – Spreadtrum Communications

We share the similar view as Apple. Cell DTX/DRX has RAN1 impact from RS perspective, e.g. UE may process the periodic RS outside active time for now. Technique C-1 may be another form of cell DTX/DRX. For example, in NCR topic, no active beam at NCR means NCR power off. Techique D-1 may be also another form of cell DTX/DRX. For example, zero power can represent cell off. For C-1/D-1, all transceivers off and zero TX/RX power can be discussed as a form of cell DTX/DRX.

29 – Telia Company AB

We support D-1 as priority solution if only one to be chosen.

30 – China Unicom

In our view, time and frequency domain techniques (e.g. SSB-less solution and SIB-less solution) has limited impacts to the RAN1's TU. In details, SSB-less SCell operation can be led by RAN4 with RAN2 involved, and SIB1-less with/without SSB-less solution can be led by RAN2 with RAN1 and RAN4 involved. So we support to include time and frequency domain techniques that are proven to have gains for NES in the previous RAN2 and RAN1 meeting, and we support the following solutions under time and frequency for Rel-18 NES normative work:

l SSB-less SCell activation in inter-band CA [RAN4, RAN2]

l NES cell with at least SIB1-less operation (both "with SSB" or "without SSB" can be considered) [RAN2, RAN4, RAN1]

31 – Ericsson LM

We support D-1 - it is UE-specific signaling enhancement with clear scope. As mentioned in our contribution, other techniques would need further study to identify full proposals.

32 – Orange

We support techiques adressing *Time/frequency domain: Adaptation/reduction/elimination of common channels/signals.*

In particular, we support the introduction of both SSB-less and SIB1-less operation, with specific interest on inter-band scenarios. As an operator this would allow energy saving without completely switching of SCells as this is done today.

33 – CEWiT

Time/frequency domain enhancements have clear benefits for energy saving and many companies have provided significant gains during SI phase. "Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4]" should be prioritized.

D-1: Adaptation of transmission power of signals and channels [RAN1] also has clear benefits and can be taken as second priority if time permits.

34 – TURKCELL

Adaptation of transmission power of signals and channels (D-1)

35 – Deutsche Telekom AG

D1 AND

Time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4]

C2 is limited to very specific not (yet) widespread deployments and is seen not as important as other which can provide immediate gains in terms of NES

36 – Panasonic Holdings Corporation

We support adaptation of transmission power of signals and channels (D-1) [RAN1] considering TU availability.

37 – LG Uplus

D-1 is preferred for this release.

38 – MediaTek Inc.

Considering RAN1 work, D-1 can be included. It is also beneficial to develop a joint adaptation mechanism together with adaptation of spatial elements.

In addition to D-1, we see SSB-less SCell for inter-band CA under "*Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation*" can be included as a RAN4-led item (with RAN2 assistance). Other schemes under the generic direction is either supported by existing NR (e.g., periodicity adaptation for common channels/signals) or pre-matured for specification work (e.g., UE WUS).

39 – Sony Europe B.V.

We think RAN1 should prioritize Time/frequency domain considering 1) it has an overlap with RAN2 and 2) the amount of time left in Rel-18.

40 – Tejas Networks Ltd.

Time/frequency domain: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation [RAN1, RAN2, RAN4] and/or D-1

41 – Motorola Mobility UK Ltd.

[Lenovo] Support time/frequency domain Adaptation/reduction/elimination of common channels/signals and D1.

Time/frequency domain adaptation/reduction/elimination of common channel signals techniques have shown to have significant energy savings - should down-select some of these techniques for manageable work load. D-1 and C-1 are related and can be merged to have a common CSI enhancement framework. C-2 is applicable only to mTRP deployments and can be considered in a later release.

42 – BT plc

Time/frequency domain:

- Paging Enhancements (A-1-4 Aligning of Paging Occasion)
- SSB-less SCell operation for inter-band CA, same Timing Advance Group (A-5)
- WUS-wake up signal, if functionality can be supported without additional UL signal.
- SSB increased periodicity
- On-demand SSB/SIB1 without the definition of new UL signalling

Power Domain

- Power adaptation for PDSCH and CSI-RS (D-1)

No support for D-5.

2.2.2 RAN2-led and RAN3-led objectives

For possible enhancements to be led by RAN2, it was observed by both RAN1 and RAN2 that adaptation of DTX/DRX (A-4), including the alignment of Cell DTX/DRX with UE DRX was beneficial. Furthermore, RAN2 concluded that A-4 is feasible. Based on these observations, the following proposal is made.

Proposal3*: Specify the adaptation of cell DTX/DRX, including the alignment of Cell DTX/DRX with UE DRX [RAN2, RAN3 and possibly RAN1].*

Please note that the objective in the WID will be further discussed once Proposal3 is agreed.

Interested companies are requested to share their views on Proposal3.

Feedback Form 4:

1 – KT Corp.

KT believes this technique can even support legacy UEs. We would like to continue with normative work for this proposal.

2 – Samsung Electronics Co.

The TR captures that cell DTX/DRX is feasible and beneficial. We support the proposal.

3 – VODAFONE Group Plc

Support

4 – LG Electronics Inc.

We think Cell DTX/DRX is essential feature of NES, and thus we support this proposal.

5 – HUAWEI TECHNOLOGIES Co. Ltd.

We agree with proposal 3 to include cell DTX/DRX. Whether/how to describe "Cell DTX/DRX" needs further discussion.

In addition to cell DTX/DRX, as described in section 2.2.1, some other RAN2-led techniques under time and frequency domain should be taken also, which mainly include the following two techniques:

o SIB1-less operation with or without SSB [RAN2, RAN1, RAN4]

o Longer SSB transmission periodicity [RAN2, RAN4]

Especially for SIB1-less, promising network energy saving gain is observed from RAN1 evaluations, and it is well discussed in RAN2 regarding the main concept also.

6 – ZTE Corporation

ZTE, Sanechips

We agree with the first part of Proposal 3 in general.

The second part of Proposal3 may cause a bit confusion. With reference to the description in the TP "*It is beneficial to align UE DRX with Cell DTX and DRX alignment among multiple UEs. The alignment mechanism can be discussed during the WI phase*", we suggest to change the second part as the following "including the alignment mechanism which is used to align the UE behaviors related to DRX operation with the Cell DTX/DRX".

We have the analysis that the dynamic sleep mode of gNB needs to coordinate with the cell load in order to maximize the NES gain. In other words, the sleep mode of gNB/Cell DTX and DRX configuration would change dynamically. So we understand it may be infeasible to align the Cell DTX and DRX configuration with (some of) the UE's DRX configurations. It may be also infeasible or signaling inefficient to let gNB reconfigure every UE's DRX configuration in order to align with the dynamical Cell DTX/DRX configuration, especially with the consideration that the determination of UE's specific DRX configuration also has core network's involvement and also needs to be adapted to the UE's service characteristics.

Therefore, we think the more reasonable way is to inform UE the information about the gNB's sleep mode/Cell DTX and DRX configuration (multiple Cell DTX/DRX configurations can be supported but only one cell configuration is activated at any one time) and let UE adjust its behaviors related to DRX operation accordingly. The possible adjustment on UE behaviors has been identified during SI phase, e.g., whether

and which DL/UL resources can be assumed as deactivated/suspended during DTX and DRX; whether and which UE-specific DL/UL signals can be assumed as deactivated/suspended; whether CSI measurements and beam management during DTX can be suspended etc. RAN2 also agreed to further discuss these possible impacts and specify the necessary enhancements.

7 – Fraunhofer IIS

We support this proposal.

8 – Intel K.K.

We agree with P3 and think that cell DTX/DRX should be the 1st priority issue to be addressed.

In addition to this, we also suggest to add paging enhancement scheme evaluated in RAN1 which showed promising gain, does not have impact to legacy UEs, and have only impact to RAN2. We can consider the following objective as starting point.

o *Enhancement to paging procedures to group paging resources in a compact manner and allow longer inactivity period at gNB [RAN2]*

9 – CATT

We support Proposal 3.

10 – InterDigital

Support the proposal, with the inclusion of RAN1 as a secondary working group.

11 – Apple Italia S.R.L.

Support. Cell DTX/DRX was well studied in both RAN1 and RAN2 in study item phase. RAN1 concluded it is beneficial and multiple sources illustrated its NES gain in simulation. RAN2 concluded it is feasible. Meanwhile, it can support legacy UEs. Thus, we think we should start normative work on it.

In addition, RAN1 should be included as one of the WGs, as this will need e.g. defining new UE behaviors and possibly new PHY signaling design.

12 – SoftBank Corp.

Support the proposal.

13 – Qualcomm Incorporated

We are ok with the proposal in general. This technique could be applicable to legacy UEs, as well, as long as proper NW configuration is used. We propose to add a note “Note: at least legacy SSB transmission remains unchanged”.

Furthermore, we think RAN1 should be included.

14 – CAICT

Support proposal 3.

15 – NTT DOCOMO INC.

We support Proposal 3.

16 – vivo Mobile Communication (H)

In the evaluation that has been done in SI, it is only shown that alignment between UE DRX and cell DTX/DRX is beneficial. Our preference is to specify that is proved to be beneficial by evaluation. Besides, it is not clear whether this proposal is applied to RRC-connected UEs only. Since all the evaluation and discussions in SI are focusing on enhancement for connected UEs, our suggested change is:

Specify enhancement on alignment between UE DRX and cell DTX/DRX for UEs in RRC_connected state [RAN2, RAN3 and possibly RAN1]

17 – Nokia Corporation

We support the proposal in general, though it is not clear what is needed for alignment of cell DTX/DRX with UE DRX, so more discussion on the exact formulation will be needed.

18 – CTSI

China Telecom:

We support the proposal.

19 – KDDI Corporation

We are fine with the proposal, and RAN2 has confirmed that it is feasible from RAN2 perspective

20 – Fujitsu Limited

We support proposal 3.

21 – Guangdong OPPO Mobile Telecom.

we support proposal3. In addition we think UE in IDLE/INACTIVE state shall not be impacted by such feature. How to avoid such impact can be further discussed in WI phase.

22 – Telia Company AB

We support proposal 3.

23 – Spreadtrum Communications

Supportive and we share the similar view as Huawei. Some common signal/channel reduction may happen for cell DTX/DRX. For example, on-demand SSB is to be used in the cell capable DTX/DRX. It should be noted that NCD-SSB may be extended for non-RedCap UEs to support the BWP operations without restriction (FG 6-1a), which is being discussed as a solution friendly for both UE and network side. In

the WG discussions and non-official offline discussions, companies have common understanding that cells using the time/frequency domain techniques are non-anchor cells. Most time/frequency domain techniques can be or need to be combined as an overall solution for the non-anchor cells.

24 – Ericsson LM

Many benefits of C-DRX alignment are already possible with existing specification (current specifications allow semi-static alignment of DRX patterns for multiple UEs and this is what most evaluations in RAN1 assumed).

At this point, it is unclear what specific technique(s) (not already possible with current specification) are to be specified under the umbrella of "adaptation of cell DTX/DRX, including alignment of cell DTX/-DRX……" . Without clear understanding of this, it is also difficult assess the impact on RAN1. We prefer further study to identify specific technique(s) rather than moving WI phase at this point.

25 – China Mobile Com. Corporation

We prefer the wording in lastest draft WID RP-223432:

• Enhancement on DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED and RRC_IDLE/INACTIVE, including the alignment of UE DRX, and inter-node information exchange on DTX/DRX [RAN2, RAN1, RAN3]

We don't like the wording of cell DTX/DRX, because the network and UE behavior for cell DTX/DRX is not clear to us. 4 examples on Cell DTX/DRX behaviour during non-active periods are captured as possible options. The reference signals can be either transmitted or not transmitted. For the case the reference signals are not transmitted, there will be impact on idle mode behavior for both legacy UEs and R18 UEs, however, the SI mainly focus on connected mode UEs. So we suggest to capture all the three RRC states, and continue study the impact on idle and inactive UEs and do down-selection the 4 options during WI phase.

26 – Orange

we support

27 – TURKCELL

We support Proposal 3.

28 – Deutsche Telekom AG

We support, but we think this is not the best solution as it implies performance reduction which has not beed studied in details duirng the too short SI phase.

29 – NEC Corporation

We support the proposal 3 in general , which is aligned with the outcome of the study. Similar to vivo, we also understand the UE RRC state is limited to RRC connected, so support vivo's rewording proposal.

30 – CEWiT Support the proposal, with the inclusion of RAN1 as a secondary working group.
31 – Panasonic Holdings Corporation We support proposal3 of cell DTX/DRX.
32 – LG Uplus Cell DTX/DRX is deprioritized since we cannot be convinced so far whether it could be stable operation in overall network.
33 – MediaTek Inc. We support proposal 3 as RAN2-led item. It is clear BS can save power consumption from enlarged inactivity time durations, which requires alignment with UE inactivity time durations. While RAN1 and RAN2 investigated this direction from different angles (UE DRX vs. cell DTX), but we think RAN2 can develop a unified solution based on the TR. For the related WGs, we suggest to remove RAN1 as RAN2 can decide whether to send LS to request RAN1 help per their decision on whether to include L1-based trigger for the adaptation.
34 – Sony Europe B.V. We support P3
35 – Tejas Networks Ltd. We support P3
36 – Motorola Mobility UK Ltd. [Lenovo] Support proposal 3.
37 – BT plc We support P3

For the following possible enhancements relevant to RAN2 or RAN3, there were no positive conclusions on the benefits.

- Cell (re-)selection techniques for better handling of legacy UEs and NES-capable UEs including mechanism(s) to prevent legacy UEs from camping on specific cells and allow NES-capable UEs to (down-)prioritize specific cells [RAN2]
- Inter-node beam activation and paging enhancements [RAN3]

https://nwm-trial.etsi.org/#/documents/8372

Interested companies are requested to share their views on the need for the above possible enhancements in RAN2 and RAN3.

Feedback Form 5:

1 – KT Corp.

If we have enough TU to consider higher layer aspects for network energy savings, Cell selection/reselection seems to be a possible candidate to be included into objectives.

2 – VODAFONE Group Plc

We support to include the technique of CHO enhancements since it was deemed feasible by RAN2, and, in our opinion simple to implement with clear benefits. Given that many of NES techniques are aimed for a small load scenario in the NW, it is very important to re-distribute the UEs before putting the cell into NES mode so that service continuity is guaranteed and such techniques can be applied.

3 – Samsung Electronics Co.

We support cell (re-)selection techniques as Rel-18 NES features of the WI.

For NES support in NR, a main consideration should be how to minimize negative impact to legacy UEs. The simplest and easiest way is to let legacy UEs not camp on NES cell (either gNB supporting NES techniques or gNB configuring NES techniques). We see it can be controlled by enhancement of cell (re-)selection techniques, e.g. enhancement of barring mechanism or (down-)prioritization of NES cell for NES-capable UEs.

We also support inter-node beam activation and paging enhancements as RAN3-led feature.

4 – LG Electronics Inc.

We think preventing legacy UEs from camping on a NES cell is beneficial in that it can minimize the impact to legacy UEs and also simplifies the design of NES feature. We want to make it clear in the objectives, e.g. “Specify a mechanism to prevent legacy UEs from camping on a NES cell”.

5 – HUAWEI TECHNOLOGIES Co. Ltd.

In our understanding, at least mechanism to prevent legacy UE camping on cells adopting Rel-18 NES techniques should be included, since as captured in the SID as shown in Note 1 copied below, we need to ensure legacy UE work appropriately in the network implementing Rel-18 NES techniques.

Note 1: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically for greenfield deployments.

Therefore, we propose to at least add the following bullet for RAN2:

· Specify mechanism(s) to prevent legacy UEs camping on cells adopting the above techniques, if necessary [RAN2]

In addition, the two RAN3 techniques (i.e. inter-node beam activation and paging enhancements) are fine to include.

6 – ZTE Corporation

ZTE, Sanechips

For the cell (re-)selection techniques, it depends on the outcome of the NES techniques in different domains.

For the RAN3 objective, since RAN3 has agreement ”On the exchange NES state over network interfaces, RAN3 can further work pending on other group decision at normative phase.”, By shutting down some equipment, the cell can enter into an NES state, and a certain capacity can be provided in this NES state accordingly.If the node providing basic coverage is aware of the supported NES states and current NES state of the capacity booster cells, the node can request the booster cell to switch to a certain NES state for energy saving or providing better capacity, so the following is suggested.

Specify inter-node beam activation, NES state exchange and paging enhancements [RAN3].

7 – Fraunhofer IIS

TR 38.864 states “For backward compatibility, there is a need to allow NES cells to prevent legacy UEs from camping. NES cells should be able to configure whether to prevent legacy UEs, while allowing NES-capable UEs to camp on.” As it was concluded in RAN-2, a new cell barring mechanism is needed and should be included in the WI.

In conclusion, our proposal based on the TR outcome is to add cell barring.

8 – Intel K.K.

Similar to Vodafone, we also support to include the technique of CHO enhancements since RAN2 also considers this to be feasible. Hence we proposed to include the following for discussion:

Enhancements of the evaluation of conditional handover condition in CHO to consider the NES mode of source/target cell [RAN2].

We also think that preventing legacy UEs from camping on a NES cell is a useful mechanism to minimise the impact to legacy UE but would prefer to limit to this case. Hence we support LG to make it clear in the objectives.

We also support to continue the discussion on inter-node beam activation in RAN3, since it’s beneficial for sleep mode activation in in certain circumstances. If time allows, we’re also ok to discuss the other features which RAN3 agreed can be further worked on.

We think it needs to be clarified what paging enhancements are targeted. Another discussion point is whether to combine RAN2 based paging enhancement proposal suggested above in our comment Section 2.2.2 together with RAN3 proposal. We are open to such consideration.

9 – CATT

The target of network energy saving technique is to minimize the impact to the legacy UEs. The network saving techniques selected for Rel-18 should be transparent to legacy UEs in principle. However, the phase deployments of the network saving techniques in the network might have the impact to the legacy UEs. It would be useful to have higher signaling indication to the UE in preventing the UE access to a given cell.

10 – InterDigital

Support cell re-selection and mobility techniques; those can be included and were studied extensively in R2.

It is beneficial for NES-capable UEs to (de)-prioritize NES cells and make it possible to bar legacy UEs from such cells. Reusing existing cell re-selection mechanism to (down)-prioritize the selection of an NES cell requires changing the frequency priority or the reselection criteria/offset by a SIB update. CHO enhancement was also considered feasible in R2.

11 – Apple Italia S.R.L.

We support to include cell (re)selection in normative phase because it is important how to handle legacy UE in NES cell and its work load is expected to be manageable.

For inter-node beam activation and paging enhancement related to RAN3, the description is very brief and it is related to SSB beam activation/deactivation at the base station. One question is whether this assumes some enhancements in RAN1 and RAN2 that better support more dynamic SSB beam activation/deactivation at the base station. If yes, whether to include it may need further discussion. Otherwise if the beam activation/deactivation is completely up to base station implementation, we are neutral on it.

12 – Verizon UK Ltd

We can support this as one of solutions for low load system.

13 – SoftBank Corp.

It seems that Cell (re)selection mechanism between legacy and NES conscious UEs will be needed whenever we intend to support a non backward compatible feature, i.e., which does not work with the legacy UEs. So it is up to the selection of features in REL-18.

But we are afraid that it could be a lackluster for NES as this sounds like we may need 2 gNBs to cover an area for a certain period of time: one for legacy UEs and the other for NES UEs...

14 – Qualcomm Incorporated

We think the following objectives should be included for RAN2/3:

- Specify mechanism(s) to prevent legacy UEs camping on cells implementing NES technique(s) [RAN2]
- Specify a mechanism so that a NG-RAN node can configure NES-capable Rel-18 UEs to prioritize/down-prioritize specific cell(s) or frequencies applying NES technique(s) [RAN2]
- Specify CHO procedure enhancement(s) [RAN2]

- Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]

15 – NTT DOCOMO INC.

Since some NES technologies are not suitable for coexistence with Legacy UE, a mechanism to prevent Legacy UE camping on cells using NES techniques (e.g. cell bared) should be included, at least.

For RAN3 features, we support them.

16 – vivo Mobile Communication (H)

For cell (re-)selection, we think it is only concluded in RAN2 that mechanism to prevent legacy UE camping on cells adopting Rel-18 NES techniques is needed. For other enhancement on cell selection/reselection, it can already be done by legacy mechanism. So we agree with Huawei to include the following bullet and don't prefer the first listed bullet:

· Specify mechanism(s) to prevent legacy UEs camping on cells adopting the above techniques, if necessary [RAN2]

We are fine with the second bullet by RAN3.

17 – AT&T

We believe that if any power saving technique is deployed which reduces or temporarily interrupts the available throughput from a given cell, then the redirection of UEs from that cell must be as smooth as possible to support a positive user experience. For that reason, we support the enhanced cell (re-)selection techniques.

18 – Nokia Corporation

We agree with the comments above that one needs to ensure that legacy UEs are treated properly when NES state is activated in the cell which would prevent legacy UE operating properly in the cell. Thus it is imperative to ensure WI develops necessary measures to control legacy and NES capable UE camping and reselection. Otherwise legacy UEs may camp on NES activated cell and would not receive proper service if any.

19 – Nokia Corporation

Another issue is that the paging enhancements [DL(1] should not be limited to RAN3, but actually it should be modified to include "specify confining paging frames and paging occasions in a cell-specific paging window [RAN2]"

20 – KDDI Corporation

With regard to reselection, in general we prefer to use the current mechanism, if there is any issue cannot be addressed by the current mecahsnim we are fine to intoruduce a new feature. So we prefer to add"if nessesary" at the end of the sentence.

e.g. Cell (re-)selection techniques for better handling of legacy UEs and NES-capable UEs including mechanism(s) to prevent legacy UEs from camping on specific cells and allow NES-capable UEs to (down-)prioritize specific cells, *if nessesary*.

21 – Guangdong OPPO Mobile Telecom.

we support cell (re)selection techniques. For NES non-capable UE, reselection to specific cell should be also disallowed.

we support inter-node beam activation enhancement, but neutral on paging enhancement.

22 – Fujitsu Limited

OK with the moderator's proposal in principle. We also support to include CHO enhancement techneques for NES WI as it is feasible by RAN2.

23 – Ericsson LM

We support the RAN3 lead item related to Inter-node beam activation and paging enhancements.

Regarding Cell (re-)selection techniques for better handling of legacy UEs, the need for this depends on the other parts of WID, i.e., the choice of NES techniques.

24 – Telia Company AB

We support Qualcomm proposal (comment) for the objectives to be clearly defined.

25 – CATT

For RAN3 part on inter-node beam activation/deactivation,we support to include this bullet in the WI objective.

26 – Spreadtrum Communications

Neutral. RAN1/RAN2 should be aligned. In RAN1 discussions and some non-official offline discussion, we get information that the cells for NES are the non-anchor cell, so they could be SSB/SIB1/paging-less. In this understanding, the cell (re-)selection may not happen in the these cells, since there is no SSB/SIB1. Therefore, we suspect the necesity of cell (re-)selection enhancement for the case where the NES cells are the non-anchor cells.

On the contrary, if the NES cells are the anchor cells (with SSB/SIB1/paging), we share the similar view as softbank that there is area to be covered by both a legacy cell (for legacy UEs) and a NEs cell (for NES UEs), and they are both the anchor cells. It is somehow strange to us. Therefore, in our view, updating the anchor cells to the NES cells may not so feasible in realistic, but using the NES cells as the non-anchor cells (e.g. capacity cells) seems more feasible.

Alternatively, we can try to align our understanding that whether a NES cell has SIB1.

27 – China Mobile Com. Corporation

We are fine with the intention to prevent legacy UE from camping on the NES cell to avoid legacy UE impact. But if cell barring + legacy dedicated frequency priority can already achieve that, we should avoid introducing new complex reselection rule.

28 – TURKCELL

We support adding Qualcomm's additional objectives for clarification.

29 – Deutsche Telekom AG

We only support:

Cell (re-)selection techniques for better handling of legacy UEs and NES-capable UEs including mechanism(s) to prevent legacy UEs from camping on specific cells and allow NES-capable UEs to (down-)prioritize specific cells [RAN2]

The other techniques proposed by QC have either not been studied/recommended or provide limited benefits (like CHO)

30 – NEC Corporation

About the cell (re-)selection, as many companies above commented, it would be necessary to ensure that there is no impact to legacy UEs when a cell is switched or operated in NES state. We generally support to work on the cell (re-)selection (i.e. first bullet) and slightly prefer to go with Huawei's rewording proposal.

On the proposal for RAN3 part, we support it.

31 – Panasonic Holdings Corporation

We support RAN2 aspect. We are neutral on RAN3 aspect.

32 – LG Uplus

We support this concept.

33 – MediaTek Inc.

We support RAN2 scope and are neutral on RAN3 scope.

34 – Sony Europe B.V.

Ok with the moderator proposal and we would like to include CHO enhancements

35 – Tejas Networks Ltd.

We support RAN2 scope .

36 – Motorola Mobility UK Ltd.

[Lenovo] We support cell (re-)selection techniques to minimize impact on legacy UEs.

37 – BT plc

We support RAN2 scope. We can discuss further on that is included.

We support RAN3 Inter-node beam activation proposal.

2.3 Other views

This subsection is to be used for any other discussions related to Rel-18 Network Energy Savings.

Feedback Form 6:

1 – VODAFONE Group Plc

As commented in Proposal 1, Power Domain techniques tackling the power amplifier efficiency, may benefit from the extension of the study item, and at least one should be included in the normative work.

2 – HUAWEI TECHNOLOGIES Co. Ltd.

In addition to RAN1/2/3-led objectives as described above, there will be RAN4-led objectives for NES also, which mainly includes the following two:

1. As described in section 2.2.1, SSB-less SCell operation under time and frequency domain is RAN4-led techniques:

o SSB-less SCell operation [RAN4, RAN2]

For SSB-less SCell operation, promising network energy saving gain is observed from RAN1 evaluations. In addition to the benefits of network energy saving, SSB-less SCell operation also has other benefits like enabling faster SCell activation, reduced overhead for common channel/signal, etc.

2. We would also need to include an RAN4-spefic objective for RRM/RF core requirements. The following can be taken as a starting point:

o Specify the corresponding RRM/RF core requirements, if necessary [RAN4]

3 – ZTE Corporation

ZTE, Sanechips

RAN4 is also assigned with TU for NES in WI phase. Based on the evaluation results in SI phase, SSB-less/SIB-less scheme including the SSB-less inter-band CA, and NES cell without SSB and SIB provides attractive NES gain, especially in the empty/low load cases. Therefore, as we commented in feedback form 3, SSB-less/SIB-less should be included in WI with RAN4 involvement. The suggested objectives are as below. More detailed clarifications can be found in feedback form 3.

Specify solutions to supporting SSB-less/SIB-less cell:

- SCell without SSB in inter-band CA, including SCell activation process at least for UL only traffic(RAN4, RAN2, [RAN1])

- NES Cell without SIB and SSB (RAN2, RAN4, RAN1)

Including System information transmitted by anchor cell, the system information update, RACH procedure

- WUS for NES cell without SSB and SIB (RAN1, RAN2, RAN4)

4 – AT&T

agree with Vodafone

5 – Fraunhofer IIS

Besides specifying NES techniques, we shoukd also take care that they are widely adopted.. Therefore, we propose to consider the impacts caused by implementing NES techniques.

TR 38.864 concluded "It is recommended that the normative phase includes not only energy saving techniques (the necessary enhancements would need to be further identified during the normative phase) but also the mitigation of their impacts when network applies network energy savings technique(s).".

In our contribution RP-223340 we identified some areas for mitigation, which could be included at the WI, captured at proposal 2: "In the normative phase standardize techniques to mitigate the impacts of energy saving on initial cell selection/discovery, UE power consumption (paging), measurement performance".

6 – CATT

The network energy saving techniques in improving the power amplifier efficiency are mostly proprietary algorithm in the gNB implementation without specification impacts. The algorithms of improving the power amplifier efficiency had been implemented by most of 3G W-CDMA/HSPA NB, 4G LTE eNB and 5G NR gNB base stations.

There are some proposals of UE-control of network transmission by UE sending the wakeup signals. The UE-control of network transmission should be avoided.

7 – Verizon UK Ltd

Agree with Vodafone, AT&T.

8 – Qualcomm Incorporated

As mentioned before, we are interested in power domain enhancements. Our main preference among those is D-5. If there is no consensus to include D-5 in Rel-18 due to limited time, then it should be targeted for the next release in our view.

9 – LG Electronics Inc.

We think the WI objective should be well-scoped, clearly focused, and manageable by WGs.

Though proponent companies propose something by saying "it is feasible" or "it is beneficial", it is not a main driver to include them in the WI objectives.

Considering the TUs allocated in each WG, and based on the discussion so far, we think the most promising objectives for NES WI are as follows (actual text needs to be modified).

· Adaptation of spatial elements (C-1) [RAN1]

· Adaptation of DTX/DRX (A-4), including the alignment of Cell DTX/DRX with UE DRX [RAN2, RAN3 and possibly RAN1]

· Adaptation of transmission power of signals and channels (D-1) [RAN1]

· Cell (re-)selection techniques for better handling of legacy UEs and NES-capable UEs including mechanism(s) to prevent legacy UEs from camping on specific cells and allow NES-capable UEs to (down-)prioritize specific cells [RAN2]

We think there is no room for other objectives.

10 – Intel K.K.

We also think WI objectives should be carefully chosen, minimizing cross-WG impacts when possible. We do not see RAN4 involvement as necessary if C-1, D-1 are chosen as RAN-1 led objectives. We suggest deprioritizing frequency domain techniques, such as SSB/SIB1-less Cell, UE WUS that require significant cross-WG work including RAN4 involvement and those have limited applicability due to potential legacy UE impact as well. For D-5, we think this can be pursued in future release as Qualcomm mentioned and we can target D-1 in Rel-18.

11 – Nokia Corporation

We propose to consider the following objective for RAN3, as these aspects need to be covered as well in real deployments: "Specify support for mitigation of impacts of network energy techniques in network deployments based on split NG-RAN, and increased autonomy for the gNB-DU to apply network energy saving techniques [RAN3]"

In addition, one needs to consider also CHO enhancements, which provide improvements on delay and robustness in case of NES events being triggered in the cell.

We would like to add that we agree that the objectives need to be carefully chosen, considering also the cross-WG aspects. For some objectives RAN4 might need to be involved as well to evaluate feasibility, as RAN4 has not been involved so far at all. In any case, techniques such as D-5 are not feasible within Rel-18 timeframe even if RAN4 is involved, as it requires substantial work by RAN4 to define suitable PA models, and update the energy consumption model taking those PAs into account. After that RAN1 would need to evaluate impact to UE power consumption and potential benefits taking into account those models, the extent of impact to legacy UEs and even Rel-18+ UEs not supporting the specific PA used by the gNB, etc. This study alone is extensive, certainly not fitting into the remainder of Rel-18, not to mention any potential specification phase. Hence, we propose to focus on D-1 as power-domain enhancement for this WI.

12 – CTSI

China Telecom:

We support to consider the SSB-less on Scell for inter-band CA as one objective, which can be led by RAN4

13 – Spreadtrum Communications

Maybe we can have a note to align our understanding of the ”NES cell”, e.g. whether it is a non-anchor cell or an anchor cell only allowing the NES UEs camping on. In SID, we have a note but there could be different interpretations for this note (especially for greenfield depolyments):

Note 1: legacy UEs should be able to continue accessing a network implementing Rel-18 network energy savings techniques, with the possible exception of techniques developed specifically **for greenfield deployments**.

14 – China Mobile Com. Corporation

We support ZTE’s proposals to capture SSB-less and SIB1-less NES cell into the WID objective.

For SSB-less and SIB1-less NES approach, we see the benefit for both network energy saving and overhead reduction. Because, the saved resources on non-anchor cell can be used for data transmission.

15 – Deutsche Telekom AG

We do not think that the objectives choosen should be based on ”the impact / work in the RAN WGs” !

We think that the driver should be only the aspect of NES benefits and the combination of logical group of features enabling the best NES gain in Rel-18 ... We remind that we claimed in our 988 doc that we should NOT spread the work on NES over multiple releases just resulting in a delay of getting the benefits !

16 – MediaTek Inc.

- We are supportive of adding Note 1 as suggested by Spreadtrum. Allowing legacy UE operating in NES cells maximizes the opportunity of real network deployments.
- For inclusion of SIB-less NES cell scope as a RAN2-led item, there is conflict with Section 6.1.7.4 provided from RAN2:
    - UE camps on an anchor cell, **not on a non-anchor NES cell without SIB** (or without SSB and SIB)
- For companies to justify D-5, there will require revision of existing NES power consumption model, which is not feasible in R18.

17 – Sony Europe B.V.

We also support to consider SSB-less operation led by RAN4

2.4 Summary of initial round discussions

On the three possible alternatives with regards to the issue of whether/how to handle additional study on network energy savings, majority (>70%) of companies indicated that they preferred or were okay with Alternative 3 (start normative work in 2023.Q1 without extension on study). Considering the majority view, moderator will henceforth focus on finalizing the scope of the work item.

https://nwm-trial.etsi.org/#/documents/8372

The following RAN1-led network energy savings techniques seem acceptable to almost ALL companies:

- Adaptation of spatial elements (C-1)
- Adaptation of transmission power of signals and channels (D-1)

The following RAN2/RAN3-led network energy savings techniques seem acceptable to most companies

- Specify the adaptation of cell DTX/DRX, including the alignment of Cell DTX/DRX with UE DRX
- Specify mechanism(s) to prevent legacy UEs camping on cells adopting the above techniques, if necessary
- Specify inter-node beam activation and enhancements on restricting paging in a limited area

3 Intermediate round discussions

The discussions in the intermediate round will focus on finalizing the WI objectives for Rel-18 network energy savings.

3.1 RAN1-led: Spatial and power domain NES techniques

The following RAN1-led network energy savings techniques seem acceptable to almost ALL companies from the initial round discussions

- Adaptation of spatial elements (C-1)
- Adaptation of transmission power of signals and channels (D-1)

The following proposal is a modified version of the objective in RP-223432 (from the rapporteur). Modifications have been made based on comments received in the initial round. Moderator recommendation is to agree on Proposal1 for the WID objective.

(intermediate round) Proposal1:

- *Specify enhancements on necessary CSI related procedures including measurement and report, and signaling to enable efficient adaptation on spatial elements (e.g. antenna ports, active transceiver chains), including*
    - *L1/L2 signaling for CSI resource configuration and/or CSI report (re)configurations/adaptations/(de)activation, and TCI (re)configurations*
    - *Support for multiple CSIs corresponding to different numbers of spatial elements*

https://nwm-trial.etsi.org/#/documents/8372

- *Specify enhancements including measurement and report for adaptation of power offset values between PDSCH and CSI-RS*
  - *L1/L2 signaling for indication of power offset between PDSCH and CSI-RS*
  - *Support for multiple CSIs corresponding to different power offset values between PDSCH and CSI-RS*

undefined *Note: Above objectives are only for UE specific channels/signals*

Companies are invited to share their views below.

Feedback Form 7:

1 – Beijing Xiaomi Mobile Software

For the second bullet of the first objective, "*Support for multiple CSIs corresponding to different numbers of spatial elements*", what does the " multiple CSIs" refer to? Form our understanding, it should be multiple CSI reports. And the multiple CSI reports can corresponds to different combinations, not only numbers, of spatial element. So we suggest to modify this bullet as :

"*Support for multiple CSI reports corresponding to different combinations of spatial elements*"

2 – Beijing Xiaomi Mobile Software

For the second bullet of the first objective, "*Support for multiple CSIs corresponding to different numbers of spatial elements*", what does the " multiple CSIs" refer to? Form our understanding, it should be multiple CSI reports. And the multiple CSI reports can corresponds to different combinations, not only numbers, of spatial element. So we suggest to modify this bullet as :

"*Support for multiple CSI reports corresponding to different combinations of spatial elements*"

3 – MediaTek Inc.

We support Proposal 1 (intermediate round) with the following note included:

Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements

The revision from Xiaomi also looks good for us.

4 – KT Corp.

Support moderator's proposal. Also Xiaomi's revision is acceptable.

5 – Samsung Electronics Co.

We support moderator's proposal. Xiaomi's suggestion is acceptable as well.

We see MTK's point on the UE capability. However, this would require WG-level discussion along with the future progress.

6 – Nokia Corporation

Regarding adaptation of spatial elements, we propose the sub-bullets are revised to separate the aspects of configuration of CSI resources / report from the operation /adaptation. This would allow better focus for

the normative phase. We also think the second sub-bullet is not needed, as it is already included in the first sub-bullet and in the main bullet. Hence we propose the following revision:

Specify enhancements on necessary CSI related procedures including measurement and report, and signaling to enable efficient adaptation on spatial elements (e.g. antenna ports, active transceiver chains), including

- *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configurations/adaptations/(de)acti and TCI (re)configurations*
- ~~*Support for multiple CSIs corresponding to different numbers of spatial elements*~~

On D-1, we propose to modify the main bullet as follows, and remove the second sub-bullet:

*Specify enhancements including **CSI** measurement and report for adaptation of power offset values between PDSCH and CSI-RS*

- *L1/L2 signaling for indication of power offset between PDSCH and CSI-RS*
- ~~*Support for multiple CSIs corresponding to different power offset values between PDSCH and CSI-RS*~~

  Note: Above objectives are only for UE specific channels/signals

The reason is that RAN1 did not evaluate / discuss what CSI enhancements would be beneficial for PDSCH transmit power adaptation during the study phase, and hence we should have such discussion during the work item phase. For example, we should consider if multiple CSI reports (e.g. one per power offset) or if one CSI report that contains extra information related to the different power offsets would be preferable.

7 – CATT

We are OK with moderator's proposal or Xiaomi's revision.

8 – Apple Italia S.R.L.

We share similar view with Nokia that it is better not to include very specific solutions in the WID, as we did not have sufficient time to discuss/debate which solution(s) may be better. It would be good to leave room to RAN1 to have more technical discussion in the WI phase. In fact, the potential RAN1 impact listed in the TR is much more than what is listed here. We are not sure if we are confident already that all the other impact won't exist. So we change the wording to "potentially including but not limited to".

We think beam management related aspects should be considered for spatial adaptation. We are not suggesting that something has to be done at this point, but given that this was not discussed, we do not want to rule out the possibility that something may be needed, especially if there is beam change involved.

In addition, we would like to avoid "multiple CSIs" or "multiple CSI reports" because it is either ambiguous (as pointed out by Xiaomi) or may imply certain signaling structure already. E.g., if "multiple CSI reports" is used, can we still have a single CSI report that includes all the information? Anyway, we think this level of detail should be left to the WI discussion.

Here is our proposed wording:

*Specify **necessary** enhancements on ~~necessary~~ CSI **and beam management** related procedures including measurement and report, and signaling to enable efficient adaptation on spatial elements (e.g. antenna ports, active transceiver chains), **potentially** including **but not limited to***

- *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configurations/adaptations/(de)acti and TCI (re)configurations*
- ***~~Support for multiple CSIs corresponding to different numbers of spatial elements~~***

*Specify **necessary** enhancements **on ~~including~~ CSI related procedures including** measurement and report**, and signaling to enable efficient ~~for~~** adaptation of power offset values between PDSCH and CSI-RS**, potentially including but not limited to***

- ***CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configurations/adaptations/(de)***
- *L1/L2 signaling for indication of power offset between PDSCH and CSI-RS*
- ***~~Support for multiple CSIs corresponding to different power offset values between PDSCH and CSI-RS~~***

  Note: Above objectives are only for UE specific channels/signals

9 – Samsung Electronics Co.

(as moderator)

1. Removing the bullet on '*support for multiple CSIs ...*' seems fine for both C-1 and D-1. I tend to agree that there are multiple ways of achieving the same objective and RAN1 is the better place to have these discussions.

2. For MTK's suggestion to add "Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements". I understand the motivation is not to increase UE complexity. I invite companies for additional views. If there are no strong views against MTK's suggestion, I will include it as part of the proposal for Wednesday's GTW.

10 – InterDigital

We also support removing the bullet on multiple CSIs for both C1 and D1, other parts look good to us.

11 – Qualcomm Incorporated

Regarding C-1, we are fine with the main bullet with some minor wording suggestions.

We propose a revision of the 1st sub-bullet since there could be methods other than L1/L2 signalling to achieve the same purpose. Furthermore, it is unclear what the plural form configurations/adaptations really means.

For 2nd sub-bullet, we propose to remove it since the main bullet should already be sufficient. In addition, this sub-bullet may generate different interpretation during the WI (e.g., assume N antenna port configurations are configured to the UE; some may interpret that UE should generate N CSI reports while others may think UE can just generate <N CSI reports).

- *Specify enhancements on necessary CSI related procedures including measurement and report, and signaling to enable efficient adaptation ~~on~~**of** spatial elements (e.g., antenna ports, active transceiver chains), including*
- ***~~L1/L2 signaling~~Mechanism** for CSI resource configuration and/or CSI report (re)configuration~~s~~/adaptation~~s~~/(de)ac and/**or** TCI (re)configuration~~s~~*
- ***~~Support for multiple CSIs corresponding to different numbers of spatial elements~~***

Regarding D-1, we support revision from Nokia.

12 – Intel K.K.

Support Nokia's version and moderator proposal to remove bullets on multiple CSIs. Rest looks fine.

13 – New H3C Technologies Co.

Support the proposal with moderator's further suggestion.

14 – Verizon UK Ltd

We are ok with moderator's latest revision

15 – LG Electronics Inc.

We share the view with Nokia in that support of multiple CSI reports (in the second sub-bullet under each of main bullets) is not the only one solution and WG-level discussion is needed. So, we support moderator's latest suggestion. Alternatively, we can remove all of sub-bullets and directly refer to the corresponding TR sections, as follows.

*Specify enhancements on necessary CSI related procedures including measurement and report, and signaling to enable efficient adaptation on spatial elements (e.g. antenna ports, active transceiver chains), ~~including~~**in line with agreements from Network Energy Savings study item (TR 38.864, Section 6.3.1.3)***

- *~~L1/L2 signaling for CSI resource configuration and/or CSI report (re)configurations/adaptations/(de)activation, and TCI (re)configurations~~*
- *~~Support for multiple CSIs corresponding to different numbers of spatial elements~~*

*Specify enhancements including measurement and report for adaptation of power offset values between PDSCH and CSI-RS**, in line with agreements from Network Energy Savings study item (TR 38.864, Section 6.4.1.3)***

- *~~L1/L2 signaling for indication of power offset between PDSCH and CSI-RS~~*

- ~~*Support for multiple CSIs corresponding to different power offset values between PDSCH and CSI-RS*~~

Note: Above objectives are only for UE specific channels/signals

16 – Samsung Electronics Co.

(as moderator)

Thanks for all the comments so far. The revised version based on the comments so far is provided below for your convenience.

(revised) Proposal 1

- *Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains), potentially including but not limited to*
  - *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configuration/adaptation/(de)a and TCI (re)configuration*
- *Specify necessary enhancements on CSI related procedures including measurement and report, and signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS, potentially including but not limited to*
  - *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configuration/adaptation/(de)a*
  - *Mechanism for indication of power offset between PDSCH and CSI-RS*
- *Note: Above objectives are only for UE specific channels/signals*
- *Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements*

17 – Telstra Limited

We are ok with the moderators revised version

18 – Motorola Mobility UK Ltd.

[Lenovo] We are ok with moderator's latest revision on proposal 1.

On UE capability of CSI/CSI-RS, whether legacy or new capabilities are defined we think should be a WG-level discussion.

19 – LG Uplus

We are fine with the moderator's latest version on this.

20 – NTT DOCOMO INC.

We are ok with moderator's latest revision.

21 – AT&T

We are ok with moderator's latest revision.

22 – HUAWEI TECHNOLOGIES Co. Ltd.

Regarding the comments on deleting the sub-bullet for multi-CSI, we think multi-CSI is clearly evaluated in RAN1 and better to be kept to make the scope clearer, of course wording changes can be done in order not to restrict to a certain manner. Note that actually the current sub-bullets (e.g. CSI resource configuration, and L1/L2 signaling) from the latest moderator proposal are not evaluated in RAN1. Therefore, we think it is better to keep the sub-bullets for CSI reporting with modification as below:

○ ~~***Support formultipleefficient*** *CSI**sreporting*** *corresponding to different* ***combinations*** *of spatial elements*

○ ~~***Support formultipleefficient*** *CSI**sreporting*** *corresponding to different power offset values between PDSCH and CSI-RS*

On the other hand, if people just want to keep it general, then it is fair to delete all sub-bullets as suggested by LG.

23 – vivo Communication Technology

Thanks moderator for providing **(revised) Proposal 1.** we would like to delete the 2nd sub-bullet under power adaptation. Based on the current specification, the power offset for between PDSCH and CSI-RS is configured in CSI-RS resource, therefore the 1st sub-bullet provide sufficient room for RAN1 to discuss different methods to adapt the power offset value based on the current configuration framework. The 2nd sub-bullet is not needed.

(revised) Proposal 1

- *Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains), potentially including but not limited to*
  - *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configuration/adaptation/(de)a and TCI (re)configuration*
- *Specify necessary enhancements on CSI related procedures including measurement and report, and signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS, potentially including but not limited to*
  - *CSI resource and/or CSI report configuration (RRC), and L1/L2 signaling for (re)configuration/adaptation/(de)a*
  - ~~***Mechanism for indication of power offset between PDSCH and CSI-RS***~~
- *Note: Above objectives are only for UE specific channels/signals*

- *Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements*

24 – CEWiT

We support **(revised) Proposal 1 given by the** moderator as it is.

We suggest to keep the second sub bullet of power domain intact. Since, currently the power offset is configured semi statically and the dynamic indication may have other mechanisms for indication of the offset even for the same CSI configuration .

25 – vivo Communication Technology

@CEWiT

In my understanding, ”indication of the offset even for the same CSI configuration .” as you mentioned is within the scope of 1st sub-bullet already (*”L1/L2 signaling for (re)configuration/adaptation/” includes cases with single or multiple CSI resource/CSI report configurations*), there is no need for the 2nd sub-bullet for this purpose.

26 – CTSI

(China Telecom)

We support the Proposal 1 revised by moderator.

And we think we can just keep the second sub bullet of power domain since most companies want to discuss the signalling mechanism, and it is more than ”*(re)configuration/adaptation/activation*”, we can just keep it.

27 – CTSI

(China Telecom)

We support the Proposal 1 revised by moderator.

And we think we can just keep the second sub bullet of power domain since most companies want to discuss the signalling mechanism, and it is more than ”*(re)configuration/adaptation/activation*”, we can just keep it.

28 – Fujitsu Limited

We are basically fine with the revised proposal 1. Meanwhile, we have the similar view as vivo that the intention of the second sub-bullet on power offset is included in the first sub-bullet. So, it can be removed.

29 – ZTE Corporation

For multi-CSI reporting, the energy saving gain and UPT have been evaluated in SI and captured in TR. It is shown that multi-CSI reporting can achieve attractive NES gain with minimal impact on UPT compared with semi-static evaluations. Therefore, we think it should be considered. For the updated proposals by moderator, our understanding is that multi-CSI which belongs to enhancements on CSI related procedure still can be discussed in WI phase.

30 – Guangdong OPPO Mobile Telecom.

we are fine with proposal 1

31 – NEC Corporation

We support (revised) proposal 1 provided by moderator.

32 – VODAFONE Group Plc

We are fine with **(revised) Proposal 1** by the moderator

33 – Spreadtrum Communications

We share some companies' view that we do not need to provide the specific schemes in WID. For example, "multiple CSIs" may not be needed explicitly, and it is not clear whether it means multiple CSI configurations or simultanneous CSI reports.

34 – China Mobile Group Device Co.

CMCC

From our understanding, the first sub-bullet is related to CSI-RS or CSI report re)configuration/adaptation/(de)activation, while the deleted second sub-bullet is targeting to CSI reporting enhancement to include multiple CSIs in CSI reporting to provide assistance information for network, which has been also evaluated during study phase. So, we suggest to keep the second sub-bullets for CSI reporting for both spatial and power domain.

35 – Fraunhofer IIS

We are fine with proposal with Nokia's and Qualcomm's revisions.

36 – Fraunhofer IIS

We are fine with proposal with Nokia's and Qualcomm's revisions.

37 – KDDI Corporation

We are ok with moderator's latest revision.

38 – Panasonic Holdings Corporation

We support the update from the moderator.

39 – Telia Company AB

We support moderator's revision 1.

https://nwm-trial.etsi.org/#/documents/8372

40 – Ericsson LM

We propose below updates:

The second sub-bullet in both objectives should be removed – the detailed enhancement should be left to RAN1 WI discussion.

For 2nd objective: clarify that 1) enhancement is for **CSI** measurement and report, and 2) L1/L2 signaling is for "indication/**adaptation** of power offset between PDSCH and CSI-RS.

- *Specify enhancements on necessary CSI related procedures including measurement and report, and signaling to enable efficient adaptation on spatial elements (e.g. antenna ports, active transceiver chains), including*
  - *L1/L2 signaling for CSI resource configuration and/or CSI report (re)configurations/adaptations/(de)activation, and TCI (re)configurations*
  - ~~*Support for multiple CSIs corresponding to different numbers of spatial elements*~~
- *Specify enhancements including CSI measurement and report for adaptation of power offset values between PDSCH and CSI-RS*
  - *L1/L2 signaling for indication/adaptation of power offset between PDSCH and CSI-RS*
  - ~~*Support for multiple CSIs corresponding to different power offset values between PDSCH and CSI-RS*~~
- *Note: Above objectives are only for UE specific channels/signals*

3.2 RAN2/RAN3-led enhancements

The following RAN2-led network energy savings techniques seem acceptable to almost ALL companies

- Specify the adaptation of cell DTX/DRX, including the alignment of Cell DTX/DRX with UE DRX [RAN2, RAN3 and possibly RAN1].

Based on the inputs and the proposal in RP-223432, the following proposal is made for the WID objective:

(intermediate round) Proposal2:

- *Specify enhancement on DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED, including the alignment of UE DRX, and inter-node information exchange on DTX/DRX [RAN2, RAN1, RAN3]*

- *Note: At least legacy SSB transmission remains unchanged*

Companies are invited to share their views below.

Feedback Form 8:

1 – MediaTek Inc.

We support Proposal 2 (intermediate round). Restriction to connected-mode is reasonable since paging and RACH configurations are already flexible by gNB configuration. The note is also important to minimize the UE impacts.

2 – KT Corp.

Support moderator's proposal 2 (intermediate round)

3 – Nokia Corporation

We propose to revise the objective as follows, to be more specific that we are talking about *cell* DTX/-DRX, and also because alignment of UE DRX can be done already by implementation:

*Specify enhancement on **cell** DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED, ~~including the alignment of UE DRX~~, and inter-node information exchange on DTX/DRX [RAN2, RAN1, RAN3]*

- *Note: At least legacy SSB transmission remains unchanged*

4 – CATT

We are OK with Moderator's proposal 2 intermediate round but prefer Nokia's revision of removing "including the alignment of UE DRX". .

5 – Samsung Electronics Co.

We support Proposal 2.

DTX/DRX mechanism here is "cell" DTX/DRX. We prefer to clarify "cell" DTX/DRX.

6 – Apple Italia S.R.L.

1. We think "cell DTX/DRX" should be used here, as otherwise it is unclear what we are talking about. It may be interpreted as UE DTX/DRX. Some companies suggest that the term "cell DTX/DRX" is not well defined, but we think it is fine because it has been used in RAN2 and it has been captured in the TR. If the concern is about terminology, we could also try to find another term.

2. we think RRC_IDLE/INACTIVE should be included as well, or at least not precluded at this stage. There is no reason to preclude new behaviors for new UEs, which can provide the network more flexibility in implementation, e.g., when supporting new UEs on a carrier only. We propose to add "RRC_IDLE/INACTIVE", or remove "RRC_CONNECTED" so that it can be further discussed in the WI.

3. we are fine either with or without ”including the alignment of UE DRX”.

Therefore, we suggest the following changes:

*Specify enhancement on **cell** DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED **and RRC_IDLE/INACTIVE**, including the alignment of UE DRX, and inter-node information exchange on **cell** DTX/DRX [RAN2, RAN1, RAN3]*

- *Note: At least legacy SSB transmission remains unchanged*

7 – InterDigital

Support the proposal. ”Cell” before DRX/DTX can be added to conform with the TR.

8 – Qualcomm Incorporated

We support the proposal.

9 – Intel K.K.

We think it is important to capture “cell DTX/DRX” in the objective, otherwise, it is vague and unclear. For Cell DTX/DRX, we understand that aligning UE C-DRX cycles is beneficial but this is already possible by implementation and we do not think it is necessary to capture as example in the objective. We are supportive to add RRC idle/inactive as well.

● *Specify enhancement on **cell** DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED **and RRC idle/inactive**, ~~including the alignment of UE DRX~~, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]*

○ *Note: At least legacy SSB transmission remains unchanged*

10 – Intel K.K.

We think it is important to capture “cell DTX/DRX” in the objective, otherwise, it is vague and unclear. For Cell DTX/DRX, we understand that aligning UE C-DRX cycles is beneficial but this is already possible by implementation and we do not think it is necessary to capture as example in the objective. We are supportive to add RRC idle/inactive as well.

● *Specify enhancement on **cell** DTX/DRX mechanism and related procedures for UEs in RRC_CONNECTED **and RRC idle/inactive**, ~~including the alignment of UE DRX~~, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]*

○ *Note: At least legacy SSB transmission remains unchanged*

11 – New H3C Technologies Co.

support this proposal

12 – Verizon UK Ltd

We are fine with proposal 2 and the clarifications on ”cell”

13 – Samsung Electronics Co.

(as moderator)

Based on the comments so far, the revised version would look like the following:

Proposal 2 (revised)

- *Specify enhancement on cell DTX/DRX mechanism and related procedures for UEs, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]*
    - *Note: At least legacy SSB transmission remains unchanged*

1. ”*including the alignment of UE DRX*” has been removed
2. ”*RRC_CONNECTED* and *RRC idle/inactive”* has been removed
3. ”cell” has been added

14 – LG Electronics Inc.

We are ok with moderator proposal. We are also ok to add “Cell” to make it clear. Regarding RRC IDLE/I-NACITVE, we prefer to limit the scope to CONNECTED.

15 – Telstra Limited

We are ok with the moderators revised Proposal 2

16 – Motorola Mobility UK Ltd.

[Lenovo] We are fine with moderator’s latest revision of Proposal 2.

17 – LG Uplus

Even though we know that this comment does not affect the current wayforward by majority, we still have a concern to the ”Cell DTX/DRX” solution in network stability point of view. We cannot be convinced that only inter-node information change is sufficient so far. We could have hardly imagined how broad range of cells are affected by a Cell DTX/DRX. To be honest, we are very careful for this solution.

18 – Fujitsu Limited

We are fine with the moderator’s updated proposal 2

19 – CEWiT

we are fine in general with the revision of proposal 2 but the note is not clear to us. If the legacy SSB is for legacy UEs then as per the proposal 3 "*Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques [RAN2]*" the cells *adopting the Rel-18 NES techniques* will not be used by legacy UEs. Hence we suggest to remove the note.

20 – vivo Communication Technology

Thanks moderator for providing updates. However, with some key words deleted, the revised proposal has deviatted from what has been concluded by the SI.

Looking at the TR conclusion section we have following two sentences on cell DTX/DRX (technique A-4)

- From RAN2 perspective, **technique A-4** is considered feasible and it is also beneficial to **align UE DRX durations with Cell DTX and DRX durations among multiple UEs.**
- **Technique A-4** of adaptation of DTX/DRX, **including the alignment of Cell DTX/DRX with UE DRX,** is beneficial for network energy savings.

It can be seen that alignment between UE DRX and cell DRX/DRX operation is the key of the feature, the work will not be focused if such information is not mentioned.

In addition, the technique A-4 that was concluded beneficial was only about RRC-CONNECTED UEs, companies may check the TR section 6.1.4 for the feature description. The concern on its impact to IDLE/INACTIVE UEs is valid, but unfortunately it was never discussed during the SI. To make the whole feature complete, we can find a way to mitigate the impact to IDLE/INACTIVE UEs but this does not mean we need enhance the IDLE/INACTIVE UE behavior as that is beyond what has been studied and concluded beneficial during the SI.

Based on the above, we have following updated proposal on top of moderator's latest **Proposal 2 (revised)**

Proposal 2 (revised)

- *Specify enhancement on cell DTX/DRX mechanism* ~~***and related procedures for UEs***~~***including the alignement of cell DRX/DRX with UE DRX in RRC-CONNECTED mode****, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]*
  - *Note: At least legacy SSB transmission remains unchanged*
  - **Note: The impact to IDLE/INACTIVE UEs due to the above enhancement will be considered**

21 – CTSI

(China Telecom):

We are fine with the updated proposal given by moderator.

22 – ZTE Corporation

We propose to delete 'Note: At least legacy SSB transmission remains unchanged'. According to the discussion in RAN2, four different TX / RX types will be discussed in WID, and one of different TX / RX types is '*Example 1: gNB is expected to turn off all transmission and reception for data traffic and reference signal during Cell DTX / DRX OFF duration*.' In Example 1, gNB could stop the SSB transmission. And in this case, gNB could avoid to wake up frequently to transmit SSB in order to obtain the maximum NES gain. We think the down-selection among the four TX / RX types can be made is WI phase . Hence, this sentence should be deleted at this stage.

23 – Guangdong OPPO Mobile Telecom.

we support the proposal in general. we are fine to add "cell" before DTX/DRX since this is intended. we are fine to remove the wording "alignment of UE DRX" and leave the detail to RAN2.

24 – NTT DOCOMO INC.

We are fine with the moderator's updated proposal.

25 – NEC Corporation

We support the revised wording from moderator.

26 – VODAFONE Group Plc

We support original Proposal 2 with clarifications by adding "**cell** DTX/DRX"

27 – HUAWEI TECHNOLOGIES Co. Ltd.

The intention to add the note "*Note: At least legacy SSB transmission remains unchanged*" is also not so clear to us, maybe the proponent can explain more

28 – Spreadtrum Communications

1) We support adding "cell" before "DTX/DRX".

2) We support not to restrict it to RRC CONNECTED state. Whether it has impact on RRC IDLE/INACTIVE state can be discussed further and WID can be updated accordingly. For RRC INACTIVE state, SDT could be impacted.

3) We support to remove "Note: At least legacy SSB...". As we mentioned before, in RAN1 discussion, cell DTX/DRX may be related to the common signal/channel reduction. In some evaluations. SSB outside active time (UE C-DRX ON) may be DTXed by gNB in assumptions. Again, the cell capable of DTX/DRX is non-anchor cell in our view, and at least the legacy UE may not served by it. If we only specify cell ON aligned to UE C-DRX ON, without any impact on common signal/channel, the ESG is limited. In the current spec, UE almost only needs to process the UE-specific RS inside active time. Anyway, if we only apply the NES techs in anchor cells or just update the current coverage cells (anchor cells) to be "NES cell" by RAN1/2 methods, it is very hard. Employing the NES techs in non-anchor cell is much easier.

29 – Fraunhofer IIS

We support the proposal.

30 – KDDI Corporation

We are ok with moderator's latest revision.

31 – Panasonic Holdings Corporation

We agree to add "cell" DTX/DRX. The other part is ok to us.

32 – MediaTek Inc.

Thanks for moderator's update on Proposal 2. RAN1 provides results for "adaptation of **UE** DTX/DRX" while the revised item only focus on **cell** DTX/DRX. In this regard, we suggest a revision to indicate the adaptation will **include both BS and UE**.

On the note, we think it is necessary since RAN2 proposal may disable SSB during a DTX/DRX duration, which will cause significant UE impact. Keeping the note is necessary from UE perspective.

Proposal 2 (revised)

- *Specify enhancement on cell-**wise** DTX/DRX mechanism and related procedures for UEs, and inter-node information exchange on cell-**wise** DTX/DRX [RAN2, RAN1, RAN3]*
  - *Note: At least legacy SSB transmission remains unchanged*

33 – BT plc

It is important that a cell performing DTX can avoid any transmission during its DTX off period. To perform reselection and paging, it is required that a UE in Idle/Inactive is aware of that. For RACH procedures, UE needs to be aware of DRX. Consequently, IDLE and INACTIVE must be included in the WID.

Proposal 2

Specify enhancement on **cell** DTX/DRX mechanism and related procedures for UEs in **RRC_IDLE, RRC_INACTIVE and** RRC_CONNECTED, including the alignment of UE DRX, and inter-node information exchange on DTX/DRX [RAN2, RAN1, RAN3].

34 – Ericsson LM

We propose below updates – 1) main enhancement should be on cell DTX/DRX with clear definition of what is to be achieved/specified (i.e. a cell has no/limited transmission/reception activity), 2) split of objectives between the WGs, particularly on RAN1 scope.

- *Specify enhancement on **cell** DTX/DRX mechanism **wherein a cell has no/limited transmission/ reception activity** and related **signaling**/procedures for UEs in RRC_CONNECTED, including the alignment of UE DRX, and inter-node information exchange on DTX/DRX [RAN2, RAN1, RAN3]*
  - ***Configuration and associated procedures for cell DTX, cell DRX and joint cell DTX/DRX operation [RAN2]***
  - ***Mechanism to align UE DRX with cell DTX and DRX alignment among multiple UEs [RAN2]***
  - ***L1/L2 signalling for activating/deactivating cell DTX/DRX [RAN2, RAN1, [RAN3]***
  - ***Inter-node information exchange on cell DTX/DRX [RAN3]***
  - *Note: At least legacy SSB transmission remains unchanged*

35 – Telia Company AB

We support moderator's Proposal 2 (revised).

Additionally, the following proposal is made for the WID objective in consideration of positive views from most of the companies

(intermediate round) Proposal3:

- *Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques [RAN2]*
- *Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]*

Companies are invited to share their views below.

Feedback Form 9:

1 – VODAFONE Group Plc

We support this objective: *Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques [RAN2]*

2 – MediaTek Inc.

We support RAN2 scope. For RAN3 scope, will inter-node beam activation also impact RAN1 and RAN2 (MIMO and/or mobility)? If it is the case, we would suggest focus on *enhancements on restricting paging in a limited area* (pure RAN3 scope).

3 – Nokia Corporation

We are fine with the first objective. For the second objective, we propose the following clarification, and inclusion of RAN2 as impacted WG:

Specify inter-node beam activation and enhancements on restricting paging in a limited area, ***including confining paging frames and paging occasions in a cell-specific paging window*** *[RAN3,* ***RAN2****]*

4 – CATT

We are OK with the proposed RAN2 and RAN3 objectives. However, we would like to clarify the RAN3 objectives that the beam activation in the inter-node coordination includes the activation of all DL channels/signals at a given beam.

5 – Apple Italia S.R.L.

We support the RAN2 objective.

For the RAN3 objective, we would be fine to include it if a note is added to clarify that it does not have any RAN1/RAN2 impact, i.e., transparent to UE.

Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]

- **Note: this does not have RAN1/RAN2 impact and is transparent to the UEs.**

6 – InterDigital

Support the proposal. For the second bullet, RAN2 can be added as a secondary group

7 – Qualcomm Incorporated

We support the proposal.

For the suggested revision from Nokia, we don't think that the aspect "including confining paging frames and paging occasions in a cell-specific paging window" is what RAN3 discussed. This aspect was discussed in RAN1 under A-1-4 and has RAN2 impact only. However, it was not studied in RAN2. Hence, we do not support the suggested revision. In addition, to avoid confusion in the wording "area", we suggest updating "in a limited area" to "in a limited **paging** area"

8 – Intel K.K.

We are fine with the first objective. For the second objective, we propose the following revision and inclusion of RAN2 as impacted WG:

Specify inter-node beam activation and enhancements on restricting paging in a limited area, ***including confining paging frames and paging occasions within a duration*** *[RAN3,* ***RAN2****]*

9 – Samsung Electronics Co.

We support the objectives of Proposal 3.

10 – Verizon UK Ltd

fine with proposal 3 in general

11 – LG Electronics Inc.

We support the RAN2 objective.

Regarding RAN3 objective, we think RAN1/2 impacts should be avoided. In this sense, we want to modify the RAN3 objective as

"*Specify inter-node beam ~~activation and~~ enhancements on restricting paging in a limited area [RAN3]*

Note: this does not have RAN1/RAN2 impact and is transparent to the UEs.".

12 – Telstra Limited

We support the objectives in proposal 3

13 – Motorola Mobility UK Ltd.

[Lenovo] We support the RAN2 objective in proposal 3.

14 – LG Uplus

We can see Nokia's intention. However, Nokia's suggestion seems a specific solution to us. As an example, we suggest the below.

- *Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques [RAN2]*
- *Specify inter-node beam activation and enhancements on restricting paging in a limited area [**RAN2,**RAN3]*

  NOTE: We can consider confining paging frames and paging occasions in a cell-specific paging window.

15 – LG Uplus

We can see Nokia's intention. However, Nokia's suggestion seems a specific solution to us. As an example, we suggest the below.

- *Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques [RAN2]*
- *Specify inter-node beam activation and enhancements on restricting paging in a limited area [**RAN2,**RAN3]*

  NOTE: We can consider confining paging frames and paging occasions in a cell-specific paging window.

16 – Fujitsu Limited

We are fine with the moderator's proposal.

17 – vivo Communication Technology

We support the latest proposal from moderator.

18 – CTSI

We are fine with the proposal.

19 – ZTE Corporation

We are fine with the RAN3 objectives in general. In addition, the suggestion by Intel about the paging enhancement can be also considered.

20 – NTT DOCOMO INC.

We are fine with the moderator's proposal.

21 – Guangdong OPPO Mobile Telecom.

for 1st bullet, one of the reasons for RAN2 to conclude this is because it is not clear which NES feature is not backward compatbile with legacy UE. but looking into the email discussion so far, features to be specified seems all relevant to UEs in RRC-CONNECTED state. so we think it is helpful for RAN2 to confirm whether it is necessary to prevent legacy UE to camp on NES cell. Hence we suggest to put "if necessary" at the end of 1st bullet

22 – NEC Corporation

We are fine with the RAN2 objective in the first bullet. For the RAN3 objective in the second bullet, we assume there should be no RAN2 impact for this, as there was no corresponding study in RAN2.

23 – Spreadtrum Communications

We share the similar view as LG to consider to confine paging in a window, which has obvious ESG.

24 – Spreadtrum Communications

We share the similar view as Nokia, Intel and LG to consider to confine paging in a window, which has obvious ESG in evaluation results.

25 – Spreadtrum Communications

We share the similar view as Nokia, Intel and LG to consider to confine paging in a window, which has obvious ESG in evaluation results.

26 – Spreadtrum Communications

We share the similar view as Nokia, Intel and LG to consider to confine paging in a window, which has obvious ESG in evaluation results.

27 – Fraunhofer IIS

We support the proposal.

28 – KDDI Corporation

We want to revise to add "**if necessary**" at the end of the first objective as below.

Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, **if necessary**.

29 – Panasonic Holdings Corporation

We support the proposal.

30 – BT plc

Support KDDI.

Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, **if necessary**.

31 – Ericsson LM

We do not see the need to specify already now the mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, which attracted the most support so far. This can be revised when the list of Rel-18 NES techniques is finalized and if it is established that selected NES technique(s) are designed such that they impact legacy UEs. Hence, our view is that this can be addressed per need, as it was agreed, for example, for the assistance information from the UE. Hence we propose the following update:

- *Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, if necessary* [RAN2]

For the following enhancements, the moderator would like to invite more views before making a recommendation:

- Specify a mechanism so that a NG-RAN node can configure NES-capable Rel-18 UEs to prioritize/downprioritize specific cell(s) or frequencies applying NES technique(s), if necessary [RAN2]
- Specify CHO procedure enhancement(s) [RAN2]

From moderator point of view, considering RAN2 only has 1 TU for the remainder of Rel-18, selecting one of the above enhancements seem reasonable.

Companies are invited to share their views below.

Feedback Form 10:

1 – VODAFONE Group Plc

For us the CHO improvements are very important as this is one of the mechanism which would allow to

re-distribute the UEs to other cells to either switch off the cells off or start any NES mechanisms. This mechanism is within RAN2 scope (only) and is declared feasible out of the study.

2 – VODAFONE Group Plc

We do not support this objective: Specify a mechanism so that a NG-RAN node can configure NES-capable Rel-18 UEs to prioritize/downprioritize specific cell(s) or frequencies applying NES technique(s), if necessary [RAN2]. Current mechanisms are totally sufficient.

3 – Nokia Corporation

We do not see an immediate need for the first bullet, and we agree with Vodafone that CHO procedure enhancements are very important (i.e. we support the second bullet). When "NES mode" is being activated in the cell, one would need to currently use handover individually at the point of NES mode activation. This would cause unnecessary delay and it may also cause unexpected events for UEs with good radio conditions. As it is assumed NES mode is being used rather dynamically, RAN2 concluded in SI phase that it would be beneficial to develop CHO event(s) that would be impacted by NES mode of the cell.

4 – CATT

We believe that the network can configure the list of NR carriers (cells) with orders (priority -based or not) for UE to access. The network could always to reconfigure the list to a UE for NES purpose. We would like to clarify whether the 1st objective "network can configure NES-capable Rel-18 UEs to prioritize/-downprioritize specific cell(s)" is covered by existing network deployment.

We are OK with 2nd objective of CHO procedure enhancement.

5 – Samsung Electronics Co.

We do not see CHO enhancement is beneficial. Comparing with total NES time scale, delay reduction of a few ms by CHO enhancement will bring negligible NES gain. The TR captures that CHO enhancement is feasible and possible but it does not say that it is beneficial from NES point of view.

Considering only 1 TU for this WI in RAN2 and other RAN2 items (DTX/DRX, preventing legacy UEs, SSB-less SCell, RAN2 support of RAN1-led items), we see that those two items cannot be supported in Rel-18.

6 – Apple Italia S.R.L.

We agree with the moderator that at most one of above topics can be included in WID. We prefer the first one.

If majority prefer 2nd topic (i.e. CHO enhancement), we can also accept it but we think the current wording is too general. In this case, we prefer to restrict CHO enhancement only considering source cell NES mode, i.e.

Specify ~~**CHO procedure**~~ enhancement(s) **of the evaluation of conditional handover condition in CHO to consider the NES mode of source cell** [RAN2]

7 – InterDigital

we support to include both objectives in WID

8 – Qualcomm Incorporated

We prefer to specify both enhancements.

However, if down-selection becomes necessary, we'd prefer CHO enhancement.

9 – Intel K.K.

For the first bullet, we also do not think it is essential to enhance further for NES-capable UE.

We support the second objective/bullet. However, we think the second objective can be made more clear, as follows:

Specify CHO procedure enhancement(s)for faster UE handover by introducing a new CHO event impacted by the source cell NES mode

10 – LG Electronics Inc.

We think both objectives should not be included considering the limited TU in RAN2. They are not essential but just small optimization.

11 – Motorola Mobility UK Ltd.

[Lenovo] We are fine with the CHO procedure enhancement objective.

12 – Telstra Limited

We are ok with both objectives in the moderators proposal with a preference for CHO

13 – LG Uplus

CHO is deprioritized.

14 – Fujitsu Limited

Our preference is to specify CHO procedure enhancement. We think the cell (de-)prioritization is archived by the current mechanism, while the CHO procedure enhancements can improve the efficiency of network energy saving by handover the UE faster.

15 – Sony Europe B.V.

Our preference is CHO enhancements

16 – CTSI

(China Telecom):

CHO can be prioritized.

17 – Samsung Electronics Co.

(as moderator)

Considering the comments so far, moderator suggestion would be to take the following:

Proposal:

- *Specify CHO procedure enhancement(s) for faster UE handover in case source cell is in NES mode*

18 – NTT DOCOMO INC.

We think both items should not be included.

They are not essential features to the NES. And, as Samsung said, RAN2 already has a lot of subjects to discuss in a limited TU.

We believe that we should focus on the essential items so that the NES functionality will be ready for release with good quality.

19 – NEC Corporation

We support the first bullet, while do not see strong need for the CHO enhancement in the second bullet.

20 – Guangdong OPPO Mobile Telecom.

we support revised proposal from moderator

21 – vivo Mobile Communication (H)

The revised proposal only consider one case that the source cell is in NES mode. There is also another case that target cell is in NES mode. From network energy saving perspective, the network would prefer the UE to select normal cells with high priority as target cell. There may be enhancement in this case. So if CHO is to be included as one objective, we suggest to revise the proposal as:

- *Specify CHO procedure enhancement(s) ~~for faster UE handover~~ in case source/target cell is in NES mode*

22 – Nokia Corporation

We support the revised objective in vivo #21.

23 – Fraunhofer IIS

We support the inclusion of both proposals if they fit to the RAN2 schedule. We believe that in both cases the enhancements will be minor though important.

24 – KDDI Corporation

We support the 2nd objective, CHO procedure enhancement. If time unit is available and majority want to have it, then we are fine to have 1st additionally.

25 – BT plc

It seems reasonable to add "*specify a mechanism so that a NG-RAN node can configure NES-capable Rel-18 UEs to prioritize/downprioritize specific cell(s) or frequencies applying NES technique(s), if necessary [RAN2]*" if techniques are specially defined to work under certain conditions. E.g., if on-demand SSB/SIB1 transmission is part of the WID and that on-demand is based on UE WUS, network should be capable to configure NES-capable Rel-18 UEs to prioritize that frequency. For that specific technique, NES-capable UE will be in idle/inactive so a new broadcasted solution is required if at some point operators want to use it.

For CHO, "*Specify CHO procedure enhancement(s) [RAN2]*" is too generic. During RAN2#120, it was agreed that there is a dependence between CHO framework and NES state "Capture the solution on enhancing the CHO framework (for faster offloading/onloading during cell deactivation/activation) enabling an evaluation of CHO conditions depending on the NES state of the source/target cell" which we support.

Proposal

Specify CHO procedure enhancement(s) ***depending on the NES state of the source/target cell*** *[RAN2]*

We support "*Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]*"

3.3 Other NES techniques

Assuming the proposals in subsections 3.1 and 3.2 are agreed as part of the work item objectives, we need to decide on what more can be done within the Rel-18 time frame considering the remaining meetings and TUs. Based on the comments received during the initial round, there are two potential areas that has substantial support:

- Time/frequency domain NES technique: Adaptation/reduction/elimination of common channels/signals (UE WUS can also be considered) in single or multi-carrier operation
- D-5 (UE post-distortion)

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Time/frequency domain NES technique: Multiple companies have also indicated support on specifying time/frequency domain NES techniques. At the same time, multiple companies were fine with the suggestion from moderator to support only additional scheme (majority indicated D-1) on top of C-1. The proposed time/frequency domain NES techniques rely on adaptation/reduction/elimination of common channels/signals in single or multi-carrier operation (UE WUS can also be considered). Specifically, the following has been proposed by the rapporteur:

- SSB-less SCell operation [RAN4, RAN2]
- SIB1-less operation with or without SSB [RAN2, RAN1, RAN4]
- On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]
- Longer SSB transmission periodicity [RAN2, RAN4]

The issue with the above four bullets is that the scope is too large for timely completion within Rel-18 considering that the proposals in subsections 3.1 and 3.2 will also need to be supported. From moderator point of view, supporting only "SSB-less SCell operation" in Rel-18 could be a compromise. This compromise would be putting the least additional workload on RAN1 and RAN2 compared to the other enhancements while supporting one form of time/frequency domain NES technique in Rel-18.

(intermediate round) Proposal4:

- *Identify feasible inter-band combinations and specify SSB-less SCell operation for inter-band CA where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]*

Companies are invited to share their views below.

Feedback Form 11:

1 – MediaTek Inc. We support Proposal 4 (intermediate round) as RAN4-led item with feasibility check first.
2 – Samsung Electronics Co. It is acceptable.
3 – Nokia Corporation From our point of view "On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]" is a more relevant and more generally applicable technique, and hence it should be prioritized over SSB-less SCell operation.
4 – Futurewei Technologies We dont support this approach of downscoping the above four approaches and then by limiting the WI to just those that only impacts RAN4. As stated by many companies, including our previous comments, TR 38.864 documents quite convincely the network energy savings through adaptation of common signal/channel transmissions allowing network to enter sleep mode, major contributor of network energy savings.

We also want to reiterate the operators' views during the discussion on Monday on the need for another quarter study. This would allow companies to be able to merge these different proposals for Time/Freq domain approaches into a merged approach. Hence, our proposal is to apply Alt 2 to this Time/Freq domain approaches i.e. another quarter of study in 1Q2023 within the to be approved WI.

5 – CATT

We are OK with the principle of Proposal 4 SSB-less SCell operation for inter-band CA. However, we have strong concern on the remaining wording "*where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary*". Currently, the gNB time alignment error (TAE) requirements for inter-band CA is 3 us, which is longer than the CP of SCS 30 kHz and up. We have concern if the TAE requirements of inter-band CA needs to be tighten up in order to support the objective.

We should not leave the rest of wording out as follows,

Identify feasible inter-band combinations and specify SSB-less SCell operation for inter-band CA ~~where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary~~ [RAN4, RAN2]

6 – Apple Italia S.R.L.

We are fine with the intention, with the understanding is that it should not have RAN1 impact, similar to intra-band SSB-less SCell.

We have a few comments:

(1) feasibility study is needed as the first stage. The current wording implies that it is already considered as feasible at least for some band combination.

(2) we think only FR1, not FR2, should be in the scope.

There is a very similar discussion on-going in RAN4 on "Issue 1-4-1: whether to reuse timing and Rx beam for target unknown FR2 SCell based on QCLed type C/D information from an inter-band active serving cell" (R4-2220440). The following was agreed for FR2, and there is no need for RAN4 to repeat the discussion for FR2. (FR1 feasibility is still under discussion in RAN4.)

For FR2 SCell activation enhancement

- RAN4 to not consider reusing timing and Rx beam to target unknown FR2 SCell based on QCLed type C/D information from an inter-band active serving cell

(3) Other than time/freq synchronization and AGC, we think L1/L3 measurement is also critical.

Therefore, we propose:

Study the feasibility of SSB-less SCell operation for inter-band CA in FR1, and if feasible, ~~I~~identify *feasible inter-band combinations and specify SSB-less SCell operation for inter-band CA* ***in FR1*** *where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization****, ~~(including~~****AGC****~~)~~, and L1/L3 measurements****, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]*

7 – InterDigital

We are supportive to include SSB-less Scell operation as the moderator suggested. We believe "On-demand SSB/SIB1 transmission" is also useful to include for the time domain.

8 – Qualcomm Incorporated

We are ok with the proposal with the following revision:

- ~~**Identify feasible inter-band combinations and**~~ specify SSB-less SCell operation for inter-band CA**, if found feasible**, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

It should be noted that feasibility is more than just checking band combinations.

9 – New H3C Technologies Co.

support this proposal.

10 – Beijing Xiaomi Mobile Software

support this Proposal 4□and also think feasibility study should be done by RAN4.

11 – Verizon UK Ltd

we can support this inter-band SSB-less proposal

12 – LG Electronics Inc.

We have a concern on enhancement on SCell activation procedures which can lead to RAN2 involvement. We can accept this objective only if RAN4 is dedicated and identifies feasible inter-band combinations. In that sense, we suggest to modify P4 as follows:

Identify feasible inter-band combinations and ***if identified,*** *specify SSB-less SCell operation for inter-band CA where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC)~~, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]~~*

13 – Motorola Mobility UK Ltd.

[Lenovo] We are ok with Proposal 4 and RAN4 first evaluating whether SSB-less SCell operation for inter-band CA is feasible.

14 – LG Uplus

This proposal is acceptable.

15 – AT&T

Support with Qualcomm's proposed revision

16 – AT&T

Support with Qualcomm's proposed revision

17 – NTT DOCOMO INC.

We share similar view with Nokia and InterDigital. We are OK to inlcude SSB-less SCell operation, but prefer to add also On-demand SSB/SIB1 transmission. If down-selection is needed between the two, On-demand SSB/SIB1 transmission should be prioritized as it is a more relevant and more generally applicable technique compared to SSB-less SCell operation.

18 – vivo Communication Technology

We agree with Nokia, IDC, DOCOMO and other companies that "On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]" is a more generally applicable feature thus should be added.

Regarding the RAN1 work load concern, our understanding is that given the restriction that existing channel/signal is to be reused, e.g. PRACH, the RAN1 effort is not significant. RAN1 can discuss the PRACH configurations, and potentially power and timing reference for PRACH transmission (no big difference from PRACH transmisison for initial access), and the trigger event when UE transmits PRACH for SSB/SIB-1 request can be discussed in RAN2.

19 – Intel K.K.

We can be OK with the proposal with following revision. We think this applies to FR1 only. For FR2, there are beam management constraints. Even for FR1, there is challenge for inter-band CA without SSB – UE has to handle 34.6us timing difference (Section 7.5.4 of TS38.133 – this is to accommodate non-collocated CCs) between CCs, which means the current CSI-RS (TRS) is not able to handle such difference (only SSB can do where all REs are occupied). Thus, at least the necessary condition must be two CCs for intra-band CA are collocated.

*Identify **feasible scenarios (including ~~inter~~-band combinations)** and specify SSB-less SCell operation for inter-band CA **in FR1 assuming collocated CCs**, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]*

Note: This assumes no new RS pattern is considered in the SSB-less SCell.

20 – Fujitsu Limited

We support the moderato's proposal. This approach would be reasonable considering the available TU and the discussion situation in WGs.

21 – CEWiT

We share similar view with Nokia Corporation suggested that "On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]" is a more relevant and more generally applicable technique, and hence it should be prioritized over SSB-less SCell operation.

22 – Samsung Electronics Co.

(as moderator)

Taking the comments into account, the revised version that I would suggest is the following:

(revised) Proposal 4

- *Specify SSB-less SCell operation for inter-band CA in FR1, if found feasible, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]*

For the comment from Intel, my thinking is that the above version should be fine with regards the the proposed note from Intel. Since RAN1 is not included, it already implies that there is no new RS pattern for SSB-less SCell.

For the comment from CATT, I am a bit confused. If I have to guess, CATT prefers to remove everything after "if found feasible"?

23 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the revised proposal 4 from the moderator, which is kind of a good compromise based on the comments from companies. Although we don't think it is necessary to do any restriction here, since anyway what the feasible band combination is would be up to RAN4 discussion, we are willing to compromise.

24 – Sony Europe B.V.

We also share the same view as Nokia

25 – CTSI

(China Telecom):

We support the revised Proposal 4 given by moderator. The SSB-less for inter-band CA can be a common scenario for operators and most work should be done in RAN4 won't heavy the work load for RAN1, therefore it should be prioritized. Though we also think that on-demand SSB is important, the extra work for RAN1 can be a lot. If companies who support the on-demand SSB be prioritized think RAN1 one can finish the work in WI, can we just keep both the techniques included in the WI objective?

26 – ZTE Corporation

We are supportive of SSB-less inter-band SCell operation.

Regarding the comments on "study feasibility by RAN4", we believe the main issue of implementing inter-band SSB-less SCell is about the band separation/combination of PCell and SCell. Furthermore, the SCell activation procedure also needs to be enhanced for SSB-less SCell, and the workload is mainly within RAN4 scope.

To move forward, we support the revised version suggested by moderator with the following minor update:

● Specify SSB-less SCell operation for inter-band CA in FR1, if found feasible, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC **for downlink**), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

Other techniques including SIB1-less operation without SSB, on-demand SSB/SIB1 can be considered if it can be limited to manageable workload.

27 – China Unicom

We support the revised proposal 4 as moderator proposed. Besides, "SIB1-less operation with or without SSB" can also be included due to the big gains for the NES and less impacts to RAN1 workload.

28 – Guangdong OPPO Mobile Telecom.

we are fine with revised proposal 4 from moderator

29 – VODAFONE Group Plc

We are fine with **(revised) Proposal 4** by the moderator

30 – VODAFONE Group Plc

We are fine with **(revised) Proposal 4** by the moderator

31 – Orange

we agree with the revised proposal and believe like China Unicom that we can add "SIB1-less operation" to the scope

32 – Spreadtrum Communications

We think "SSB-less in SCell" is low hanging fruit to be specified easily.

Also, we agree with Nokia, IDC, DOCOMO, vivo, ZTE and other companies that "on-demand SSB" can be specified. It is also related to "BWP without restriction" topci (FG 6-1a implementation). Such NCD-SSB like solution is a compromise solution for both UE and network energy/cost efficiency. If it is not introduced, there could be negative impact on several topics. In addition, "on-demand SSB" or "NCD-SSB like" is also tighly related to cell DTX/DRX.

33 – China Mobile Group Device Co.

We are fine with the revised proposal 4 by the moderator.

34 – Fraunhofer IIS

We agree with Nokia that "On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]" is a more promising technique for NES than the proposed one. Also, we don't know how long SSB-less may take because there was no RAN4 feasibility study. If RAN4 concludes that synchronization is a problem, then the technique will become complex and may not fit to the TUs.

In addition, we support Futurewei's comment on reiterating the operator's concerns and the need for an extended study (Alt2) on the Time/Frequency domain techniques. Further, such a study should also focus on mechanisms to mitigate of the impact of NES techniques in line with the TR 38.864 conclusion that recommended: "It is recommended that the normative phase includes not only energy saving techniques (the necessary enhancements would need to be further identified during the normative phase) but also the mitigation of their impacts when network applies network energy savings technique(s).".

35 – KDDI Corporation

We support proposal4.

36 – Panasonic Holdings Corporation

We support the proposal.

37 – Ericsson LM

We propose below update. This objective needs further study particularly from RAN4 viewpoint before any normative work can be considered. This is already reflected in the TR : "*At least the feasibility and/or potential requirements of acquiring synchronization/measurements (including AGC aspects) from other cell with SSB transmission in inter-band CA needs study.*"

- ·***Study and i****dentify* ***potentially*** *feasible inter-band combinations* ***for~~and specify~~*** *SSB-less SCell operation for inter-band CA where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including AGC), including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]*

38 – BT plc

We are fine with the revised proposal 4 by the moderator.

D-5 (UE post-distortion): Three companies (Qualcomm, Verizon, and AT&T) have indicated support on further study and/or support of D-5 in Rel-18. During the study item, D-5 was evaluated by only a single source. Furthermore, as indicated in the TR, the PA scaling values used for D-5 evaluation were not covered by RAN1 power consumption scaling model. Due to these aspects, there was no positive conclusion on D-5. Considering all these aspects, it does not seem reasonable to include D-5 as part of the Rel-18 work item (to study or to specify) at this point. Moderator's recommendation is to further consider D-5 as an enhancement for Rel-19 at a later phase.

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Companies are invited to share their views below.

Feedback Form 12:

1 – MediaTek Inc. Agree with Moderator's observation and recommendation.
2 – Samsung Electronics Co. Agree with moderator. Study item conclusion on this point is already clear.
3 – Nokia Corporation Agree with the moderator's observation. As is the case for all techniques that eventually do not make it to the Rel-18 WI, they can be proposed again for future releases, as per normal procedures.
4 – Apple Italia S.R.L. Agree with moderator's observations and the recommendation of not including D-5 in R18 WI.
5 – CATT We agree with moderator's conclusion and recommendation not to include D-5 in the objective.
6 – InterDigital We support the moderator's conclusion and recommendation.
7 – Qualcomm Incorporated There were actually four companies (Verizon, AT&T, Vodafone and Qualcomm) that have indicated support of further study and/or support of D-5 in Rel-18. Indeed, as indicated in the TR, the PA scaling values used for D-5 evaluation were not covered by RAN1 power consumption scaling model. This was due to the fact that in order to allow evaluations of techniques that didn't involve the power domain, a simplified PA power consumption model was agreed to be used, one that didn't capture the PA efficiency scaling with transmit power (D1) and backoff (D5) change. To be more precise, the model doesn't correctly capture the PA power consumption in all power techniques: D-1 (when transmit power is changed) and in D2, D3, D4 and D5 (when backoff is changed). If companies believe further evaluation is needed as a condition for adoption, an effort can be made by RAN1 to provide several PA efficiencies values for certain transmit powers and backoff values. We support specifying D-5 in Rel-18.
8 – LG Electronics Inc. Agree with Moderator's observation and recommendation.

9 – Motorola Mobility UK Ltd.

[Lenovo] Agree with Moderator's observation and recommendation for D-5.

10 – Verizon UK Ltd

We are open minded but indeed like D-5 category a lot. We think NES is a multi-release effort, early study of some longer term very promising technologies is warranted we think, often more than some easier but short in potential technologies.

11 – LG Uplus

We agree with moderator's suggestion. In the other hand, this feature seems interesting but require more study with considering various type of devices and circumstances. It could be treated in conjunction with AI/ML.

12 – AT&T

Same view as Qualcomm. But if distortion/relaxation based techniques cannot be agreed in R-18, they should definitely be a key focus area for NES in R-19 and beyond.

13 – NTT DOCOMO INC.

Agree with Moderator's observation and recommendation.

14 – vivo Communication Technology

We are fine with moderator's recommendation on D-5. The UE impact including complexity and power consumption due to UE post-distortion operation was not fully studied during the SI due to limited time, more studies on these aspects would be needed in the future, if needed.

15 – CEWiT

We support the moderator's conclusion and recommendation.

16 – CTSI

(China Telecom):

We support the moderator's observations and recommendation.

17 – NEC Corporation

We agree with moderator's observation and recommendation.

18 – Guangdong OPPO Mobile Telecom.

agree with moderator's observation and fine not to do it in Rel18

19 – VODAFONE Group Plc

We share the same view as Qualcomm and AT&T.

20 – TELECOM ITALIA S.p.A. Same as Vodafone and others. This is a very promising technique
21 – Fraunhofer IIS We recognize the importance of investigating D-5 further. We are fine with moderators recommendation in general. Alternatively, an extended study phase within R18 (Alt2) can possibly include D-5 as well along with the Time/Freq domain techniques of interest.
22 – KDDI Corporation Agree with Moderator's observation and recommendation.
23 – Panasonic Holdings Corporation We support the proposal.
24 – BT plc Agree with moderator's proposal and recommendation, left D-5 as a potential enhancement for Rel-19. It is not incongruent to go for Alternative 3 "start normative work in 2023.Q1 without extension on study" and allow RAN1 to continue the SI phase.

3.4 Outcome of intermediate round

The following was endorsed during the Wednesday GTW session

Alternative 3: Start the normative work on network energy savings in 2023.Q1. There is no extension on the study of network energy savings techniques.

Proposal 1

- Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains) [RAN1, RAN2]
- Specify necessary enhancements on CSI related procedures including measurement and report, and signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS [RAN1, RAN2]
- Note: Above objectives are only for UE specific channels/signals
- Note: Legacy UE CSI/CSI-RS capabilities applies when considering total number of CSI reports and requirements

Proposal 3

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- Specify mechanism(s) to prevent legacy UEs camping on cells adopting the Rel-18 NES techniques, if necessary [RAN2]
- Specify inter-node beam activation and enhancements on restricting paging in a limited area [RAN3]

Proposal 5

- Specify CHO procedure enhancement(s) in case source/target cell is in NES mode [RAN2]

Moderator's recommendation on D-5 (UE post-distortion)

- Further consider D-5 as an enhancement for Rel-19 at a later phase

The following was endorsed in principle for inclusion as part of Rel-18 network energy savings work item and will be further discussed in the final round to converge on the exact scope

- Adaptation of cell DTX/DRX
- SSB-less SCell operation

4 Final round discussions

4.1 Adaptation of cell DTX/DRX

During the Wednesday GTW, adaptation of cell DTX/DRX was agreed in principle for normative work in Rel-18. For the final round, the discussion will be focused on finalizing the WI objective:

Proposal 2 revised during the Wednesday GTW

- Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DTX~~DRX~~/DRX with UE DRX in RRC-CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]
- Note: At least legacy SSB transmission remains unchanged
- Note: The impact to IDLE/INACTIVE UEs due to the above enhancement ~~can~~should be ~~considered~~avoided

Companies are invited to make comments on Proposal 2

Feedback Form 13:

1 – vivo Communication Technology

The above proposal reflects the SI study and the conclusion very well, we support.

2 – MediaTek Inc.

We also support current version. To address the alignment order issue raised in GTW, the following simple revision may help:

Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DTX~~DRX~~/DRX ~~**with**~~ **and** UE DRX in RRC-CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]

3 – LG Electronics Inc.

We support the moderator proposal. For the first note, we strongly prefer to keep it to minimize the impacts to legacy UEs. For the second note, we are ok as it is, but also ok to remove it.

4 – Apple Italia S.R.L.

We think it is beneficial to consider two cases, one case with legacy UEs and **the other case without legacy UEs**. For the first case, both notes should be applied, but this can be achieved by via gNB implementation (e.g. continue SSB transmission and any other signals needed by legacy UEs). For the second case, if the network chooses to use the technique for a cell without legacy UEs, it may be considered not to transmit or reduce legacy SSB, and new UE behaviors may be defined. Supporting both cases would provide more flexibility and more energy saving for the network.

As also commented during the meeting, this technique should be applicable to a SSB-less SCell also, so the first note can be a bit confusing in this sense. We understand there is some consideration on UE impact, and we also agree that we should be careful.

Our preference is to **remove both notes for now, and it can be further discussed during the WI phase**.

We are fine with MediaTek's update on the main bullet.

5 – vivo Communication Technology

@Apple

Thanks for your comment. Just to share some of the technical understanding from our side.

1. The cell DTX enhancement as studied and concluded in SI was about the connected mode UEs, i.e. A-4. Looking at the TR, A-4 itself does not require new behaviors for IDLE/INACTIVE UEs to work.

2. The other techniques, if jointly used together with cell DTX enhancement, may requires some changes to IDLE/INACTIVE UEs, e.g. common channel reduction, but thoses changes are required by the common channel reduction features, not cell DTX feature. Currently in the WI scope the only technique that impacts common channel transmission is SSB-less Scell, but this is applicable to connected mode CA UE only, but no impact to IDLE/INACTIVE UEs. The first note just mean that SSB transmisison is not impacted by cell DTX operation, however, it does not preclude if SSB transmisison is reduced by other features that are jointly applied, e..g. SSB-less Scell.

3. Removing the notes would make the scope quite ambigous, i.e. whether and how much impact to IDLE/INACTIVE UEs, is totally unclear, which is not desirable

Therefore, we strongly believe both notes should be kept.

6 – Samsung Electronics Co.

We support the moderator's revised proposal.

7 – Qualcomm Incorporated

We support the proposal (revised during the Wednesday GTW). We think both notes should be kept. The suggested revision from MediaTek is also fine.

8 – Intel K.K.

We are OK to move forward with moderator or MTK proposal

9 – Spreadtrum Communications

We share the similar view as Apple to remove both Notes.

If a cell capable of cell DTX/DRX is non-anchor cell (e.g. SCell in CA), there could be no SSB/SIB1 and no IDLE/INACTIVE UE will be impacted.

However, if the cell capable of cell DTX/DRX is anchor cell (e.g. PCell in CA or serving cell in non-CA), there could be SSB/SIB1 in the cell, how the cell can be DTXed for SSB transmission? It will definitely impact IDLE/INACTIVE UE. Or, we only call cell DTX/DRX if it is DTX for UE-specific RS, but in our view it is fake DTX, since gNB cannot enter any sleep mode due to SSB transmission. It is not realistic for cell DTX, if SSB is still transmitted. Alternatively, the cell transmission window for cell DTX needs to cover each occasion of SSB burst, but it is too restrictive and energy saving gain is reduced largely.

Anyway, in our view, if the cell capable of cell DTX is anchor cell (e.g. PCell in CA or serving cell in non-CA), only UE-specific signal/channel is DTXed does not mean a real cell DTX, and the energy saving gain in realistic is not as large as that of evaluation results.

10 – CEWiT

We also share the similar view as Apple and Spreadtrum Communications to remove both Notes. The first note is not needed for the cells not accommodating legacy UEs.

11 – Spreadtrum Communications

Supplementary to emphasize **SSB/SIB/paging** for energy consumption in cell DTX scenario:

If the cell capable of cell DTX/DRX is anchor cell (e.g. PCell in CA or serving cell in non-CA), gNB cannot enter any sleep mode while **SSB/SIB/paging** transmission.

12 – Guangdong OPPO Mobile Telecom.

we support proposal2. And We support to keep both Notes. 1st Note is the least condition not to impact legacy UE. For 2nd Note, both legacy UE and new UE in IDLE/INACTIVE state should be treated in the same way because cell DTX/DRX is for UE in RRC-CONNECTED state, it could be network's implementation not to affect legacy UE by proper network's implementation e.g. by scheduling legacy UE out of cell DTX/DRX duration.

As for SSB-less SCell, without SSB (and also SIBs broadcast) it is only "visible" for new UE in connected state i.e. there is no impact on UEs in IDLE/INACTIVE state at all.

13 – Motorola Mobility UK Ltd.

[Lenovo] We are generally fine with moderator's proposal and the change proposed by MTK.

Regarding the notes, we are ok to remove both notes and discuss during the WI phase whether during a cell DTX/DRX, all transmission and reception is turned off or only limited transmission/reception of SSB/reference signals occurs for the cell as mentioned in the TR and for what type of cell e.g., only supporting NES-capable UEs, and its impact to IDLE/INACTIVE UEs.

14 – HUAWEI TECHNOLOGIES Co. Ltd.

Regarding the first note, we suggest to update it as below:

Note: At least ~~**legacy**~~ SSB transmission ~~**remains unchanged**~~ **is not impacted due to cell DTX/DRX** or

Note: No change for SSB transmission due to cell DTX/DRX

As several companies mentioned above, it is good to allow applying cell DTX/DRX on SSB-less SCell also if applicable, the existing note in the moderator proposal preclude the chance for the combination of these two features. Note that the above updated note can also achieve the intention to avoid further enhancement on SSB.

On the other hand, we do agree with Apple that it is more beneficial to consider both the case with legacy UE and without legacy UEs, so we are fine to remove both notes also if it can be acceptable to other companies.

15 – New H3C Technologies Co.

we are fine with main bullet this revised proposal without two notes

16 – KDDI Corporation

We are fine with the moderator or MTK proposal.

17 – Fujitsu Limited

We are fine with the proposal by moderator. Also, our preference is to keep the both notes for the focused scope in this WI. We understand that some enhancements can be done for new UEs assuming the absence of legacy UEs in a cell, but more focused discussion should be performed given the limited TUs in Rel-18.

18 – CTSI

(China Telecom):

We are fine with the revised proposal without the two notes.

19 – CTSI

(China Telecom):

We are fine with the revised proposal without the two notes.

20 – Nokia Corporation

We think the notes are very important to keep the scope focused and we are not OK to remove them. As mentioned by several operators in the previous rounds and in GTW, it is important that the techniques coexist well with legacy UEs. Hence, we think the revised note proposed by Huawei #14 is a good alternative:

Note: No change for SSB transmission due to cell DTX/DRX

21 – NEC Corporation

We support the revised proposal and think both notes should be kept to ensure no impact to SSB transmission by cell DTX/DRX.

22 – ZTE Corporation

For the main bullet, the suggestion by MTK addresses our concerns during GTW, the version suggested by MTK is okay to us.

For the first note, the version suggested by Huawei seems better. We are also fine with the majority views to keep or remove the note.

23 – China Mobile Com. Corporation

We are fine with current version. And we prefer to keep the two notes, which are good guidance for normative works. Without the notes, we are worrying there would be impact on either new or legacy idle and inactive mode UEs.

24 – Panasonic Holdings Corporation

We are ok with either Moderator proposal or MTK's update.

25 – Fraunhofer IIS

We generally support the revised proposal.

One proposal to possibly improve the wording of the last note: "The impact to IDLE/INACTIVE UEs due to the above enhancement should be minimized"

26 – Ericsson LM

We are OK with moderator proposal and also with Mediatek suggested update. Our preference is keeping both the notes. For first note, we are OK with Huawei's suggested update (i.e. "Note: No change for SSB transmission due to cell DTX/DRX").

27 – BT plc

BT wants to clarify a few first note "At least legacy SSB transmission remains unchanged". Truth is that legacy SSB periodicity transmission may affect only legacy UEs.

Proposal:

If legacy UEs are present, at least legacy SSB **periodicity** transmission remains unchanged.

28 – NTT DOCOMO INC.

We are OK with the moderator proposal or MTK's proposal.

4.2 SSB-less SCell operation

During the Wednesday GTW, SSB-less SCell operation was agreed in principle for normative work in Rel-18. For the final round, the discussion will be focused on finalizing the WI objective:

Proposal 4 revised during the Wednesday GTW

- Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), and L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

Companies are invited to make comments on Proposal 4

Feedback Form 14:

1 – vivo Communication Technology

We are not sure about the necessity of including "and L1/L3 measurements", as those measurements may instead be performed based on other reference signals like CSI-RS.

2 – LG Electronics Inc.

We don't want to involve RAN2 in this topic considering the limited TU in RAN2. Thus, we suggest to remove the last part "including potential enhancement on SCell activation procedure if necessary" and remove RAN2 from the affected WG.

3 – MediaTek Inc.

We support restriction of "for FR1 and co-located cells". Regarding the concern from vivo on "and L1/L3 measurements", we think inclusion of **L3 measurements** is necessary since SSB is the common reference signal. In this regard, the following revision can be considered:

Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), and ~~L1/~~L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

4 – Apple Italia S.R.L.

We support the moderator's proposal.

We are also fine with MediaTek's proposal to remove L1 measurement and only keep L3 measurement. This is necessary at least for SCell activation purpose. Once the UE starts the operation on the SCell, indeed

the measurement can be performed based on CSI-RS as commented by vivo.

5 – vivo Communication Technology

Thanks MediaTek and Apple for the responses. We are fine to remove L1 measurement and keep L3 measurement.

6 – Qualcomm Incorporated

We support the restriction to FR1 and to co-located cells.

For SSB-based measurement on SSB-less SCell, SS-RSRP might be reused from SS-RSRP measured in the cell with SSB but beam patterns are frequency dependent, so depending on the frequency offsets, there may be errors. More importantly, reusing RSSI (in deriving SS-RSRQ) or SS-SINR from the cell with SSB is inaccurate due to different interference/loading in different carriers. Hence, we support the addition of L1/L3 measurement impact in the scope.

7 – Samsung Electronics Co.

1) We are OK to clarify "FR1 and co-located cells".

2) We don't see the need for adding "L1/L3 measurement". Even if keeping only L3 measurement, it is unclear what additional RAN4 specification work (and possibly RAN2) is necessary under the assumption of FR1 and co-located scenario.

3) For RAN2 work, we agree with the comment from LGE.

8 – Intel K.K.

As explained during GTW, we support to include the restriction "FR1 and co-located cells" considering typical use case, FR2 beam management constraints, and more importantly to limit additional work load of study at RAN4.

Also, we suggest to remove "L1/L3 measurements". In our understanding, for SSB-less operation the PCell measurements will be reused for SCell and UE will not perform any extra measurements, while the wording in the proposed objective may give an impression that there can be some separate measurements.

Moreover, if there is no anticipated impact in RAN2 other than UE capability, we are OK to remove RAN2 from list of WGs. RAN2 can anyway discuss UE capability regardless of whether RAN2 is listed or not.

To this end, we suggest revision as follows:

Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), ~~and L1/L3 measurements~~, including potential enhancement on SCell activation procedures if necessary [RAN4~~, RAN2~~]

9 – HUAWEI TECHNOLOGIES Co. Ltd.

We support the proposal from the moderator.

1. Regarding whether to keep "L1", in our understanding L1 measurement needs to be kept here. Firstly, at least for SCell activation it is better to rely on SSB on PCell or another SCell to do some L1 measurement

(e.g. beam related information), which can make the SCell activation faster. Secondly, once the UE starts the operation on the SCell, the L1 measurement can be performed either based on CSI-RS or SSB on another cell, just like a normal cell with SSB and CSI-RS. Thirdly, the objective here doesn't mean that UE will always rely on SSB on the another cell for all L1 measurements, just to clarify that since SSB is not transmitted on the SCell, then it can use the SSB on another cell for some typical measurements, including L1 measurement. **Note that keeping L1/L3 measurements here doesn't mean any new measurement needs to be introduced (i.e. no RAN1 impact expected), as companies commented just to reuse the measurements on the other cell with SSB. Keeping it here would make the objective clearer.**

2. Regarding the comments from LG, we want to clarify that RAN2 is listed here mainly because of some general RRC impact for SSB-less operation. For SCell activation itself, from our side we don't see RAN2 work.

10 – Spreadtrum Communications

Fine to restrict it to FR1 and to co-located cells.

Open to keep "L1/L3 measurement". RAN1 can study the potential impact on L1 measurement, if CSI-RS should base time on the SSB in the inter-band PCell. As well, RAN4/2 can study the potential impact on L3 measurement. If L1 measurement is added, maybe RAN1 should be involved.

11 – Apple Italia S.R.L.

To respond to Intel's comment on L1/L3 measurements, it seems that there may be some misunderstanding on the intention for adding it. The purpose is for RAN4 to study the feasibility of using the measurement of SSBs transmitted on PCell or another SCell for the SSB-less SCell, exactly like what Intel explained. Adding it means that RAN4 needs to study this together with time/freq synchronization and AGC aspects. This does not propose any new measurements.

Huawei has a good point that the beam-related information would require L1 measurement. In this sense, it is better to keep L1 measurement in the objective. RAN4 will sort it out during the study.

We wonder if the following modification can address Intel's concern. "at least partially" is used to reflect the fact that UE may still do other L1 measurements e.g. based on CSI-RS configured on the SCell.

Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), **and at least partially uses** L1/L3 measurements **on PCell or another SCell for the SCell**, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

12 – Motorola Mobility UK Ltd.

[Lenovo] We support the Moderator's proposal with the addition of L1/L3 measurements.

13 – Guangdong OPPO Mobile Telecom.

We support this version. For L1/L3 measurement we think the wording should be kept. The discussion on [98e-30-BWP-WithoutRestriction] show that SSB is more likely deployed in the field. so we need to consider the case that even CSI-RS is not configured in the concerned serving cell. In that case UE

need rely on the L1/L3 measurement in the relevant serving cell. And we agree with Huawei that no new measurement need be introduced if measurement is ”borrowed” from other serving cell.

In addition we also think we can remove RAN2 from bracket for this objective. The potential enhancement on SCell activation will be assessed in RAN4 also. If there is any business to do with RAN2, RAN4 can send LS to RAN2. As for the work related to RRC parameters, we think this is business as usual i.e. not necessary to list RAN2 only because of this.

14 – Verizon UK Ltd

In general, supportive of the proposal

15 – NTT DOCOMO INC.

We are generally fine with the proposal. Regarding whether to keep L1 measurement, we share similar view with Huawei/Apple that it is better to keep L1 measurement in the objective.

16 – New H3C Technologies Co.

we are fine with this proposal with VIVO and LG’s comment to removing “and L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary” and ”RAN2”

17 – Fujitsu Limited

We are fine with the moderator proposal.

18 – KDDI Corporation

We are fine with the moderator proposal and the restriction to FR1 and to co-located cells. We also ok to have both L1 and L3 measurements at this moment.

19 – Nokia Corporation

We are not OK with removing RAN2 from the objective based on the argument that RAN2 doesn’t have enough TUs to do the work. The main criterion to list a WG as impacted is that the work is expected to generate impact on specifications maintained by that WG (beyond UE capabilities and adding RRC parameters). As mentioned by Huawei above, one can anticipate general RRC impacts from this objective, and hence we are not OK to remove RAN2 from the list. In case it becomes clear after RAN4 feasibility study that no RAN2 impact is needed, then we could consider revising the WID in a future RAN Plenary meeting.

20 – CTSI

We are fine with the proposal and agree with Huawei to keep the ”L1/L3 measurement”, at least L1 and L3 should be kept or removed at the same time.

21 – VODAFONE Group Plc

We are supportive of the moderator’s proposal

22 – Orange

we support the proposal, inter-band CA on FR1 & co-located sites are indeed in line with our priorities

23 – China Mobile Com. Corporation

We are fine with the current version.

24 – Panasonic Holdings Corporation

On ”and L1/L3 measurements”, we think both of 1) to use SSB in PCell or another SCell and 2) to use CSI-RS in SSB-less SCell for L1 measurement are OK. For L3 measurement, only ”to use SSB in PCell or another SCell” should be used. Therefore, only ”L3 measurements” should be described. L1 measurement can be discussed in WG level including the case to support both 1) to use SSB in PCell or another SCell and 2) to use CSI-RS in SSB-less SCell.

25 – HUAWEI TECHNOLOGIES Co. Ltd.

We also think RAN2 should be kept at least at this stage as commented by Nokia. As we explained before, there is RRC impact for SSB-less SCell operation.

26 – Ericsson LM

Similar to what other companies have commented, we would like to see RAN2 work here minimized. We suggest to have SSB-less SCell operation for inter-band CA investigated first in RAN4, without RAN2 involvement. If RAN4 conclusion is that the solution is feasible, RAN2 can get back to it later, but also then we think there should not be much impact on RAN2 and RAN2 load can be assessed at that time.

27 – ZTE Corporation

For the comments on the RAN2 part, we share similar views with Intel, Huawei,Nokia that the main impact of SSB-less SCell operation on RAN2 is RRC signaling. The SCell activation procedure enhancement is within RAN4 scope, instead of RAN2.

For the L1/L3 measurement, our understanding is that the intention is to identify whether/which L1/L3 measurements in the SCell activation procedure or after SCell is activated on SCell needs to rely on other cell. This should be discussed in RAN4 for SSB-less SCell operation. Therefore, if the majority sees the need of mentioning that, we are okay to keep “L1/L3 measurement” with the following update.

- Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell’s time/frequency synchronization (including downlink AGC), and **potential**L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

28 – Fraunhofer IIS

We agree with Qualcomm to limit it to FR1 and co-located cells, and to keep the addition of L1/L3 measurement impact in the scope.

We also agree with Nokia to not remove RAN2. At this point in time it is not clear how many RAN2 TUs are needed, as the workload depends on the outcome of the RAN4 study. Therefore a study phase may be reasonable to re-evaluate the impact based on the outcome of the RAN4 study.

29 – BT plc

Time alignment is the requirement here but not the physical cell location. Hence, we have concerns about the meaning of co-located.

Why this needs to be limited to FR1? Can we ensure without now that it is impossible to achieve inter-band time alignment in FR2?

Why do we need to include L1 measurements? What are companies' concerns?

Proposal:

Specify SSB-less SCell operation for inter-band CA for **~~FR1 and co-located~~time aligned** cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), and **~~L1~~???**/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

4.3 Any other issues to be discussed?

This subsection is to be used for any other proposals not covered in 4.1 and 4.2. Please consider the workload in the WGs when making proposals for additional enhancement.

Feedback Form 15:

1 – vivo Communication Technology

We have 4 meetings for RAN1 in WI phase and 7TUs in total. Based on the current conclusion, we only have two RAN1-led objectives, CSI enhancements for spatial and power adaptation, for which some commonality is observed in the required enhancements, as commented by multiple companies in the previous round.

Therefore, we believe there is possibility for RAN1 to work on on additional objective. The on-demand SSB/SIB-1 transmission got large number of support from the previous round, and it can be kept simple if the existing L1 channel is to be reused as the UE request. Therfore we propose to add the following objective.

- On-demand SSB/SIB1 transmission [RAN1, RAN2, RAN4]
    - Note: No new L1 signal/channel will be introduced for the UE request

2 – LG Electronics Inc.

At least from RAN1/RAN2 perspectives, it's already fully loaded by agreed objectives. We think there is no room for other objectives that take RAN1/RAN2 TUs.

3 – Intel K.K.

Based on Wednesday GTW discussion, there is expected to be some discussion on whether/how to add the following RAN2 objective on paging enhancement which was evaluated in RAN1, showed a promising gain, with no legacy UE impact, and only impact RAN2. We suggest adding it under RAN2-led objectives.

Specify paging enhancements to confine paging frames and paging occasions within a cell-specific paging window [RAN2]

4 – Spreadtrum Communications

We share the similar view as vivo. RAN1 work load still has room for other objectives. On-demand SSB can be chosen as it is also stable, and many companies show interest on it. In BWP without restriction topic, NCD-SSB is an option, and it is a form of on-demand SSB. It has potential to be a energy/cost efficient solution for both UE and network. The flexible SSB as time reference to assist CSI-RS can serve as a solution for several topics, e.g. NES, BWP without restriction, mobility...

5 – CEWiT

We also have the similar view as vivo. On-demand SSB can be included as many companies have interest on it.

6 – Samsung Electronics Co.

(as MODERATOR) I would suggest that we focus on the following proposal:

- ***Specify paging enhancements to confine paging frames and paging occasions within a cell-specific paging window [RAN2]***

For "On-demand SSB/SIB1 transmission", I stand by my earlier assessment as RAN1 chair that it will overload RAN1. It is clear from the previous rounds that there are quite a number of companies which share this view.

7 – LG Electronics Inc.

We are not comfortable with adding more objectives to RAN2. Considering 1 TU allocated to RAN2, only essential topic should be progressed in WI. Note that RAN2 is already overloaded by agreed objectives. The "Paging enhancement" is obviously an "enhancement" as the name stands for, and we don't want to include it in the WI.

8 – Guangdong OPPO Mobile Telecom.

We don't support RAN2 to discuss paging enhanement. The gain is not clear since this issue was never discussed in RAN2 before. Because paging is a common procedure shared by all UEs, if there is any change over Uu interface, it may cause backward compatibility issue. And we fully agree with LGE in terms of RAN2 work load.

9 – Guangdong OPPO Mobile Telecom.

One more point, we would like to keep the Note in objective part : "Note: Strive for a common framework for the adaptation of spatial elements and adaptation of DL transmission power on multiple CSIs enhancements"

10 – Apple Italia S.R.L.

We do not support adding additional objectives for RAN2 as we think the current load is appropriate. We have clearly heard the complaints that we are not getting the work done in time and/or with good quality, so let us keep the scope reasonable.

In addition, as explained in our contribution, we have reservation on the potential of the technique. The large gain was shown by a single source only for systems with zero traffic load and large paging load during the SI phase. Realistically speaking, such gain may not be achievable because: (1) Paging load may not be so large (2) It is not typical to have very low traffic load and very high paging load. (3) This only works if the large paging load is mainly contributed from the new UEs. Otherwise, the legacy paging configuration still needs to be used to support legacy UEs.

This technique was not studied in RAN2, which also makes it less appropriate to be included as a RAN2 objective.

11 – Nokia Corporation

We support the objective in moderator comment #6, and we believe it is feasible. Even though we support the enhancement for on-demand SSB/SIB1 transmission as well, we respect the moderator/chair's assessment on workload, as we believe it is important to be responsible in RAN Plenary on how much we load the WGs.

12 – vivo Communication Technology

RAN1 has 7 TUs for the WI, with 2 objectives. RAN2 has 6 TUs and now we have 3 RAN2 led objectives and all the RAN1 and RAN4 led objective will impact RAN2. If RAN1 cannot accomodate more objectives, we think the same rule should apply to RAN2, i.e. no additional RAN2 objectives.

13 – Samsung Electronics Co.

Same view as above companies – RAN2 TU is already fully occupied. We do not support additional RAN2 objective.

14 – New H3C Technologies Co.

we don't support additional RAN2 objective because it will overload RAN2.

15 – Fujitsu Limited We agree with LGE and others' opinion that RAN2 is already overloaded and the paging enhancements was not discussed in RAN2 in SI phase. Then we don't support to add this objectives at this late stage.
16 – CTSI We also agree with companies that RAN2 is overloaded and the objective shouldn't be added.
17 – Ericsson LM We agree with RAN1 chair's assessment on the RAN1 workload. We have concern on the RAN2 workload based on all of the intended objectives. No new objectives with RAN2 objectives should be added.
18 – Fraunhofer IIS We agree with vivo's analysis and support adding the objective: "On-demand SSB/SIB1 transmission"

4.4 Summary of the final round discussions

Proposal 2: Situation after the final round is that there are no serious comments on the main text of the proposal but there are still a bit of different views on the notes. The majority view is to keep the notes for a better focused normative phase which the moderator agrees with. Moderator recommendation is to take the following and closing the discussion on this topic. Further discussions will not be necessary nor constructive.

Proposal 2 (for endorsement via email)

Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DTX/DRX and UE DRX in RRC-CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2, RAN1, RAN3]

- Note: ~~At least legacy SSB transmission remains unchanged~~ No change for SSB transmission due to cell DTX/DRX
- Note: The impact to IDLE/INACTIVE UEs due to the above enhancement should be ~~avoided~~minimized

The change compared to the moderator proposal is the cleaner wording suggested by Huawei for the first note and the wording from Fraunhofer on the second note ('avoided' changed to 'minimized').

Proposal 4: Discussions in the final round mainly revolved around "L1/L3 measurements". Considering clarification from Huawei and Apple that the intention is not to introduce new L1/L3 measurements but reuse existing measurements, moderator's opinion is that current version is fine (and RAN1 is not listed as one of the responsible WGs anyway). Also, multiple companies indicated that RAN2 should not be included as one of the responsible WGs. Considering rapporteur's comment that RAN2 work is limited to general RRC impact

for SSB-less operation, current version should be acceptable. Similar to Proposal 2, moderator view is that additional discussion will not help. Agreeing to the current version of the proposal seems the best course of action.

Proposal 4 (for endorsement via email)

Specify SSB-less SCell operation for inter-band CA for FR1 and co-located cells, if found feasible by RAN4 study, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), and L1/L3 measurements, including potential enhancement on SCell activation procedures if necessary [RAN4, RAN2]

Other proposals: Two other proposals were mentioned as additional enhancements on top of what is currently agreed for Rel-18. However, multiple companies have indicated in the initial, intermediate, and final round that these proposals would overload the WGs. Moderator agrees with these assessments and hence will not recommend these proposals for Rel-18 network energy savings WI.

WID finalization: Based on the outcome of the discussions, the rapporteur has provided an updated version of the WID in https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Inbox/Drafts/%5B98e-05-R18-NES%5D. The draft WID which will be further revised after the endorsement of Proposal 2 and Proposal 4. Moderator suggests an extended round of discussions just for the purpose of adding any supporting IMs and doing a final check on the wording of the WID.

5 Extended Round: WID finalization

Please check RP-223432 (draft WID from the rapporteur). The objective section will be revised with the agreements taken under [98e-05-R18-NES]. **In other words, no comments on objective section of RP-223432 necessary.** For the other sections (e.g. motivation section), if you have any comments, please provide your comments here. The rapporteur will take your comments into account and revise the WID.

Feedback Form 16:

1 – MediaTek Inc.

We see WG lists for serval scope items can be simplified. Given we already have the note in draft WID, "**Note: Lead WG of each scope item can trigger necessary specification work of another WG(s) via LS**.", the following revisions are therefore suggested:

- *Specify necessary enhancements on CSI and beam management related procedures including measurement and report, and signaling to enable efficient adaptation of spatial elements (e.g. antenna ports, active transceiver chains) [RAN1~~, RAN2~~]*
- *Specify necessary enhancements on CSI related procedures including measurement and report, and*

signaling to enable efficient adaptation of power offset values between PDSCH and CSI-RS [RAN1~~, RAN2~~]

- *Specify enhancement on cell DTX/DRX mechanism including the alignment of cell DRX/DRX with UE DRX in RRC-CONNECTED mode, and inter-node information exchange on cell DTX/DRX [RAN2~~, RAN1~~, RAN3]*
- *Specify SSB-less SCell operation for inter-band CA, if found feasible, where a UE measures SSB transmitted on PCell or another SCell for an SCell's time/frequency synchronization (including downlink AGC), including potential enhancement on SCell activation procedures if necessary [RAN4~~, RAN2~~]*

2 – Samsung Electronics Co.

(as moderator)

@MTK: As mentioned above, the intention of this subsection is to discuss other sections of the WID. For the already endorsed WID objectives, I don't plan on making any changes.

3 – Qualcomm Incorporated

For Section 5 on impacted TS/TR, TS 38.215 should be added into the table if the L1/L3 measurement aspect is included in objective for SSB-less SCell operation in inter-band CA.

Other comments: we assume "(phase 1)" in the title "New WID on Network energy saving for NR (phase 1)" of WID draft will be removed. In addition, the sentence "Dependency on non-3GPP (draft) specification:" in Section 2.3 should be removed.

4 – Samsung Electronics Co.

1) Section 3: We suggest the following update (in bold and underline) to reflect the SI more accurately:

"The techniques in time and frequency domains mainly aim to reduce the power consumption for dynamic part by trying to shutdown more symbols on one or more carriers to achieve BS micro sleep, and even the static power part by enlarging the interval between the contiguous active transmission/reception occasions to achieve BS light/**deep** sleep. The techniques in spatial and power domains mainly aim to reduce the power consumption of the TRX chains and PAs by trying to shutdown more spatial elements and/or reduce **transmission power**/power spectrum density, or increase the PA efficiency."

2) Section 5: addition of TS38.300 is necessary.

3) Suggest to remove "(phase 1)" in the WID title (as Qualcomm commented).

5 – Samsung Electronics Co.

(as moderator) If you want to be added as a supporting IM, please indicate so in this section.

6 – AT&T

Please add AT&T as supporting company. Thank you for moderating, Younsun.

7 – Spreadtrum Communications

Please add Spreadtrum as supporting company. Thank you for moderating, Younsun.

8 – LG Electronics Inc.

Please add LG Electronics as supporting company. We are also OK to remove ”(phase 1)” in WID title, as Samsung and Qualcomm commented. Thank you for moderating, Younsun.

9 – Motorola Mobility UK Ltd.

Please add Lenovo as supporting company. We are ok with the changes commented by Qualcomm and Samsung. Thank you Younsun for moderating.

10 – Apple Italia S.R.L.

Please add Apple as supporting company. Thank you!

11 – CHTTL

Please add CHTTL as supporting company. Thank you for moderating, Younsun.

12 – Samsung Electronics Co.

Please add Samsung as supporting company. Thank you.

13 – Fujitsu Limited

Thanks Younsun for moderating the discussion. We Fujitsu is willing to be a supporting IM.

14 – New H3C Technologies Co.

Please add New H3C as supporting company. Thank you

15 – ITRI

Please add ITRI as supporting company. Thank you.

16 – MediaTek Inc.

Please add MediaTek Inc. as one supporting company. Thanks for the efforts of Moderator and Rapporteur in effectively converging the WID.

17 – KDDI Corporation

Please add KDDI as supporting company. Thanks for the efforts.

18 – Nokia Corporation

Please add Nokia and Nokia Shanghai Bell as supporting companies. Thank you for the efforts.

19 – CTSI

Please add China Telecom as supporting companies. Thank you for the efforts.

20 – HUAWEI Technologies Japan K.K.

[As Rapporteur]

An updated draft WID has been uploaded in the draft folder below, with addressing comments (from section 4.4 of [98e-05-R18-NES]) so far, and with reflection of agreed objectives, as well as mentioning of usual RAN4 part and the note about LS. Additionally the time budget sheet is updated as per the latest endorsed RP-220980.

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Inbox/Drafts/%5B98e-05-R18-NES%5D

Please take a look when making further comments.

21 – VODAFONE Group Plc

Please add Vodafone as a supporting company. Thank you for the moderating efforts.

22 – Sony Europe B.V.

Please add Sony as supporting company. Thank you

23 – China Mobile Com. Corporation

Please add CMCC as supporting company. Thank you for the effort.

24 – Nokia Corporation

On the WID draft, we are not fine with the note about LSs: ”Note: Lead WG of each scope item can trigger necessary specification work of another WG(s) via LS.”

It is not clear what is the intention here. If this is usual procedure then we don’t need to write it down, if it is something new then someone should clearly explain what it implies, and why we need it in this particular WID.

25 – Ericsson LM

We support Samsung’s proposed updates for Section 3, and removal of “phase 1” from the title.

Please add Ericsson as a supporting company for the WI.

26 – BT plc

Please add BT as supporting company, thank you for the effort

27 – ZTE Corporation

Thanks for the great efforts. Please add ZTE Corporation and Sanechips as two supporting companies.

28 – Fraunhofer IIS

Please add Fraunhofer as supporting company. Thanks so much for the great effort!

29 – Telia Company AB

Please add Telia Company as supporting company.

30 – CATT

Thanks Younsun for moderating the discussion. Please include CATT as the supporting company.

31 – FirstNet

Please add FirstNet as a supporting company.

32 – Futurewei Technologies

Futurewei would like to be added as a supporting company.

33 – Verizon UK Ltd

Verizon also supports. You can list us as a supporting company too.

34 – Intel K.K.

Thanks Younsun for the efforts in moderating the discussion and towards convergence to the current WID objectives. Please add Intel as a supporting company

35 – Motorola Mobility UK Ltd.

Please add Lenovo and Motorola Mobility as supporting companies. Thank you for the efforts.

36 – NTT DOCOMO INC.

Please add DOCOMO as supporting company. We are also OK to remove ”(phase 1)” in WID title. Thank you for the great effort.

37 – Samsung Electronics Co.

1) Regarding the note for LS, we agree to Nokia’s comment. Suggest to remove it.

2) When we discussed on SSB-less SCell, it was clarified that no intention to introduce new L1/L3 measurements but reuse existing measurements (and RAN1 is not the responsible WG for this item). With this, it is proper NOT to add 38.215 in section 5 unless there is any other justification.

38 – Qualcomm Incorporated

Please include Qualcomm as a supporting company.

(We assume that the changes that are up for email discussion will be incorporated in the WID before the end of the meeting.)

39 – KT Corp.

Please add ”KT Corp” in the list of supporting companies. Thanks for your efforts.

40 – Panasonic Holdings Corporation

Please add ”Panasonic” as supporting company.

41 – NEC Corporation

Please add NEC as a supporting company. Thank you for your great effort.

42 – III

Please add III as a supporting company.

43 – Telstra Limited

Please add Telstra as a supporting company - thank you

44 – LG Uplus

Please add LG Uplus as a supporting company. Thanks for your efforts.

45 – CEWiT

Please add CEWiT as supporting company. Thank you for your efforts.

46 – TURKCELL

Please add Turkcell as a supporting company. Many Thanks

47 – Fraunhofer IIS

Please add Fraunhofer IIS and Fraunhofer HHI as supporting companies. Thank you very much fro your great effort.

48 – HUAWEI Technologies Japan K.K.

[As Rapporteur]

There was mistake in the time budget when referring to RP-220980 on the TUs for RAN4 106bis which was shortened by excel due to small front and shown as larger values. Now it is fixed as in Time_budget_request_for NES WI-update per RP-220980-fix.xls

49 – Samsung Electronics Co.

(as moderator)

Thanks for all your efforts!

50 – InterDigital

Please add InterDigital as a supporting company if it is not too late.