[98e-30-BWP-WithoutRestriction] - Version 0.0.3

RAN

https://nwm-trial.etsi.org/#/documents/8328

3GPP TSG-RAN Meeting # 98-e DRAFT of RP-223470

Electronic Meeting, December 12-16, 2022

Title: Summary for [98e-30-BWP-WithoutRestriction]

Agenda item: 9.11 (input documents under 9.11 and 9.3.4.6)

Source: Moderator (Vodafone)

Document for: Information

1 Introduction

This NWM discussion will focus on how to handle BandWidth Parts without Restrictions, based on the following 12 documents.

Table 1:

9.11	NR UE capabilities	RP□222725	LS on BWP operation without bandwidth restriction (R4-2220437; to: RAN; cc: RAN2, RAN1; contact: vivo)	RAN4
		RP□222923	Support of BWP without restriction	Qualcomm Incorporated
		RP□222963	On BWP without restriction	Nokia, Nokia Shanghai Bell
		RP□223030	Consideration on solutions for BWP operation without bandwidth restriction	OPPO
		RP□223074	Discussion on options for ”bwp-WithoutRestriction”	CMCC

		RP□223113	Discussion on BWP operation without restriction	vivo
		RP□223149	Discussion on BWP operation without bandwidth restriction	CATT
		RP□223175	On BWP without restriction	Apple
		RP□223248	Discussion on BWP without Restriction	MediaTek Inc.
		RP□223366	Way forward on solution for BWP operation without restriction	Ericsson

Table 2:

9.3.4.6	RP□223172	Motivation of WID revision for R18 eFeRRM	Apple	discussion
	RP□223173	Revised WID: Even Further RRM enhancement for NR and MR-DC	Apple	RP□221696

2 Background

From the draft report of RAN#97:

*- **BWP operation without restriction**: RAN #96 tasked RAN1/2/4 to ensure that Feature Group 6-1a "bwp-WithoutRestriction" works in an early implementable form in R18, or, possibly R17, and report progress to RAN #97. Based on LS in RP-221908 from RAN1 and RP-221911 from RAN4 this was further discussed and concluded (RP-222630).*

The following is the conclusion in RP-222630, with the 4th major bullet outlining the next steps:

- No new solution for FG 6-1a shall be added to Rel-17
- If CSI-RS based RLM/BM/BFD are supported by a UE, FG6-1a can work without any issue. FG1-7

(CSI-RS based RLM) and FG 2-24 (SSB/CSI-RS for beam measurement) are mandatory with capability signalling features.

No change to TU allocation for current RAN4 work in Q4 2022. RAN asks RAN 4 to do a high level analysis of the options (copied below) in RAN 4's answer to Q2 in RP-221911 and report it to RAN#98 for RAN decision.

Options from RP-221911:

a) Perform BM/RLM/BFD based on CSI-RS within active BWP

b) Perform BM/RLM/BFD based on SSB outside active BWP

i) UE's capability to operate using larger BW covering SSB outside active BWP, or a UE that is equipped with a separate RF chain

ii) BM/RLM/BFD on SSB outside BWP are performed with shared MG or NCSG for L3 measurement, or dedicated MG or NCSG for RLM/BFD/BM measurements.

c) NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD

In their two meetings in October and November RAN 4 have made progress on the above task and their report to this RAN#98e is in the LS in RP-222725=R4-2220437.

During the RAN 4 discussions, the above options from RP-221911 were expanded and then downscoped into the following candidates (below). The categorisation (below) is used by all of the input contributions on this topic in agenda item 9.11.

- *Candidate options*
  - *Option A) Perform BM/RLM/BFD based on CSI-RS within active BWP*
  - *Option B) Perform BM/RLM/BFD based on SSB outside active BWP*
    - *Option B-1) UE's capability not requiring additional measurement gap for BM/RLM/BFD*
      - *Option B-1-1) Using larger BW covering SSB outside active BWP without interruptions*
      - *Option B-1-2) Using larger BW covering SSB outside active BWP with interruptions*
    - *Option B-2) BM/RLM/BFD on SSB outside BWP within measurement gaps*
      - *Option B-2-2) Dedicated MG or NCSG for RLM/BFD/BM measurements*
  - *Option C) NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD*

3 Round 1

3.1 discussion and questions

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From a review of the input documents on this topic in agenda item 9.11 (i.e. not the 2 documents related to proposed WID updates) the moderator observes some majority opinions but no absolute consensus across the contributors. As many of the discussions have already been held and opinions formed, the moderator suggests the following questions in order to attempt to identify a way forward on this topic.

There were relatively few companies who submitted contributions promoting B-1-2 and B-2-2, so, can we downscope and decide to stop discussing B-1-2 and B-2-2?

Q1: Can we stop discussing B-1-2 as a candidate for Rel-18 standardisation?

Feedback Form 1:

1 – Nokia Corporation Support. The need for interruptions make B1-1-2 unattractive to use in the network.
2 – MediaTek Inc. Yes. Top 3 preferences from RAN4 LS are A, C and B-2-2 (NCSG), as clarified in RP-223248. We can focus on them and drop all others.
3 – Qualcomm Incorporated Yes. Although we do not have objections to discussing this option (B-1-2) but we are fine if the discussion of it stops. We would like to focus the discussion on B-1-1.
4 – Apple AB we should discuss B-1-1, B-1-2 and B-2-2 as a package. we are fine to drop all of them. However, if B-1-1 is included, we should at least include either B-1-2 or B-2-2. Otherwise, if SSB outside of BWP is configured, UE has no choice but to implement the more power-consuming option B-1-1. RAN4 features or requirements should not limit or restrict UE to a specific implementation.
5 – Classon Consulting [for FUTUREWEI] agree with Apple
6 – Guangdong OPPO Mobile Telecom. Support option A, C, and B-1-1 as high priorities. Compared to B-1-1, either option B-1-2 with interruption or option B-2-2 with NCSG also provides the feasibility of UE implementation. Also fine to include at least one of them if allowed.
7 – China Telecom Corporation Ltd. Yes. B-1-2will bringunpredictable interruption and system performance loss.
8 – Beijing Xiaomi Mobile Software We are fine to drop B-1-2 if this is the majority view.

9 – NTT DOCOMO INC.

We are fine to drop B-1-2 and share same view with Nokia and China Telecom.

10 – Fujitsu Limited

We are fine to drop B-1-2, which is not attractive from network perspective.

11 – CATT

Yes, we think some down selection is needed and we support to drop B-1-2 which is less attractive.

12 – vivo Mobile Communication (S)

The Option A, C are top priorities. Option B-1-1 can also be considered due to interest from industries. B-1-2 can be dropped due to negative impact to system performance.

13 – China Mobile Com. Corporation

Yes. Downselection on options are necessary. We support to drop B-1-2.

14 – Samsung Electronics Co.

Among above options, our preference as following:

- 1st preference: option A only
- 2nd preference: option A, option B-1-1, or Option B-2-2 based on UE capability

The detailed reason for our preference as following:

- As indicated in RP-222725 from RAN4 LS, with RAN4 analysis from 4 aspects (RRM requirements impact (Spec impact) / workload in RAN4, Mobility performance impact, Throughput impact (Data interruption) and UE power consumption / UE complexity) , option A is most attractive solution with low impact for all above 4 aspects. Also option A already supported in existing specification, and adopted for Rel-17 and option A shall be considered as default solution regardless whether new additional solutions can be considered.
- In additional to option A, based on feedback from other companies we are fine to consider other candidate options i.e. option B-1-1 as proposed by some infra-vendors and operators meanwhile we also pointed out option B-1-1 has worst impact on UE complexity and power consumption. For compromise, probably both option B-1-1 and B-1-2/B-2-2 can be considered as optional features.

15 – KDDI Corporation

We are fine to drop B-1-2, which is not attractive from network perspective.

16 – Ericsson LM

Yes we support the proposal to drop B-1-2. B-1-2 has major impact on network performance due to interruption. All the Options are independent so they should be assessed on their individual merits and demerits.

17 – Spreadtrum Communications

Yes. How to define the interruptions is not clear, e.g. whether they are like the MGs?

18 – ZTE Corporation

Agree

19 – NEC Corporation

We are fine to drop B-1-2 since it seems not so attractive due to interruption.

20 – Intel Corporation (UK) Ltd

Yes, we agree to down-scope B-1-2

21 – Telia Company AB

We agree to drop B-1-2.

22 – Huawei Technologies Sweden AB

We are fine to remove B-1-2, with our priorities being Option C or B-2-2. Agree with Apple comment on the implementation limitation, which shall be avoided.

23 – VODAFONE Group Plc

(as Vodafone) yes

24 – BT plc

Support. Option B-1-2 will reduce throughput in a way that it is not a realistic option for deployment.

Q2: Can we stop discussing B-2-2 as a candidate for Rel-18 standardisation?

Feedback Form 2:

1 – Nokia Corporation

Support. The need for measurement gaps (interruptions) make B-2-2 unattractive to use in the network.

2 – MediaTek Inc.

No. B-2-2 NCSG should be kept for further discussion, as clarified in RP-223248. But we can drop B-2-2

MG since better metrics are already achieved by B-2-2 NCSG.

3 – Qualcomm Incorporated

Yes. Similar feedback as for B-1-2. Although we do not have objections to discussing this option (B-2-2) but we are fine if the discussion of it stops. We would like to focus the discussion on B-1-1.

4 – Apple AB

similar feedback as B-1-2. Feedback Form 1

we should discuss B-1-1, B-1-2 and B-2-2 as a package. we are fine to drop all of them. However, if B-1-1 is included, we should at least include either B-1-2 or B-2-2. Otherwise, if SSB outside of BWP is configured, UE has no choice but to implement the more power-consuming option B-1-1. RAN4 features or requirements should not limit or restrict UE to a specific implementation.

Post

5 – Classon Consulting

[for FUTUREWEI] agree with Apple

6 – Guangdong OPPO Mobile Telecom.

Similar feedback as for B-1-2.

7 – China Telecom Corporation Ltd.

Yes. B-2-2 is not very attractive for operators, and it bring additional workload to RAN4.

8 – Beijing Xiaomi Mobile Software

No. Compared with B-1-1, B-2-2 has low power consumption. But if we go with option A or C, we are fine to drop B-2-2.

9 – NTT DOCOMO INC.

We are fine to drop B-2-2 and share same view with Nokia and China Telecom.

10 – Fujitsu Limited

We are not sure which option will remain after this dropping discussion, but B-1-1 is more attactive than B-2-2 from network perspective and hence B-2-2 can be dropped.

11 – CATT

Yes, we think some down selection is needed and we support to drop B-2-2 which is less attractive. We think no matter NCSG or MG configured for serving cell measurement is strange and not typical, it is not preferred from NW perspective.

12 – vivo Mobile Communication (S)

The option C and option A are top priorities. Option B-1-1 can also be considered due to interest from industries. B-2-2 can be dropped due to large negative impact to system performance.

13 – China Mobile Com. Corporation

Yes. We support to drop option B-2-2 for downselection.

14 – Samsung Electronics Co.

As commented in Q1, we are fine either removing all options in option B ; or considering both option B-1-1 and B-2-2

15 – KDDI Corporation

We are fine to drop B-2-2 and share same view with Nokia and China Telecom.

16 – Ericsson LM

Yes also support the proposal to drop B-2-2. B-2-2 has major impact on both UE and network implementations. Another drawback is that B-2-2 will require significant amount of work in RAN4.

17 – Spreadtrum Communications

Yes. The MG may complicate NW/UE complexity, and some activities of UE processing SSB may be UE autonomous behaviors.

18 – ZTE Corporation

Agree

19 – NEC Corporation

We are fine to drop B-2-2.

20 – Intel Corporation (UK) Ltd

Yes, we agree to down-scope B-2-2

21 – Telia Company AB

Support to drop B-2-2.

22 – Huawei Technologies Sweden AB

No, subject to the outcome of the discussion on the solution(s) to consider. If B-1-1 would be considered, it is also or more reasonable to support B-2-2 to allow full UE power saving in a scenario where NCD-SSB is not transmitted. B-2-2 is preferred over B-1-2 because it avoids the autonomous interruption which is difficult to handle from NW perspective.

23 – VODAFONE Group Plc

(as Vodafone) as Nokia, support to drop B-2-2

24 – BT plc

Support. Similar reasons than Q1

Regarding option A, discussion at RAN #97e had assumed that it was completely specified. However, during the subsequent RAN 4 discussions some doubts were raised about some smaller aspects. Most companies appear to support the adoption and completion of option A. However, no one commented whether any capability signalling would be needed for any Release 18 completion aspects.

Q3: Should RAN plenary request RAN 4 to complete their checks of option A and, if some things are missing, complete option A in Rel 18?

Feedback Form 3:

1 – Nokia Corporation

What is the assumption for SSB-based intra-frequency mobility measurements?

If the UE cannot use own-cell SSB for BM/RLM/RLF when it is outside of its active BWP, it would seem natural to assume that it cannot perform SSB-based intra-freq neighbour detection/measurements without interruptions/gaps. If so, this option becomes even worse than B-1-2/B-2-2 as it needs additional signals to be transmitted by the network AND it still needs constant measurement gaps/interruptions to track intra-freq neighbours.

If the Option A UE can perform SSB-based intra-freq neighbour detection/measurements without gaps/interruptions, then the UE would seem to be by definition also capable for Option B-1-1 and it would not need the additional CSI-RS for BM/RLM/RLF.

Hence we don't see Option A as an interesting direction to spend additional RAN4 work either.

2 – MediaTek Inc.

No further check is needed – CSI-RS-based RLM/BFD/BM is already specified and supported (as was also indicated in earlier meetings) as indicated by RAN4.

On neighbor cell measurements, RAN4 already discussed mobility performance impact and marked low impact for all solutions. RAN4 has the understanding that a UE supporting B-1-1 may still require measure-

ment gaps for inter-band measurements, depending on network deployments. Given that RAN4 already agreed not to mix L1 and L3 measurements, we would suggest RAN plenary not to repeat RAN4 discussion and make decision based on the information provided in RAN4 LS.

3 – Qualcomm Incorporated

We think that similar to B-1-2 and B-2-2, the discussion of Option A can be de-prioritized for the following reasons:

Option A is not good for Network Energy Savings. It requires to transmit yet another always-on signal, the need for which could be easily avoided.

Option A is not good for minimizing gaps or interruptions (compared to any other option), since the UE will anyhow have to measure the SSB for RRM, as Nokia pointed out. Since the UE anyhow measures SSB for RRM, unclear why forcing to use CSI-RS for RLM, wasting both gNB power and UE battery, should be promoted.

4 – Apple AB

it is worrisome that some companies suggest CSI-RS based BM/RLM/RLF is not needed or can be deprioritized. it is noted that opiton A is the existing solution that can have been implemented. As a general practice, newly introduced feature should not impact on the existing feature.

Based on RAN4 discussion, no further check in RAN4 is needed.

5 – Classon Consulting

[for FUTUREWEI] we should use our existing features (A and then C) before developing new ones.

6 – Guangdong OPPO Mobile Telecom.

Share the views of most companies that option A is the existing solutions. Further enhancement of it such like timing requirements seems not an urgent issue.

7 – Beijing Xiaomi Mobile Software

Agree with other companies that option A is existing feature. There is no need to check it in RAN4.

8 – NTT DOCOMO INC.

We also think further check of option A is not necessary or at least it should be low priority.

9 – Fujitsu Limited

We also think Option A is an existing feature, and we want to understand better what needs to be done in RAN4 before tasking so.

10 – CATT

Share a similar view with MediaTek and Apple that option A is an existing solution which has been implemented, and also it has been reached consensus in RAN#97 that if CSI-RS based RLM/BM/BFD is supported by a UE (i.e. option A), FG6-1a can work without any issue, so no further check is needed in RAN4.

11 – vivo Mobile Communication (S)

As concluded in RAN4 LS, further study is needed to decide on whether timing requirements may need to be updated.

Technical issues are provided as below.

According to existing requirements, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE during the last 160 ms. In our understanding, the requirements were only specified for UE supporting FG6-1 that there should be SSB within active BWP. For UE supporting FG 6-1a, when CD-SSB is not in the active BWP, measurement gap should be configured for intra-frequency and serving cell measurement. Some UEs may use measurement gap to acquire DL timing together with L3 intra-frequency measurement. For example, for RedCap UE which the supported maximum bandwidth is 20MHz, it was agreed that when SSB is not within the active BWP measurement gap should be configured. However, no similar conditions are specified in existing timing requirements for normal UE. Moreover, even if measurement gap is configured, e.g., for intra-frequency measurement, the gap periodicity could be configured as 160ms, or periodicity of SSB itself could be 160ms. There could also be other inter-frequency measurements with gap on multiple frequency layers being configured. In these cases, UE could not meet timing tracking requirements as SSB would not be available during 160ms due to that gap would be used for measurements on other frequency layers. Otherwise, measurement delay requirements for inter-frequency layers may not be met.

Thus, RAN plenary should request RAN 4 to complete their checks of option A and complete option A in Rel 18.

12 – Nokia Corporation

There are several companies saying that option A) is existing, and some companies are saying that questions related to mobility measurements should be ignored. We agree that option A) is (essentially) existing, IF the SSB-based mobility measurements do not lead to interruptions or need measurement gaps and the UE with SSB outside of its active BWP can be considered to work exactly the same as if the SSB was within its active BWP for intra-freq mobility. However, it appears that this assumption is not commonly held, meaning that additonal RAN4 work is needed (as pointed out by Vivo), the network needs additional always-on signals (as pointed out by Qualcomm) and the network has to cope with performance-degrading intra-frequency SSB measurement related interruptions (or measurement gaps).

It is worth noting that the UE must search for and measure intra-frequency signals all the time, whereas the inter-frequency measurements are there only when the gNB initiates inter-frequency search. Hence the comparison of intra-freq measurement gaps/interruptions to those of inter-freq is misleading.

13 – China Mobile Com. Corporation

We do not think additional work is needed for CSI-RS based measurement. If further confirmation is necessary, we are OK to let RAN4 have checks on optionA.

14 – Samsung Electronics Co.

We would like to highlight in previous RAN-P we already concluded (conclusion in RP-222630) option A is only option in Rel-17 and no issues identified which means option A shall be considered as baseline option A regardless new options needed or not in Rel-18.

Option A already supported by existing specification, from Samsung we didn't see any further check needed for option A.

If companies have request, we can further discuss in RAN4 any RAN4 RRM requirements need to be clarified or added for option A, but there is nothing to be check for the feasibility on option A.

Also as mentioned by other companies, from RAN4 response LS, the impact on RRM mobility for option A is low, which shall address the comments from Nokia.

15 – KDDI Corporation

We share the view with docomo, further check of option A is not necessary or make it low priority.

16 – Ericsson LM

We also share the view of most of the companies that no further work on option A is needed in RAN4. No further RAN4 clarification is needed. Option A is an existing feature and can be implemented/used if needed.

17 – China Telecom Corporation Ltd.

We also think CSI-RS based measurement is a existing feature.

For the timing requirement issue mentioned in RAN4 LS and explained by vivo, we can further check in RAN4.

18 – Spreadtrum Communications

It can be postponed until the final option(s) is decided in RAN plenary.

19 – ZTE Corporation

We understand there is disagreement on whether Option A is already fully supported or if anything is missing in RAN4. So, if we want to consider this as a possible option, we are ok to ask RAN4 to continue checking if anything is missing for Option A

20 – NEC Corporation

Our understanding is that option A is already there and don't see needs for further checking it again.

21 – Intel Corporation (UK) Ltd

Yes, we agree with moderator proposal and support that RAN plenary requests RAN4 and other WGs (if needed) to complete option A in Rel-18 and make sure that UEs can make the measurements.

22 – Huawei Technologies Sweden AB

As new solutions are considered for Rel-18 and it has been concluded in RAN#97 that option A is already supported in Rel-17, any missing bits (i.e. only a clarification on the timing requirements applicability seems to be needed) for option A may be better addressed as Rel-17 maintenance.

23 – VODAFONE Group Plc

(as Vodafone) support getting RAN 4 to check and complete option A.

Q4: Would a new Rel 18 signalling capability bit be needed to indicate support for anything that was missing in option A in Rel 17?

Feedback Form 4:

1 – Nokia Corporation

Potentially yes.

Does the FG6-1a UE need CSI-RS for BM/RLM/RLF when the SSB is not within the active BWP?

Does the FG6-1a UE need measurement gaps or interruptions for intra-freq mobility measurements when the SSB is not within the active BWP? If so, the requirements may need to be defined.

2 – MediaTek Inc.

No new capability is needed. The only capability update needed is to clarify CSI-RS based RLM/BFD/BM are prerequisites for FG6-1a.

3 – Qualcomm Incorporated

Have no strong view on whether new bit for Option A is needed. Given that we think any discussion of Option A can be de-prioritized, since Option A is not supporting network power saving goals nor does it reduce interruptions, we are ok with not adding any bit in support of Option A.

However, a new bit is needed for B-1-1.

4 – Apple AB

option A is an existing solution. No additional signaling is needed.

5 – Classon Consulting

[for FUTUREWEI] no new signaling

6 – Guangdong OPPO Mobile Telecom.

Probably not. But it also depends on the conclusion of Q3 whether any new requirements were involved.

7 – Beijing Xiaomi Mobile Software

No new signalling

8 – CATT

No new signaling is needed.

9 – vivo Mobile Communication (S)

It can be discussed in RAN WG meetings. In general, if new timing requirements for option A are specified in Rel-18, then Rel-18 and onwards UEs should meet the new timing requirements when supporting option A for BWP operation without CD-SSB. However, Rel-15/16/17 UEs can only meet the existing timing requirements. It means network configuration is restricted from configuring measurement gap and measurement objects which may cause UE not being able to meet the existing timing requirements.

If anything new related to option A is supported from Rel-18, it needs further discussion how it can be handled.

10 – Nokia Corporation

We agree that there may not be any necessity for a new capability, if the implications to FG6-1a can be clarified and there is no disagreement on what FG6-1a means. (support for CSI-RS based BM/RLM/RLF, interruptions/measurement gaps related to mobility measurements, etc.). If, however the needed clarifications are controversial and there are different understandings on what FG6-1a actually means we may need a new capability for option A). However, we share Qualcomm's view that additional work on option A) FG6-1a could be down-prioritized as likely something that is not of practical use in the networks anyway.

11 – China Mobile Com. Corporation

No capability signaling is needed. Firstly, we do not think anything is missing. Secondly, as company commented, timing requirements need further check. We had discussed before that supporting RAN4 requirements should not be a UE capability. Hence, no matter anything is missing or not, no capability signaling is needed.

12 – Samsung Electronics Co.

We didn't see any needs on new capability signaling in additional to existing feature 6-1a. For CSI-RS based on BM/RLM/BFD, feature 1-7 and 2-24 are mandatory features.

13 – Ericsson LM

We do not see need for any new capability signaling. As responded to Q3, we do not see any work in needed in RAN4.

14 – Spreadtrum Communications

May not

15 – ZTE Corporation

We think it really depends on what is missing (By the way, if a Rel-18 capability is finally deemed as needed, we assume this means the functionality is considered as broken in earlier releases)

16 – NEC Corporation

Before discussing it, it may be good to check whether there is anything new in Rel 18. If the answer is no, then not need to introduce new signaling capability bit.

17 – Intel Corporation (UK) Ltd

We think that new capability signalling can be one possible solution to make sure that UEs can make CSI-RS based measurements. Another approach is to update an existing capability to mandate that a UE supporting FG 6-1a should also support CSI-RS-based RLM/BM/BFD.

18 – Huawei Technologies Sweden AB

It would be good to reach consensus on this question as missing signaling for Option A would mean that RAN4 LS content was not correct – it said that Option A was already supported. We understand no new capability signaling is needed.

19 – BT plc

No, as our understanding is that nothing new has been defined.

No company seems to challenge the output of RAN 4 in their LS in RP-222725, however, two documents (RP-222963 Nokia, and RP-223366 Ericsson) discuss the network and operational complexity aspects that were not included in the request to RAN 4.

Q5: Please provide any technical concerns or comments (or agreement) with the points about network and operational complexity raised in RP-222963 and RP-223366.

Feedback Form 5:

1 – Nokia Corporation

As the originators of 2963, our main concerns with many of the options are two-fold for the system operation:

1. The need for new signals that the system needs to implement and integrate with the existing transmissions. to support a sub-set of devices This adds overhead and R&D effort when we can always configure the UE so that the SSB is within the active BWP and trust that 100% of the UE base works fine.

2. The need for interruptions/measurement gaps (not just for the BM/RM/RLF, but also for intra-freq mobility) that will diminish the attractiveness of the feature to be deployed. In addition to the obvious performance loss there is a need for additional network implementation effort for this sub-set of devices to manage these gaps/interruptions, when we can configure these UEs always with a BWP that contains the SSB.

Thus, in our view, if a particular UE population needs measurement gaps or interruptions for intra-freq

mobility and/or for BM/RLM/RLF when the SSB is not within the active BWP, then it is very likely that these UEs will never be configured with such a BWP.

2 – MediaTek Inc.

Network and operational complexity aspects were discussed in RAN4 and RAN4 agreed to focus the analysis on the points identified in the LS. We see the analysis from RAN4 is therefore complete.

Our understanding is that network can either reuse the CSI-RS for FG6-1a or apply FG6-1 (wideband BWP). There is no additional network and operational complexity mandated. We do not see the need to reopen the technical discussion in RAN Plenary.

3 – Qualcomm Incorporated

No specific comments on the contributions, but would like to point out that only B-1-1 can meet the requirements raised in them. Although Option A may also be argued to meet the requirements but it requires adding more signals while not offering any benefits.

4 – Apple AB

NW impact can be one of the aspects to evaluate different options. If necessary, we are fine to give RAN4 extra time to evaluate this. However, the eventual decision should be made all rounded by taking different aspects into consideration.

5 – Guangdong OPPO Mobile Telecom.

Agree with Apple.

6 – Beijing Xiaomi Mobile Software

Agree with MediaTek

7 – NTT DOCOMO INC.

We share similar view with Nokia that some options requiring additional transmission of RS and/or interruption/gap for BM/RLM lead to the increase of overhead, NW operation effort and implementation effort. Therefore, as commented, we are fine to drop or deprioritize those options.

8 – CATT

The network and operational complexity are not included in the RAN4 high-level analysis, but they can be considered when discussing the downselection. So the interruption-based and MG-based solutions are not preferred due to the large network impact.

9 – vivo Mobile Communication (S)

Network impact was considered in RAN4 discussions. For example, mobility performance impact should be considered as system criteria and thus also impact to network. Throughput loss can also be considered from network perspective, though only impact from UE side were concluded and captured in RAN4 report.

It should be enough to decide the options to be supported based on RAN4 high-level analysis. Regardless of how many further analyses is done, there has to be trade-off being considered.

In addition, for option C the NCD-SSB overhead is quite small. Even considering SSB periodicity of 20ms, the overhead is less than 1% considering CBW larger than 50MHz. Usually, NCD-SSB periodicity is supposed to be longer than CD-SSB, which means the overhead could be less than 0.5%.

For Option A, CSI-RS resources are typical has larger bandwidth, shorter periodicity and narrower beams than NCD-SSB, and it would be expected that it has larger overhead than NCD-SSB.

10 – Samsung Electronics Co.

We can understand the points raised by some infra-vendors for network and operational complexity, that's the reason we are open to consider other candidate options in additional to option A even we didn't saw any issues with existing solution. On the other hand, as indicated in RAN4 LS, the analysis from RAN4 consider several aspects including UE complexity/power consumption as well.

In the end, if RAN can't narrow down with single solution, one compromise solution is to introduce several options with UE capability.

11 – KDDI Corporation

We share the view with Nokia.

12 – Ericsson LM

As proponent of RP-223366, our main concern is that RAN4 analysis did not consider the network complexity of implementing different options. For example, as L1 measurements are done periodically all the time. This means Option B-1-2 will cause regular interruptions unknown to the network and resulting in throughput loss, loss of grants, loss of CSI/HARQ feedback etc. Then B-2-2 has quite a lot of complexity of handling dedicated gaps for L1 measurements given that there will also be gaps for L3 measurements i.e. concurrent L1 and L3 gaps will be needed. Option C will require NCD-SSB implementation in all the cells in all the networks increasing significant implementation effort and overheads.

13 – Spreadtrum Communications

Supportive for the views in two contributions. In our view, some activities of UE processing SSB of serving cell may be UE autonomous behaviors.

14 – ZTE Corporation

We don't have further comments on top of those raised in the mentioned contributions and we are supportive of B-1-1.

15 – Intel Corporation (UK) Ltd

Options A and C would require transmission of additional signals by gNB (CSI-RS or NCD-SSB), but the overall impact on the network complexity is expected to be reasonable.

16 – Huawei Technologies Sweden AB

In our view, this topic was already sufficiently addressed by RAN4. Two points in short: 1) any option discussed here is up to NW implementation, and NW always has the option to place a UE in a BWP with SSB, so no forced implementation or efforts; 2) placing UE in a BWP without SSB is motivated by power saving but not performance improvement or overhead reduction.

Assuming that the above network and operational aspects are broadly accepted as being important factors, they indicate a reason to support B-1-1. While RAN 4 highlight that B-1-1 has a negative impact on UE battery consumption, several UE equipment makers support B-1-1, so presumably the battery impact is tolerable to them and/or can be mitigated by implementation means.

One potential way forward is that the specifications for Option B-1-1 are completed in Release 18, but, that it is clearly documented that this is an **optional** feature.

Q6: Please indicate your views on specifying B-1-1 as an optional feature in Rel-18.

Feedback Form 6:

1 – Nokia Corporation

It should be obvious that all non-RedCap UEs can support a BWP that includes the SSB, no matter what the BWP bandwidth. This always allows the network to configure the active BWP to be wide enough to contain the SSB. The choice of configuring the UE with a narrower BWP when there is no need for the capacity is a compromise between network's scheduling flexibility in frequency and UE's ability to have narrower BB BW to buffer and process, but there is nothing in such a BWP configuration to prevent the UE from using the SSB even if it was not within the active BWP without any interrptions or measurement gaps.

Hence we see B-1-1 as the simplest solution for all the UEs to support and all the networks to deploy.

2 – MediaTek Inc.

Any feature, whether optional or not, should be beneficial to be specified. RAN4 reports high power consumption with B-1-1, which clearly conflicts with the target of a narrowband BWP. B-1-1 as evaluated by RAN4 is clearly inferior to other solutions, namely A, C, B-2-2 NCSG. We question the need to continue discussing B-1-1 in view of this.

In RP-223248, it further stresses B-1-1 with narrowband BWP can **only** achieve <3% power saving gain w.r.t. wideband BWP. Since existing "R15" solution with wideband BWP and reduced PDCCH monitoring can already provide better power saving gain, the need of B-1-1 solution for R18 is not justified.

We therefore cannot agree moving forward with B-1-1.

3 – Qualcomm Incorporated

Yes, we think B-1-1 should be defined as a UE capability in Rel-18. Early implementability can be discussed in addition.

In our view, the whole point of B-1-1 is to achieve significant UE power savings while avoiding any negative impacts to the network. Obviously, significant power savings is defined as much more than 3%, therefore, we respectfully disagree with the MediaTek assessment. The achievable power savings is UE implementation dependent. Because B-1-1 requires no new requirement definition, it is understood that there was no point in spending RAN4 time on assessing the real power gain.

4 – Apple AB

As a general assumption in RAN4, interruption is considered when UE's bandwidth, carrier frequency and/or numerology is changed or when RF chain is power on/off. This assumption is taken as UE's minimum requirement for many features, including but not limited to, BWP switching, SCell activation, Tx switching etc.

When no interruption is allowed in B-1-1, as a minimum requirement, it should be assumed UE's bandwidth and carrier frequency should be kept unchanged. This will require UE to stay with wider BW all the time.

it is still questionable for us if such a feature should be introduced when RAN4 has concluded it is the option with the highest UE power consumption.

5 – Classon Consulting

[for FUTUREWEI] do not support

6 – Guangdong OPPO Mobile Telecom.

Generally fine.

7 – China Telecom Corporation Ltd.

We support specifying B-1-1 as an optional feature in Rel-18, and disucss the early implementation further.

8 – Beijing Xiaomi Mobile Software

No. We have concern on the power consumption of B-1-1.

9 – NTT DOCOMO INC.

We support specifying B-1-1 as optional feature in Rel-18. It is the most attractive option as it can avoid any negative impacts to NW.

10 – CATT

We are fine to specify it as an optional feature in R18.

11 – vivo Mobile Communication (S)

If the feature is supported in Rel-18, it should be an optional feature.

We are fine to introduce B-1-1 considering interests from industries. As concluded by RAN4 LS, Option C and Option A have less power consumptions and UE complexity impact comparing with option B-1-1.

Following RAN4 study, B-1-1 should not be the only optional feature. To respect RAN4 study, we suggest to consider option A, C and B-1-1 as a package to be specified in R18.

12 – Nokia Corporation

We forgot to comment on the ”optional” part of the question. Yes, we agree this should be an optional feature. If a particular UE implementation architecture cannot achieve any power saving gain, or for other reasons the implementation/testing effort is considered not worth it, then the UE would choose not to support the feature. On a general note, we agree with Qualcomm’s comment.

13 – China Mobile Com. Corporation

OK to have B-1-1 as optional feature in Rel-18.

14 – Samsung Electronics Co.

As commented in Q1 and Q5, we are fine to consider option B -1-1 as additional optinal solution in additional to existing solution option A (as optional feature with UE capcability).

15 – KDDI Corporation

We support specifying B-1-1 as an optional feature in Rel-18.

16 – Spreadtrum Communications

No. Option A) or C) is our first preference from perspective of UE complexity and power consumption.

17 – Ericsson LM

We support Option B-1-1 as optional capability. Compared to the case when SSB is within BWP (existing solution/specs), the overall UE power consumption will not be very significant because firstly the UE RF front end is also on over the BW of the BWP and secondly, typically the UE is always configured with DRX cycle and most power saving is achieved in the time domain.

18 – MediaTek Inc.

Some further response for reflecting the truth:

- **B-1-1 is the only solution marked with ”high UE power consumption” as indicated in RAN4 LS**. It is RAN4 view instead of a particular company’s view
- The whole discussion is about BWP, and **R15 already provides complete solutions with flexible BWP configuration**:
  - If CSI-RS available in NW and UE supports CSI-RS for RLM/BFD/BM,
    - NW can configure **narrowband BWP** with only CSI-RS for RLM/BFD/BM
  - **else**

- NW can configure **wideband BWP with reduced PDCCH monitoring**

B-1-1 somehow ignores existing solutions and enforces NW to configure narrowband BWP and UE to apply WB RF. The high UE power consumption doesn't justify any need of B-1-1. Capturing the above available R15 solutions can instead be a better way forward to conclude this issue.

19 – ZTE Corporation

We agree a new UE capability (i.e. optional feature) can be introduced for this. We think it could also be supported in Rel-17, as the specification impacts to both RAN2/4 are very limited.

20 – NEC Corporation

Yes, we support to specify B-1-1 since it is the simplest way to move forward assuming the UE is capable of wider BW transmission/reception.

21 – Intel Corporation (UK) Ltd

Our first preference is to specify a single solution in Rel-18 or at least keep the number of solutions minimum to avoid fragmentation of possible UE/NW implementations. Our first preference is to introduce either Option A or Option C solutions.

The Option B-1-1 benefits for the network implementations are clear. However, it is our understanding additional studies in RAN4 are required (e.g., on UE complexity and power consumption, feasibility of interruption-less operation) and it is not preferable from the workload perspective.

In addition, we expect that any feature to be defined in Rel-18 will be introduced as an optional feature.

22 – Huawei Technologies Sweden AB

Similar to some comments above, we also question the B-1-1 from the UE power consumption point of view, as concluded by RAN4 LS. Therefore, we see no need to pursue it.

23 – VODAFONE Group Plc

(as Vodafone) support completing B-1-1

24 – BT plc

we agree with first Nokia's comment. Fine to support this as an option Rel-18 feature

Option C (NCD-SSB) has a reasonable level of support but at least RP-222963 (Nokia) highights concerns about the extra overhead signalling created by the use of NCD-SSB. To also allow companies who did not submit written contributions to this meeting to state their views, will everyone please respond to the following question.

Q7: Please indicate your (brief) views on specifying option C as an optional feature in Rel-18.

Feedback Form 7:

1 – Nokia Corporation

Nokia concern is not just the extra overhead of the NCD-SSB, but

- Unless the NCD-SSB is deployed as a static signal in a cluster of cells in the same PRBs, the UE would need to rely on the CD-SSB of the other cells for mobility measurements. This would either imply measurement gaps/interruptions, or if no gaps/interruptions are needed to search/measure intra-freq neighbour CD-SSB, then no such need is in place for BM/RLM/RLF measurements based on own-cell CD-SSB either.
- The network has to implement support for multiplexing all the transmissions to the UEs not using NCD-SSB with the NCD-SSB. This is an additional overhead that penalizes the UEs that are not standing to gain anything, but also additional network complexity that needs to be integrated and tested with he already established functionality.

Turning on NCD-SSB in a cluster of cells when there maybe occasionally some UEs in some of the cells needing the signal is a decision that would easily become negative unless the penetration of UEs supporting the NCD-SSB and greatly benefiting from using this is very high. This further creates a chickeng&egg problem as it is not attractive to turn the signal on in the network, it is not likely for the feature-supporting UE population to start approaching 100% either.

2 – MediaTek Inc.

With solution A already in the spec, we do not see the need to introduce any new feature for the same functionality. As a compromise we are fine to go with Option C, which is a low hanging fruit by reusing the Redcap requirements. The analyzed impacts are also minimum according to RAN4 LS.

3 – Qualcomm Incorporated

No strong view on Option C. However, if there is room for a single solution only in the end then it should be B-1-1, not C.

4 – Apple AB

On top of option A which has been already specified in the current spec, we prioritize option C over the other options.

5 – Classon Consulting

[for FUTUREWEI] support along with A

6 – Guangdong OPPO Mobile Telecom.

Support

7 – China Telecom Corporation Ltd.

If it is allowed to include 3 opitons in Rel-18, we are open to consider Option C in addition to Option B-1-1 and Option A.

8 – Beijing Xiaomi Mobile Software

If we are going to choose between option A and C, we then prefer option A. But option A and C has higher priority than B-1-1.

9 – NTT DOCOMO INC.

We are open to consider option C if option B-1-1 can be supported.

10 – CATT

On top of option A, if we are going to define additional solutions, we support to specify option C. But we would like to indicate that if we specify all the solutions as optional, we need to clarify that UE has to support at least one of the solutions in R18 (FFS for early implementation) when it supports FG 6-1a, otherwise, the issue is not resolved.

11 – vivo Mobile Communication (S)

Option C has minimum system impact, especially when RedCap is supported in the network, and minimum power consumption among all the options. Even if RedCap is not supported in the network, NCD-SSB has less overhead than CSI-RS, as analysed in feedback to Q5. Thus, Option C should be top priority to be supported in Rel-18.

12 – China Mobile Com. Corporation

Option C can be the optional solution if NCD-SSB is transmitted in the network side already. So no additional overhead is expected and UE can have SSB within its active BWP. Hence, we support to specify option C in Rel-18.

13 – Nokia Corporation

For the reasons explained in our earlier comment, we cannot agree to Option C) as the solution. It is worth noting that there'd need to be a large percentage of NCD-SSB-supporting RedCap UEs in the system before there is any incentive for the network to deploy NCD-SSB and take the troubles that come with it. It is very likely that the needed RedCap device penetration will never happen and non-RedCap UEs form the large majority of the devices in the systems, in which case the RedCap deployments would not drive the NCD-SSB availability in the networks. There is no incentive whatsoever for the network to deploy (implement, integrate, test, and take the burden of the additional compexity and constant overhead) NCD-SSB for UEs that can support wider BWs. Hence option C) has in our view a high likelihood to remain a paper-only solution, if specified.

14 – Samsung Electronics Co.

We disagree to include option C. Extending NCD-SSB to non-redcap UE, just duplicated the effort without any benefits if we already consider option A, and option B in the end.

15 – KDDI Corporation

We share the view with docomo, open to consider option C additionally if option B-1-1 is supported.

16 – Spreadtrum Communications

Supportive. In Network energy savings topic, on-demand SSB (somehow like NCD-SSB) gained many companies' interests in study item. If the on-demand SSB is a tendency for energy/cost-efficient network, it can be used for BWP without restriction purpose. Besides, on-demand SSB is more friendly for UEs than the wider bandwidth at UE side.

17 – Ericsson LM

Firstly we support the idea to have only one option and support B-1-1 as replied to Q7. We have concern to add Option C (NCD-SSB) as another feature. NCD-SSB will be needed in all the cells increasing overheads since RedCap will not be prevalent in the entire network. Using NCD-SSB for all the non-RedCap UEs will require very significant implementation effort in the network.

18 – ZTE Corporation

We are fine to support this. We think we will need to clarify whether the support of option C means all NCD-SSB related functions (e.g. NCD-SSB based RACH, RRM, paging monitoring, QCL…) are applicable to non-RedCap UEs

19 – Intel Corporation (UK) Ltd

Our first preference is to specify a single solution in Rel-18 or at least keep the number of solutions at minimum. We are open to specify Option C.

20 – Huawei Technologies Sweden AB

Same as Apple. When NCD-SSB is available within the active BWP, it is clearly beneficial and straightforward to have L1 measurement based on NCD-SSB even L3 measurement may need to be performed over CD-SSB (in case NCD-SSB is not transmitted in cells in proximity). Again, support of option C does not mean NW has to transmit NCD-SSB – it is still up to NW implementation.

21 – VODAFONE Group Plc

(as Vodafone) Not opposed to option C, but see that - for network energy saving and signalling overhead reasons - implementation and deployment of NCD-SSB for Redcap UEs may take many years. Hence no urgency for option C in release 18.

WID updates: these are really dependent upon the conclusions on the above points, and so will be best to discuss in any second/subsequent round. However, initial opinions are sought on whether it would be best to modify the eFeRRM WID (as suggested in 3172/3173 by Apple, Oppo); or to have a new WID; or to use TEI-18.

Q8: Please comment on your preferred approach to documenting any future work on this topic (e.g., update of the eFeRRM WID, new WID, TEI-18, etc).

Feedback Form 8:

1 – Nokia Corporation

B-1-1 can be defined as a TEI-18.

- New UE capability
- One sentence fix in 38.300
- Potential clarification in 38.213

A) and C), if needing measurement gaps or interruptions for intra-freq mobility, become very similar to B-1-2 and B-2-2. A new WI would seem to make the best sense.

A) and C), if not needing measurement gaps or interruptions for intra-freq mobility, a TEI-18 would suffice, but then the point of A) and C) is lost and these UEs could just use the CD-SSB without gaps/interruptions.

2 – MediaTek Inc.

RAN4 specification is related to gap-less operations for measurements, which has been the focus of MG enhancements. In this regard, R18 MGE WI should be an effective WI to include the specification work.

3 – Qualcomm Incorporated

We have already provided the text changes to implement the possible agreement on B-1-1, and they are quite minimal. Therefore, we think that, after spending time in multiple Plenaries, the Plenary could just agree on the chosen solution and send proposed CRs to the WGs for checking and endorsement. We don't think a WID scope extension is needed.

4 – Apple AB

With option A, the current spec is not broken. We don't see an absolute necessity to introduce new features. To accommodate other vendors' request, we are OK to consider including option C and B-1-1/B-2-2 in R18 eFeRRM WI, since all these options can be considered as RRM enhancement.

However, we are not OK with only introducing B-1-1 since it will limit UE to a specific implementation and more importantly with higher power consumption.

5 – Guangdong OPPO Mobile Telecom.

Support to update of eFeRRM. Agree with Apple that different solutions may have impact on different features and all of them can be considered as RRM enhancement.

6 – Beijing Xiaomi Mobile Software

We are ok to update eFeRRM if specification update is needed.

7 – vivo Mobile Communication (S)

We don't have strong view. It also depends on the options to be supported in Rel-18.

8 – CATT

It depends on the solutions to be specified. If we are going to specify option A, C only, we think the specification impact is small, we can directly work on CR in TEI and no need to extend any specific WI.

9 – China Mobile Com. Corporation Depending on the outcome of downscoping, if the work can be completed in 1Q, it is possible to have TEI, otherwise, we can update eFeRRM WI.
10 – Samsung Electronics Co. It depends on this RAN-P conclusion, if RAN-P can conclude with single solution as option A only, then I believe no further work needed or TEI-18 enough without TU assignment. Otherwise, it's better to include into Rel-18 WI i.e. eFeMIMO WID from project management perspective.
11 – Spreadtrum Communications For Option A) and C), they can be both TEI-18, since no much standard efforts are forseen.
12 – Ericsson LM B-1-1 can be done as TEI18 since it requires mere clarification. Option C can also be done as TEI18 but as commented earlier it has big NW impact. Especially Options B-1-2 and B-2-2 will require big effort and will need new R18 WI. B-2-2 will require also RAN2 signaling for new L1 gaps.
13 – ZTE Corporation From RAN4 perspective, our preference is to accommodate the agreed objectives into the FeRRM WID instead of creating a new WID. If Option C is also adopted, then it depends on the answer to the observations to Q7. Our preference would be to apply all functionalities to non-RedCap UEs and we think this could be done in TEI-18.
14 – Intel Corporation (UK) Ltd TEI framework may be used for Option A due to very limited scope. For any other solutions the work can take large amount of time and a new separate WID would be the most straightforward approach to handle the issue. We prefer not to merge this topic into the existing eFeRRM WID due to possible impact on the progress for other eFeRRM objectives.
15 – Huawei Technologies Sweden AB We have no strong view on where to place the work, and Extension of existing R18 RRM WI seems a reasonable option (except for Option A aspects).

3.2 Moderator's summary of Round 1

Q1: Can we stop discussing B-1-2 as a candidate for Rel-18 standardisation?

20 of 24 companies indicated their support to stop discussing B-1-2. Of the other 4 companies, they indicated that some implementation freedom would be useful (e.g. by specifying B-1-2 or B-2-2) if B-1-1 was adopted.

Moderator's summary: we can stop discussing B-1-2 as many companies do not support its inclusion in Rel-18.

https://nwm-trial.etsi.org/#/documents/8328

Q2: Can we stop discussing B-2-2 as a candidate for Rel-18 standardisation?

18 of 24 companies indicated their support to stop discussing B-2-2. Of the companies indicating interest in B-2-2, most want it (only) if B-1-1 is supported. Mediatek requests that B-2-2 NCSG is kept for further discussion but supports the dropping of B-2-2 MG.

Moderator's summary considering my suggestion for Q6 to discuss B-1-1 in a GTW, my proposal is to also discuss whether to specify B-2-2 NCSG in the same GTW session.

Q3: Should RAN plenary request RAN 4 to complete their checks of option A and, if some things are missing, complete option A in Rel 18?

Responses were rather diverse with several companies seeming to want option A to be abandoned. However, the previous RAN plenary regarded option A as already supported in Rel 17 (RP-222630); and the RAN 4 LS indicates that "CSI-RS based RLM/BFD/BM requirements are already specified".

However, RAN 4 indicated that a low amount of effort might be needed for "Further study is needed to decide on whether timing requirements may need to be updated". While several companies that support option A seem to dispute the 'further study' statement from RAN4, no one commented to correct/challenge the issues raised by Vivo.

Moderator's proposed way forward: RAN to request RAN 4 to ensure that the technical specification work for option A is complete.

Q4: Would a new Rel-18 signalling capability bit be needed to indicate support for anything that was missing in option A in Rel 17?

Thanks for the responses on this question.

Moderator's summary: It seems that it would be best to wait to see what – if any – work is needed from RAN 4 to complete option A.

Q5: Please provide any technical concerns or comments (or agreement) with the points about network and operational complexity raised in RP-222963 and RP-223366.

There were plenty of comments but, while some people felt RAN 4 might need to be involved, there were no fundamental rejections of the issues raised by these two infrastructure makers.

Moderator's summary – there is no need to conclude on this question

Q6: Please indicate your views on specifying B-1-1 as an <u>optional</u> feature in Rel-18.

https://nwm-trial.etsi.org/#/documents/8328

There seems to be about 15 companies for specifying B-1-1, with about 6 against and 1 neutral. There is some reasoned preference for B-1-1 network infrastructure makers and support from operators, while there are UE power consumption concerns from some but not all on the UE side.

Moderator's summary: we need some GTW time to decide on what to do with B-1-1. I suggest two questions, one on specifying B-1-1 and another on specifying "both B-1-1 and B-2-2 NCSG".

Q7: Please indicate your (brief) views on specifying option C as an optional feature in Rel-18.

The views are rather evenly split: the work load from NCD SSB seems to be low, but also the likelihood of early network implementation seems, low and the benefits of NCD-SSB seem low.

Moderator's proposal: The moderator suggests to leave specification of option C to R19 or a later release when NCD SSB deployments become clearer and the opportunities for non-RedCap inter-operability testing with NCD SSB become clearer.

Q8: Please comment on your preferred approach to documenting any future work on this topic (e.g., update of the eFeRRM WID, new WID, TEI-18, etc).

Thanks for the response. It seems that we should pause this topic until we know what (if any) work we should do on this topic in Rel-18.

4 Second Round

4.1 Questions

Q9: Any strong concerns with the conclusion that "*RAN requests RAN 4 to ensure that the technical specification work for option A is complete.*"?

Feedback Form 9:

1 – Apple AB Option A has been completed and specified for long time. We think it is complete, expect for some minor issue related to timing. However, we are OK to task RAN4 to double confirm and fix it if necessary.
2 – Qualcomm Incorporated In our view, companies who plan to use Option A could bring it up directly in RAN4 if they believe anything is missing, so we don't think a request from the Plenary is necessary. However, if the majority prefers to make this conclusion, we would not object.
3 – Samsung Electronics Co. We believe Option A already be there as legacy solution supported by existing specifications, no addtional work in RAN4 forseen. If companies see some missing part, this discussion in RAN4 can be triggered by

contribution as businese as usual. We are also ok to have such RAN request even we didn't see the strong needs.

4 – Guangdong OPPO Mobile Telecom.

No concern.

5 – KDDI Corporation

We share the view with Qualcomm, proponents who plan to use option A can bring an issue directly to RAN4, if needed.

6 – vivo Mobile Communication (S)

Given the issues related to timing requirements being raised in RAN4, it is reasonable to task RAN4 to improve the specifications, if option A is agreed to be supported in Rel-18, so that the feature can actually work at least from standardization perspective. Option A is not completely ready now.

7 – CATT

Share the similar view as Samsung, option A is already supported by existing specifications and the discussion can be triggered by contributions in RAN4. But if all companies want to have this RAN request, we are OK with it.

8 – Ericsson LM

We do not see any task from RAN to RAN4 regarding Option A. We agree with some of the previous comments that companies who think there is any issue with Option A can bring this directly in RAN4.

9 – China Mobile Com. Corporation

We believe nothing is missing for optionA. We are OK with either companies bring contributions directly to RAN4 or RAN task RAN4 to discuss.

10 – NTT DOCOMO INC.

We share view with companies that there would be no strong need to have proposed conclusion as any issue with Option A can be discussed in RAN4 based on contributions.

11 – NTT DOCOMO INC.

We share view with companies that there would be no strong need to have proposed conclusion as any issue with Option A can be discussed in RAN4 based on contributions.

12 – Fujitsu Limited

Similar to other companies, Option A is a completed feature and maintenance discussion can be done in RAN4 even without any guidance from RAN.

13 – Nokia Corporation

Even though the discussions indicate that there may not be 100% common view on what the gNB can expect the FG6-1a to be capable of, and making sure that the industry is fully in alignment on what is the correct interpretation would be beneficial, we don't see a strong need to have RAN task RAN4 to continue work on the matter.

14 – Nokia Corporation

Even though the discussions indicate that there may not be 100% commonly agreed view on what the gNB can expect the FG6-1a to be capable of, and making sure that the industry is fully in alignment on what is the correct interpretation would be beneficial, we don't see a strong need to have RAN task RAN4 to continue work on the matter.

15 – China Telecom Corporation Ltd.

We support moderator's recommendation.

16 – Intel Corporation (UK) Ltd

Support moderator proposal. We think that capabilities for the feature need to be clarified at least and RAN4 discussion can be helpful to conclude on the support of the feature and identify the missing parts (if any).

17 – Spreadtrum Communications

No concern

18 – Huawei Technologies Sweden AB

As we are discussing all solutions here, there is no harm if RAN ensure completeness of the specification, especially that companies have already commented this week that some elements are missing for Option A. Therefore we support such RAN request. If we allow to "handle this in RAN4 as usual", then there is a risk that those open issue concerns remain unresolved.

19 – ZTE Corporation

No strong concern. It is also fine to discuss it based on company contributions in RAN4 (without RAN request).

20 – MediaTek Inc.

We have strong concern. There is no need of additional specification for option A.

21 – Classon Consulting

[for FUTUREWEI] Likely not needed, but no harm

The moderator proposes to request GTW time for the following two questions:

1. Shall RAN specify B-1-1 in Rel 18 as an optional feature?
2. Shall RAN specify both B-1-1 and B2-2 NCSG in Rel 18, both as optional features?

Q10: Please provide feedback and any necessary corrections/improvements to these questions.

Feedback Form 10:

1 – Qualcomm Incorporated

1) Yes, we think B-1-1 should be defined as a UE capability in Rel-18. Early implementability can be discussed in addition.

Regarding MediaTek's comments in the previous round, we note that RAN4 assumed wide RF bandwidth kept by the UE all the time, but we do not agree with that assumption. Again, the point of B-1-1 is significant power savings with appropriate implementation, while not adding gaps/interruptions, nor using unnecessary additional always-on signals wasting network energy.

2) We would not object to B2-2-2 conditioned on that it is in addition to B-1-1, not replacing it. However, given some companies concerns on multiple solutions, we would prefer not to tie these two solutions together.

2 – Apple AB

As indicated in the initial round, it is not acceptable for us to specify B-1-1 as the only option in Option B. However, we are open to including both B-1-1 and B-2-2. Otherwise, if NW chooses to only configure CD-SSB (i.e. no CSI-RS and NCD-SSB), UE has no choice but to implement the option with high power consumption. This is against the principle of RAN4 requirements not to restrict UE's implementation.

If we look at other similar requirements specified in RAN4, e.g. gap less measurement, the spec allows both with and without interruption since it is about the tradeoff between UE complexity/power consumption and spectrum efficiency/NW complexity. Such implementation flexibility should be left to UE.

3 – Samsung Electronics Co.

Both option B-1-1 and option B-2-2 have cons and pros. When driving conclusion, we need to consider the impact on both NW and UE side. We believe our proposal to consider both option B-1-1 and B-2-2 with UE capability in addtional to option A is the compromised wayforward.

4 – Guangdong OPPO Mobile Telecom.

1□support

2□Except option B-1-1, additional solution(s) with interruption or NCSG may provide more feasible implementation for UE. It depends on whether B-1-2 or B-2-2 would be agreed.

5 – KDDI Corporation

1. Yes, we think B-1-1 should be specified as an optional feature with a UE capability in Rel-18.
2. We share the view with Qualcomm, if B2-2-2 is in addition to B-1-1, not replacing it, and then we are fine to have it additionally. We don't prefer to tie these two solutions together either.

6 – vivo Mobile Communication (S)

Firstly, the feature(s) introduced in Rel-18 should be an optional feature.

We are fine to specify B-1-1 in Rel 18, but not okay to specify both B-1-1 and B-2-2 if it means other options are out of Rel-18. According to RAN4 report, B-2-2 needs at least medium standardization efforts. We don't understand to introduce almost a new feature, i.e., dedicated NSCG for L1 measurements, at this late stage of Rel-18 while there is other better ranked solution of option C which is ready or almost ready.

7 – Ericsson LM

1. We support B-1-1 as the only optional feature in R18.

2. We do not support to also add B-2-2. This will create firstly market segmentation. Secondly B-2-2 requires significant work in RAN4. Given work load in RAN4 it is unrealistic to complete it in R18. Also this has some impact in RAN2 since L1 NCSG gaps are needed.

8 – Ericsson LM

1. We support B-1-1 as the only optional feature in R18.

2. We do not support to also add B-2-2. This will create firstly market segmentation. Secondly B-2-2 requires significant work in RAN4. Given work load in RAN4 it is unrealistic to complete it in R18. Also this has some impact in RAN2 since L1 NCSG gaps are needed.

9 – China Mobile Com. Corporation

We are OK to specify option B-1-1 as optional feature in Rel-18, but we do not agree to specify both B-1-1 and B-2-2. To address this BWPwithoutrestriction issue, existing CSI-RS based solution (option A) is already supported as commented by many companies. This new option is only used to address if UE does not indicate support of CSI-RS. Introducing multiple options will cause burden also to the network side. And option B-2-2 requires significant work in RAN4 compared to B-1-1.

10 – CATT

1. we are fine to introduce B-1-1 as optional on top of option A and C.

2. But we are not OK to specify B-2-2 which will cause large RAN4 workloads (for example, whether the gap for L1 and L3 can be configured simultaneously and how to handle the collision) and higher network complexity (need to consider the gap coordination between L1 and L3). Share the same view as vivo that there is no need to define a new feature at this stage while there is other better solutions.

For the issues mentioned by Apple, we understand it didn't restrict the UE implementation. Because option B-1-1 is not the only solution, there are still option A which is already existed and maybe option C if introduced. As we commented in the first round, since all the solutions are optional, UE has to support at least one of them if it report FG 6-1a. Otherwise, the issue cannot be resolved. But UE can decide which solution to support. There is no reason for the NW to configure nothing (no CSI-RS and no CD-SSB) to UE if it reports FG 6-1a but doesn't support B-1-1.

11 – NTT DOCOMO INC.

1) We support to specify Option B-1-1 as optional feature in Rel-18.

2) We share same view with Qualcomm and KDDI that we would not object to Option B-2-2 if Option B-1-1 is supported.

12 – Fujitsu Limited

We are OK to specify something in Rel-18 if there is a demand from market. If something is specified, our preference is B-1-1 and we don't want to introduce multiple options.

13 – Nokia Corporation

1) We are OK to introduce B-1-1 as an optional Rel-18 feature

2) We are not OK to continue working on B-2-2. In our understanding B-2-2 needs additional RAN4 work, and we don't see the added value in pursuing this option that is very unlikely to be more attractive for the network to support over configuring a sufficiently large BWP to contain the SSB, rendering the standardization (and the possible implementation effort of the companies starting to look into this) as effort wasted.

Do the companies wishing to bundle the B-1-1 and B-2-2 together foresee that the UE supporting one shall support both, and the network can choose whether to prioritize the additional burden of measurement gaps when it wants to squeeze the last micro-amp out of the UE power saving, or avoid the measurement gaps when it does not see this beneficial? Or do the proponents expect that the UE picks and chooses one of the two implementations and the network would be expected to support both?

14 – Intel Corporation (UK) Ltd

Our preference is to keep the number of solutions at minimum to avoid fragmentation of UE/NW implementations. A mix of UEs with different capabilities in the field would make NW implementation very challenging, and the whole concept may become useless. We recommend to discuss during the GTW how to reduce the number of implementation options.

15 – China Telecom Corporation Ltd.

1) We support to introduce B-1-1 as an optional feature

2) We are not supportive of continuing working on B-2-2. As several companies commented, B-2-2 brings additional RAN4 workload and negative performance impact. In addition, if the networks are not going to upgrade to be able to configure the gap, the B-2-2 cannot be useful as well.

16 – Spreadtrum Communications

We still suspect the active BWP without SSB is really meaningful. NCD-SSB is there, why not to use it? From network overhead, in R15, TRS is the baseline RS for synchronization rather than SSB. The NCD-SSB with 160ms periodicity can provide the time reference, and TRS with 20ms periodicity can be used for synchronization. In R15, we did not put too much burden on SSB in my memory, since multi functions of RS is not pursued in NR.

Anyway, if majority view is to go for some implementations for optional capability FG 6-1a, we can live with them.

17 – Huawei Technologies Sweden AB

1. No. Option B-1-1 was evaluated to have significant power consumption impact.

2. As compromise, we accept to specify both B-1-1 and B2-2 in Rel 18 as optional features, provided that option C is also supported.

This Q10 question needs to be handled in package with other potential solutions. Therefore we would suggest to evaluate yet anther option:

Should RAN specify Option B-1-1, B-2-2 and Option C in Rel-18 as optional features?

18 – MediaTek Inc.

Unfortunately, RAN4 conclusion, especially regarding UE power consumption, is not taken into consideration in promoting B-1-1. Similar to RAN4, we have strong concern on high UE power consumption.

We remains very concerned in specifying B-1-1 at all.

We object specifying B-1-1 only (1st bullet).

If B-1-1 and B-2-2 NCSG are specified, they can only be specified as optional features in R18 with no early implementability.

19 – ZTE Corporation

The questions are generally ok.

Our preference is to only support B-1-1 as an optional feature, latest from Rel-18, but we should also consider early implementation.

We will not object the additional support of B-2-2 NCSG (as an optional feature) in addition to B-1-1 (again as an optional feature), for the sake of compromise. However, similarly to others, we think that specifying B-2-2 NCSG will require a much bigger effort in RAN4 (and maybe in RAN2 as well), with the high risk that this will finally not be really implemented in any networks (also based on the comments of a number of network vendors so far).

20 – Classon Consulting

[for FUTUREWEI] Not OK with developing new features in place of the existing ones (A and C), in particular not OK with B-1-1 alone.

Thinking about the opportunities for IoDT testing, etc:

Q11: Any strong concerns with leaving any specification of Option C (NCD-SSB) to a later release?

Feedback Form 11:

1 – Qualcomm Incorporated

No concern

2 – Apple AB

if we have to define an alternative on top of option A, we think option C can be a competitive solution and considered in R18. We don't see a clear logic between postponing NCD-SSB from R18 and Redcap

UE scales and deployment. 3GPP should focus on viable technical solutions. Exact configuration and development can be left as the operators' and infra-vendors' choices.

3 – Samsung Electronics Co.

We support the proposal,not consider option C in Rel-18 given we already have several options there.

4 – Guangdong OPPO Mobile Telecom.

No strong view.

5 – vivo Mobile Communication (S)

We absolutely have strong concerns on leaving option C (NCD-SSB) to a later release.

As we commented in the 1st round, the overhead of NCD-SSB is quite small and it is smaller than CSI-RS of option A. It outperforms option B-1-1 and B-2-2 in terms of UE power consumption and UE complexity, especially.

There are concerns from infra vendors that option C depends on commercialization and deployment of RedCap. We don't think it is true. NCD-SSB is supported already from Rel-15 at least from specification. The existing L1 measurement requirements are applicable for both CD-SSB and NCD-SSB. So, the feature is already supported by the specification. RAN4 concluded some clarification may be needed, e.g., to clarify that existing L1 measurement requirements can be applicable to both CD-SSB and NCD-SSB. There will be no change to the requirements itself. On the other hand, it can be considered no clarification is needed□ i.e., the L1 measurement requirements for SSB are applicable to both CD-SSB and NCD-SSB by default, though we are totally fine to clarify this in RAN4.

For FG 6-1a, NCD-SSB can be used just for L1 measurements as starting point. Thus, it is not a must for network to deploy NCD-SSB in each cell, but in the cell with UE supporting FG 6-1a with NCD-SSB. If there is large number of UEs supporting FG 6-1a with NCD-SSB, it is natural for network to configure NCD-SSB in most of the cells and NCD-SSB can also be used for L3 mobility then.

Therefore, we don't see any justification to leave option C to a late release.

We iterate our proposal in the 1st round that option A, C and B-1-1 should be agreed as a package.

6 – Ericsson LM

No objection. We even support the idea to leave Option C to a later release. If NCD-SSB becomes more common due to RedCap commercialization in future then it will be easier to implement NCD-SSB for non-RedCap UEs. However, we cannot speculate this at this stage and should wait for future release.

7 – China Mobile Com. Corporation

According to RAN4 LS, NCD-SSB has all "low" impact in several aspects, and also no impact on RAN4 specifications. If network already transmit NCD-SSB, we do not understand why this cannot be used for L1 measurement. We prefer to keep NCD-SSB.

8 – China Mobile Com. Corporation

According to RAN4 LS, NCD-SSB has all ”low” impact in several aspects, and also no impact on RAN4 specifications. If network already transmit NCD-SSB, we do not understand why this cannot be used for L1 measurement. We prefer to keep NCD-SSB.

9 – CATT

Similar view as CMCC. And based on RAN4 LS, option C has a lower impact than option B. There is no reason to remove option C but keep option B. If option C is postponed, it should mean no introduction of option B either.

10 – Fujitsu Limited

It depends on the choice of other options, but we don’t want to introduce multiple options for the same purpose.

11 – Nokia Corporation

We support the proposal not to consider option C in Rel-18.

12 – China Telecom Corporation Ltd.

We would also prefer to keep option C. Given this is a Rel-18 discussion, although NCD-SSB has not been deployed for the time being, it is still a good option for later deployment considering the small impact on BS, UE and also RAN4 workload.

13 – Spreadtrum Communications

We share the similar view as vivo, CMCC, CATT and other companies. As mentioned in the previous question answer, we think TRS is the basline RS for synchronization in NR principle. Why the UE should always use CD-SSB for synchronization? It is confusing to us. If TRS cannot provide the time reference in some cases, i.e. it is not standalone, the long periodicity NCD-SSB or ”CD-SSB processing with RF retuning” can be helpful. The multiple functions of a single RS is avoided to the best efforts in R15, that’s the lesson we got in LTE for CRS...

14 – VODAFONE Group Plc

(as moderator) Given that at least one company has strong concerns, I now intend to use the GTW to also ask the following question on option C:

3: Shall RAN specify option C in Rel 18 as an optional feature?

Further feedback is welcome.

15 – Huawei Technologies Sweden AB

Given lack of consensus on options B-1-1/B-2-2, we have strong concern to leave option C to a later release. We suggest to keep Option C in Rel-18 with following technical reasons:

1. The main concern of option C is that RedCap UE may not penetrate in the entire NW, so not all cells are going to transmit NCD-SSB. This is true, but even NCD-SSB is transmitted in only one cell, it is still beneficial for UEs in that cell to use NCD-SSB for L1 measurement. L1 measurement is typically more frequent than L3 measurement, and compared to measuring CD-SSB outside BWP either with MG/NCSG

or larger BW, using NCD-SSB can reduce the interruption or improve the power consumption. In addition, NCD-SSB within active BWP can better reflect the channel condition that UE would experience than the CD-SSB outside active BWP.

2. The earlier we support option C, the more UEs can benefit from NCD-SSB when it is transmitted by the NW. Postponing option C to Rel-19 means all Rel-18 UEs cannot benefit from L1 measurement using NCD-SSB when it is transmitted some time in future.

3. Spec impact of option C is very low, so it's a low hanging fruit as Mediatek has commented.

4. Another concern of option C is the NW complexity and efforts. However, it is still up to NW to decide whether, when and in which cells to transmit NCD-SSB, and no one is forced to transmit NCD-SSB by supporting option C in the spec. In addition, it's unclear why we should highlight the NW complexity of option C but not the UE complexity of option B-1-1 as indicated in the RAN4 LS.

In addition, it's clear from the RAN4 analysis that Option C has its advantages. In the Initial round discussion, 17 companies were OK with it and only 3 companies had concerns. As comparison, 15 companies were OK with Option B-1-1, with 7 companies opposing.

16 – MediaTek Inc.

We have strong concern with leaving Option C to a later release. Option C (NCD-SSB) has low expected work load in RAN4, and, in our view, is the best unified solution for network to offload UEs with narrowband BWP (for both eMBB and RedCap).

17 – ZTE Corporation

If the network already deployed NCD-SSB for RedCap, then it beneficial to allow non-RedCap UEs to also use it. Furthermore, as commented by other companies, the specification effort for this is very limited. Therefore, we prefer to keep this option open in Rel-18, not only for the purpose of bwp-WithoutRestriction.

So we also have a real concern to decide now to postpone the specification of Option C to a later release.

If companies are not ready to already agree now to support Option C in Rel-18, at most what we can do is to avoid taking a decision on this for the moment (and not preclude the possibility to discuss this again). We think that Option C qualifies as a potential TEI18 item and it should be possible to consider this also at the end of the release, especially if new justifications to support this will emerge

18 – Classon Consulting

[for FUTUREWEI] if we want a new rel-18 solution (something other than A) then we should focus on C. So from that perspective should not defer.

Q12: Any other comments or essential corrections to the moderator's round 1 summary?

Feedback Form 12:

1 – Apple AB

Thanks moderator for the efforts and good summary, which we agree with in principle. Regarding B-1-2, it has different pros and cons from B-2-2. We agree that we don't need to keep both. However, it is better to keep it open until the final choices are made.

2 – Samsung Electronics Co.

For Q4, ”Whether new capability signaling required for option A”, clearly as majority companies mentioned no new signaling required which aslo the conclusion in previous RAN-P (RP-222630 FG6-1a can work without any issue and RAN4 discussion (RAN4 LS RP-221911 : RAN4 has requirements to support BM/RLM/BFD based on CSI-RS within active BWP and no spec change is needed).

3 – vivo Mobile Communication (S)

Moderator did great work on this tough topic and we appreciate it. We are generally fine with moderator’s round 1 summary except for Q7. We think the views listed by moderator cannot justify that option C should be left to a late release. Our views can be found in feedback to Q11.

4 – Ericsson LM

Round 1 summary is OK. Thanks to moderator’s good work especially given the controversies and difficult discussions.

5 – China Mobile Com. Corporation

Thanks for moderator’s hard work. On Q4, we do not think signaling is needed for Q4. Even though some requirments need to be fixed for optionA, there is no need to have Rel-18 new signaling to indicate.

6 – MediaTek Inc.

Thanks for moderator’s great effort. On summary to Q6 (initial round), we suggest the following revision:

There seems to be about 15 companies for specifying B-1-1, with about 6 against and 1 neutral. There is some reasoned preference for B-1-1 network infrastructure makers and support from operators, while ~~there are UE power consumption concerns from some but not all on the UE side.~~ there is only one company among UE vendors that disagrees RAN4 conclusion on high UE power consumption with B-1-1.

4.2 Moderator’s summary of round 2

With regard to Q9 on Option A, the moderator proposes to modify the proposed conclusion to:

1: Companies with concerns about the completeness of Option A should submit contributions to RAN 4. RAN requests RAN 4 to treat any such documents.

With regard to Q10, most companies ignored the moderator’s request to correct/improve the questions for the GTW session and instead answered the proposed GTW questions.

Hence the moderator proposes that we ask the following questions in the GTW session:

2: Shall we specify B-1-1 in Rel 18 as an optional feature?

Yes: No:

3: Shall we specify both B-1-1 and B2-2 NCSG in Rel 18, both as optional features?

https://nwm-trial.etsi.org/#/documents/8328

Yes: No:

With regard to Q11, the moderator accepts the strong concern raised by several companies and hence proposes the following additional question for the GTW session.

4: Shall we specify option C (NCD-SSB) in Rel 18 as an optional feature?

Yes: No:

With regard to Q12, the moderator thanks the companies for their comments, corrections and feedback.

What (if anything) to discuss in the 3rd round is dependent upon the outcome of Wednesday's GTW session.

5 Third Round

5.1 Questions

5.2 Moderator's summary of round 3

6 Summary