

[97e-05-BWP-WithoutRestriction] - Version 0.0.3

RAN

3GPP TSG-RAN Meeting # 97-e RP-22XXXX

Electronic Meeting, September 12-16, 2022

Title: Summary for [97e-05-BWP-WithoutRestriction]

Agenda item: 9.11, 9.10, 7

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 10 documents.

Table 1:

RP-221908	LS on BWP operation without restriction (R1-2208168; to: RAN, RAN2, RAN4; cc: -; contact: Qualcomm)
RP-221911	Reply LS to R2-2204009 on Feature Group 6-1a "bwp-WithoutRestriction" (R4-2214355; to: RAN, RAN1)
RP-222067	Support of BWP without restriction
RP-222132	Discussion on Feature Group 6-1a "bwp-WithoutRestriction"
RP-222155	On BWP operation without CD-SSB
RP-222241	On BWP operation without bandwidth restriction
RP-222306	On FG6-1a - BWP without restriction
RP-222338	Discussion on support of BWP without restriction
RP-222395	Discussion on BWP operation without bandwidth restriction
RP-222427	On BWP without restriction

The discussion also relates to the request from RAN #96 in **RP-221870**:

To task the relevant Working Groups (RAN 1, 2, 4) to make progress on their discussions related to the RAN 2 LS in R2-2204009, aim 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.

The RAN 1 LS in RP-221908 indicates the following RAN 1 status:

The LS from RAN 4 in RP-221911 indicates the following:

RAN4 would like to thank RAN2 for the LS on BWP operation without bandwidth restriction. RAN4 has discussed the questions asked in the LS, and would like to provide the answers and share the current status of the discussion in RAN4.

Question 1:

Whether it is a valid scenario in the standard to support the operation of BWP without SSB where the UE does not perform BM/RLM/BFD due to the lack of necessary reference signal (SSB and CSI-RS) in the active BWP.

Answer:

From the existing RAN4 specification point of view, it is not a valid scenario.

Question 2:

If the answer to question 1 is that this is not valid, how should the UE perform BM/RLM/BFD when the active BWP does not contain SSB.

Answer:

RAN4 has examined the Rel-15, Rel-16 and Rel-17 specs. The following possible solutions for the issue are identified.

- Perform BM/RLM/BFD based on CSI-RS within active BWP*
 - RAN4 has requirements to support BM/RLM/BFD based on CSI-RS within active BWP and no spec change is needed*
- Following potential independent implementations/features requires either existing RAN4 requirements to be updated or new requirements to be developed.*
 - Perform BM/RLM/BFD based on SSB outside active BWP*
 - UE's capability to operate using larger BW covering SSB outside active BWP, or a UE that is equipped with a separate RF chain*
 - 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.*

- *NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD*
- *Note: RAN4 does not reach consensus on whether to work on the above items in Rel-17 including to update the existing RAN4 requirements or to develop new requirements*

2 Discussion

It appears from many of the documents (including RP-222241 (Samsung), RP-222338 (Mediatek), RP-222395 (CATT)) that performing BM/RLM/BFD on CSI-RS with the active BWP is a potential solution to BandWidth Parts Without Restriction.

However, from the length of the debate on this topic within 3GPP and e.g. from the extract - below - from RP-222155 (Vivo), it appears that this use of CSI-RS has not achieved successful interoperability testing with a sufficient number of infrastructure vendors and hence CSI-RS is not widely implemented in UEs:

*Though CSI-RS based solution is already supported by 3GPP specification, **it is not available by NW or UE implementation so far**. Therefore, it would be worthy of considering other possible solutions for performing BM/RLM/BFD with SSB outside active BWP if the solution is more implementation friendly.*

As a result, several documents (e.g. RP-222067 (Qualcomm) and RP-222132 (CMCC)) propose that (if CSI-RS is not supported for BM/RLM/BFD) the UE should be able perform measurements on the Cell Defining SSB that is outside of the active BWP, withOUT the need for measurement gaps.

But in RP-222338, Mediatek seems to indicate that measurement gaps would be useful for a UE to measure a Cell Defining SSB that is outside of the active BWP. In contrast, in RP-22306 Nokia proposes that any solution should not use measurement gaps.

When looking at these additional mechanisms, the LS from RAN 4 in RP-221911 indicates that existing RAN 4 requirements do not cover the UE measuring an SSB outside of the active BWP. From RP-222067, Qualcomm indicates that adding the requirements for a UE that does not need measurement gaps should not be too large a task for RAN 4, while RP-222338 (Mediatek) implies that specifying the measurements with gaps would be a somewhat larger task.

Several documents (e.g. RP-222338 (Mediatek), RP-222155 (Vivo), RP-222427 (Apple)), also discuss the use of the RedCap NonCell Defining SSB as a solution that should be able to reuse much of RAN 4 work needed for R17 RedCap UEs.

3 Initial Round

3.1 Questions

The first GoToWebinar session (Monday) will discuss this topic, and RP-222067 (Qualcomm) and RP-222241 (Samsung) are scheduled for presentation.

For the Initial Round of discussion, feedback is requested on the following 4 questions:

Q1 – do you believe that CSI-RS based BM/RLM/BFD measurement is the only solution for an active BWP without SSB, or, do you agree that an additional solution/solutions should be developed?

Feedback Form 1:

1 – Nokia Corporation

It appears that CSI-RS based BM/RLM/BFD is the only solution with existing specification support as of today. The drawback of this solution is that mobility measurements based on SSB can be expected to cause service interruptions, making it unattractive for the network to configure these UEs so that the SSB is not within the active DL BWP.

If UEs could use BWP outside of the active BWP without interruptions for measurement (both BM/RLM/RLF as well as mobility), that would be an attractive solution. If, however new signals, such as NCD-SSB, and/or service interruptions due to BM/RLM/RLF or mobility measurements would be needed with the additional solution/solutions, we don't see such solutions useful.

2 – Guangdong OPPO Mobile Telecom.

No, we are open to discuss other solutions in Rel18.

3 – Nordic Semiconductor ASA

Currently, this is the only solution, which is in fact "Mandatory with capability bit". The basic design principle in R15 has been that UE does not expect to receive outside of active BWP. It feels a bit strange, that this principle would be abandoned in R18 and in the early-implementable form. We are open to provide gNB with more flexibility, are those measuring-gaps or NCD-SSB (if available in network for other purposes anyway).

4 – MediaTek Inc.

Thanks moderator for coordinating the discussion. Before providing our answer, we would like to clarify that **MTK contribution (RP-222338) doesn't say specification work for gap-based solution has larger effort**. Instead, our contribution indicates "Rel-17 NCSG is a better candidate to start with than Rel-16 NeedForGaps because the L3 measurement requirements for Rel-17 NCSG have been completed and it provides more capability granularity for UE to report {*gap, ncs, nogap-noncs*}", which implies we can **largely reuse existing RAN4 specification**. But, the condition is that RAN plenary agrees to proceed with additional work on support active BWP without any SSB or CSI-RS, which, in our view, is not deemed necessary.

Back to Q1, we do believe CSI-RS based BM/RLM/BFD is the only solution for UE to support active BWP without SSB (either CD-SSB or NCD-SSB) based on existing specification (Rel-15/16/17). Additional solution is not deemed necessary for the following reasons:

- If offloading is network priority, utilizing wider BWP containing SSB is a Rel-15 solution supported by all UEs
- If network would like to achieve offloading as well as UE power saving, network can utilize multiple solutions:

- If UE cannot support CSI-based BM/RLM/BFD, network can apply a wider BWP with Rel-15/16 UE power saving solutions to minimize the most dominating PDCCH monitoring power consumption. Note:
 - Rel-15 BWP already support configuration of reduced PDCCH monitoring
 - Rel-16 further provide solutions wake-up signaling (DCI format 2_6) and cross-slot scheduling
- If UE supports CSI-based BM/RLM/BFD, network can use a narrowband BWP with CSI-RS but without SSB. Note:
 - Given CSI-RS is commonly used in existing network, additional CSI-RS overhead is minimum

From RAN4 reply LS, it is clear that at least SSB/CSI-RS in active BWP is the fundamental assumption for NR UEs. In this regard, extending NCD-SSB for offloading of non-RedCap UE is a more sensible solution to achieve **maximum UE support and offloading benefits**. Alternatively, gap-based solution is another available and unified solution for both non-RedCap and RedCap UEs. To minimize the interruptions for L1 and L3 measurements, the identified solution in RAN4 reply LS, i.e., "BM/RLM/BFD on SSB outside BWP performed with **shared** MG or NCSG for L3 measurement", may be considered if needed.

5 – Panasonic Corporation

We support the view to have additional solution for BWP without SSB.

6 – ZTE Corporation

We support the idea to develop additional solutions. This can be done in different steps in Rel-17 and Rel-18 (as further commented below)

7 – NTT DOCOMO INC.

We support to have additional solution for BWP without SSB. In particular, it would be attractive and worth discussing/specifying for operator if the additional solution does not require any additional RS transmission on top of CD-SSB and any interruption/scheduling restriction due to RLM/BM/BFD.

8 – vivo Mobile Communication (S)

As summarized by moderator, the CSI-RS based BM/RLM/BFD measurement is not supported so far by commercialized equipment based on our knowledge. There would be a reason for that. Thus, we agree additional solution/solutions should be developed to provide both NW and UE flexibility of how to support BM/RLM/BFD measurement.

We understand it is preferable if the additional solutions do not introduce interruptions. If that is the case, NCD-SSB based BM/RLM/BFD measurements within active BWP could be the best solution.

9 – AT&T GNS Belgium SPRL

CSI-RS based BM/RLM/BFD measurement may be not the only solution for an active BWP without SSB. Additional solutions could be studied and specified in Rel-18

10 – Classon Consulting

[for FUTUREWEI] any new solution is outside what can be done in rel-17

11 – Apple AB

Based on the spec of R15/16/17, CSI-RS based BM/RLM/BFD measurement is the only solution for an active BWP without SSB. We don't see a clear benefit of supporting SSB outside of BWP on top of CSI-RS, especially when CSI-RS based L1 measurement has been supported in the field.

For the new solutions, the related impacts including complexity and performance need to be further discussed. It is too late to be considered in R17. We can compromise to discuss this in R18 by introducing a new objective in R18 RRM WI.

12 – Samsung Electronics Co.

[For Samsung] We believe that CSI-RS based RM/RLM/BFD is the only solution for an active BWP without SSB due to the following:

- From RAN4 perspective, both SSB outside active BWP and NCD-SSB approaches need additional works on studying the impact on existing requirements, such as RLM/BFD delay requirements, the interruption or gap needed for switching-to and from the SSB
- It should be noted that Rel-17 RRM core requirement impact is also closed (officially on March), and it is not reasonable to have such big feature to be added in Rel-17 framework.
- Without such RAN4 requirements to be defined in Rel-17 RRM specification, it means there is no RAN4 requirement to guarantee such Rel-17 features' performance.

13 – Qualcomm Incorporated

We support the view to have additional solution (not CSI-RS based) for BWP without SSB. This obviates the need to configure measurement gaps (in the gapless option) for both RRM and RLM, which is obviously is not a benefit provided by the CSI-RS option, which would still require gaps for RRM.

We fail to understand the comments (Apple, Samsung) on needing to study new RAN4 requirements for the gapless option. The requirement should be obviously what we already have for BWP-with-restriction.

14 – Beijing Xiaomi Mobile Software

According to the current specification, CSI-RS based BM/RLM/BFD measurement is the only solution for an active BWP without SSB (CD-SSB & NCD-SSB). We are ok to discuss additional solution, e.g. SSB outside BWP, non-CD SSB.

15 – CATT

We agree that CSI-RS based BM/RLM/BFD measurement is the only solution for an active BWP without SSB according to current specification.

We do not see a strong need for additional solutions. In our view, for UEs that support FG 6-1a and CSI-RS based BM/RLM/BFD, network may configure the UEs for CSI-RS based BM/RLM/BFD when the active BWP does not contain SSB. And for UEs that support FG 6-1a but do not support CSI-RS based BM/RLM/BFD, network configuration ensures that active BWP always contains SSB.

16 – Rakuten Mobile

We support to have additional solution for BWP without SSB. For Rel-17, we could consider solution with minimum spec. impact.

17 – China Mobile Com. Corporation

Existing specifications only support CSI-RS based measurement for active BWP without SSB. We are open to discuss UE support of SSB measurement outside of active BWP. But only one UE capability to measure SSB outside of active BWP should be considered without any interruption/scheduling restrictions/gaps to avoid the negative impact on performance.

To summarize, two approaches can support 6-1a:

1. Support CSI-RS based BM/RLM/BFD measurement within active BWP
2. Support SSB based BM/RLM/BFD measurement outside active BWP without any interruption/scheduling restrictions/gaps

With option2, existing RAN4 requirements most likely can be reused. If UE has concerns on power consumption, then it can choose to perform BM/RLM/BFD based on CSI-RS within active BWP.

NCD-SSB is also one possible solution, but it depends on whether NCD-SSB is available at network side.

18 – Orange

We support other solutions than CSI-RS based measurements, which we believe has negative impact on performance. We support the solution based on SSB measurements outside the active BWP, with a preference for gapless measurements. In general we see BWP as a necessary feature for UE power saving in 3.5 GHz, and would like solutions to spread the load across the entire operational bandwidth.

19 – Telia Company AB

We are open to other solutions besides current Rel15 specified "Mandatory with capability signalling" and based on CSI-RS based BM/RLM/BFD measurement. Our preference is to have gapless measurement solutions as target.

20 – NEC Corporation

As stated in RAN4 LS reply, our understanding is that CSI-RS based BM/RLM/BFD is the only solution with existing specification support. We are open to discuss additional solutions in Rel-18.

21 – Spreadtrum Communications

Yes, we believe that CSI-RS based BM/RLM/BFD measurement is the only solution for an active BWP without SSB.

If the majority agree that an additional solution/solutions should be developed, we think NCD-SSB based solution is the only solution which can be considered, as the possible impacts could be very small. That is to say, any other solutions except NCD-SSB based solution should not be considered in Rel.17.

22 – HUAWEI TECHNOLOGIES Co. Ltd.

It is clear that CSI-RS based BM/RLM/BFD is an already supported solution in existing standard since Rel-15. For the scenarios given in the RAN2 LS, we are open or even positive to develop additional solutions to better support FG6-1a, with justified feasibility and clear benefits from both NW and UE sides.

However, based on the current discussions in all WGs, in Rel-17 it is impossible to achieve consensus and complete on any of other candidate solution. In Rel-18, there would be more chance to develop additional solution (s) to make FG 6-1a more useful, in which case both NCD-SSB based measurement and measurement based on SSB outside active BWP can be further discussed.

23 – VODAFONE Group Plc

[as Vodafone] We believe that it would be useful to have an additional solution in Rel 17. This would be useful in providing synergies with the intra-frequency neighbour cell measurements that need to be performed, and it should have a variant that does not use measurement gaps.

24 – KPN N.V.

We support other solutions than CSI-RS based BM/RLM/BFD measurement. And the preference is to have solutions with gap-free measurement as target.

25 – Intel Corporation (UK) Ltd

We are open to formalizing or defining additional solutions other than use of CSI-RS. While CSI-RS-based measurements are certainly a possibility, they are also yet to be commonplace.

Regarding “additional solutions”, in fact, it can already be possible based on UE implementation to receive and perform measurements on an SSB outside of its active DL BWP, without requiring a gap/interruption, e.g., by use of larger reception bandwidth. This option would be more of *formalizing* the solution as against “developing” a new solution, and could possibly still be considered for Rel-17 given the very limited spec impact for this option. In particular, we do not expect any new RAN4 requirements necessary for the approach relying on larger UE Rx bandwidth to receive an SSB outside of active DL BWP.

Further, we are also open to introduction of NCD-SSB for non-RedCap UEs, but it may better suit Rel-18 timeline.

26 – Ericsson LM

The claim that CSI-RS based solution though already supported by 3GPP specification, but not not available by NW or UE implementation is incorrect. There are implementations and deployments available with both UEs and networks. Hence, we are really discussing introducing an alternative for UEs that have not implemented this mandatory feature.

Q2 Do you support that 3GPP should complete the specification(s) for the UE to perform measurements

on a Cell Defining SSB that is outside of the active BWP withOUT the need for measurement gaps? If yes, in Rel 17 or Rel 18?

Feedback Form 2:

<p>1 – Nokia Corporation</p> <p>Yes</p>
<p>2 – Guangdong OPPO Mobile Telecom.</p> <p>In general we think it is too late to discuss any new solution in Rel-17. We are open to discuss the solutions listed in RAN4's LS in Rel-18. For example it can be part of the Rel18 RAN4 WID NR_RRM_enh3.</p>
<p>3 – MediaTek Inc.</p> <p>No, considering the following reasons:</p> <ul style="list-style-type: none">- It violates the fundamental assumption for UE that there is at least one RS in active BWP or there is gap for UE RF retuning.- There are feasible solutions that doesn't violate the above assumption, i.e., NCD-SSB and shared MG/NCSG for L3 and L1 measurements
<p>4 – Panasonic Corporation</p> <p>To support it from Rel.18.</p>
<p>5 – ZTE Corporation</p> <p>Yes, possibly in Rel-17</p>
<p>6 – NTT DOCOMO INC.</p> <p>Yes, it is preferable to support it in Rel-17.</p>
<p>7 – vivo Mobile Communication (S)</p> <p>We are fine if 3GPP will further complete the specification(s) for the UE to perform measurements on a CD-SSB outside of the active BWP without the need for measurement gaps.</p> <p>Regarding in which release to support this new feature, it is depending on what solution/solutions are selected to develop specifications. In our contribution R4-222155, three possible UE implementations being analyzed, i.e.,</p> <p>Option 1: UE using larger BW without switching</p> <p>Option 2: UE using larger BW with switching</p> <p>Option 3: UE using vacant/separate RF chain</p>

Option 1 has minimum specification impact and could be completed in Rel-17. The other two options need more specification work and would only be feasible in Rel-18.

8 – AT&T GNS Belgium SPRL

From the AT&T view, it is not desirable to specify new solutions this late in the Rel-17 "frozen" specifications.

9 – Classon Consulting

[for FUTUREWEI] not for rel-17. For rel-18, unclear why it should be limited to without gaps ... various options should be considered.

10 – Apple AB

It is too late to discuss and decide it in R17. For R18, all three candidates identified in RAN4 LS should be considered. They have their own pro and con. For example, the option without measurement gap may end up with much more frequent BWP switching and associated interruption. Or, it may be at the price of higher power consumption if UE always stays with wider BW. It is too early to preclude any option at this stage.

11 – Samsung Electronics Co.

According to our reply to Q1, No. it is not desirable to discuss such big feature at this very late stage in Rel-17.

12 – Qualcomm Incorporated

Yes, and it is preferable to support it in Rel-17, given that no new requirements need to be added and the specification change is minor.

As it was discussed, Rel-18 could be also a possibility if early Rel-18 CRs implementing the capability could be agreed well before Rel-18 completion. However; RAN2 didn't come back with an answer confirming this possibility, so then Rel-17 remains the only option of making the solution available.

13 – Fujitsu Limited

Yes (just one options should be chosen. If we agree with this approach, nothing else should be specified).

In our understanding, Rel-18 should be the baseline to add a new feature, but Rel-17 can also considered depending on the market demand.

14 – Beijing Xiaomi Mobile Software

Yes and from rel-18

15 – CATT

We do not think it is needed according to our comments above.

16 – Rakuten Mobile

Yes, from Rel-17.

17 – China Mobile Com. Corporation

Yes. If UE perform measurement on SSB outside of active BWP without any interruptions/scheduling restrictions/gaps, then no new requirements are needed, existing requirements can be reused with some clarifications in the spec. We see it is feasible to complete the work in Rel-17.

18 – Orange

yes, in Rel-17

19 – Telia Company AB

Yes, but maybe too late for Rel17 as it is already "frozen".

20 – NEC Corporation

No.

RAN4 LS reply clearly stated that there are two potential independent implementations/features. Regarding which way we should go with, our understanding is there is no consensus yet. Further discussions within Rel-18 time frame are needed.

21 – Spreadtrum Communications

According to RAN4's LS, it is not essential to consider a measurement gap-less based solution in R17. However, we are open to discuss and specify it in R18, if necessary.

22 – HUAWEI TECHNOLOGIES Co. Ltd.

No, we think more discussion in RAN4 is still needed in order to decide which way is the best way to go between gap-less and gap-based, if measurement based on SSB outside of active BWP is supported. Gap-less has cons like more UE power consumption and scheduling restriction, while gap-based has the drawback of additional gap. In addition, per the RAN4 reply LS both needs either updating the existing requirement or new requirement in RAN4. Therefore, it is better to address the issue in Rel-18 instead of rushing to conclude here, with more sufficient time we have more chance to develop good solution to make FG 6-1a more useful.

23 – VODAFONE Group Plc

[as Vodafone] yes in Rel 17

24 – KPN N.V.

Yes, and from Rel-17.

25 – Intel Corporation (UK) Ltd

Yes, we support such a solution. While it is certainly possible for Rel-18, we are also open to formalizing the solution in Rel-17 as the spec impact is rather limited. We do not expect new RAN4 requirements for this option.

26 – Ericsson LM

If any alternative solution to this issue should be pursued, the impact to the network should be minimized. Then this option would have the least impact.

Q3 Do you support that 3GPP should complete the specification(s) for the UE to perform measurements on a Cell Defining SSB that is outside of the active BWP WITH measurement gaps? If yes, in Rel 17 or Rel 18?

Feedback Form 3:

1 – Nokia Corporation

No

2 – Guangdong OPPO Mobile Telecom.

Please refer to previous answer

3 – MediaTek Inc.

Yes (conditioned on RAN Plenary decides to support active BWP without SSB or CSI-RS) and in Rel-18.

According to RAN4 reply LS, gap-based solution is feasible. More importantly, it is a **unified** solution for both non-RedCap and RedCap UEs (which cannot open wider BW than 20 MHz), which ensures **maximum offloading benefits**. If RAN Plenary decides to support active BWP without SSB or CSI-RS, **shared MG** or NCSG for L3 measurement”, can be specified.

4 – Panasonic Corporation

It is not required to specify it for now as no specific request is raised.

5 – ZTE Corporation

Possibly yes, but in case in Rel-18

6 – vivo Mobile Communication (S)

There are different gap-based solutions provided in RAN4 LS, i.e.,

Option 1: Shared MG or NCSG for L3 measurement

Option 2: Dedicated MG or NCSG for RLM/BFD/BM measurements

For UE performing measurements on a CD-SSB outside of the active BWP WITH measurement gaps, it needs to develop new requirements. Both options would need large normative efforts to complete the specification work.

Performing RLM/BFD/BM with measurement gaps would require shorter periodic gaps than for L3 measurement, which wil introduce large overhead for NW and degrade system performance. Otherwise, RLM/BFD/BM measurement performance could be compromised.

Thus, we think gap-based solution could be considered with low priority if solutions are down-selected for Rel-18.

7 – Nordic Semiconductor ASA

If RLM/BFD/BM without additional RS is clearly an industry desire, we do not understand why "need for gap" could not be a reported capability to accommodate for different implementations in the field.

And is the intention of some companies, that below sentence (and similar sentences) suddenly disappear from specification in R17? TS38.213 sub-clause 12; "A UE does not expect to monitor PDCCH when the UE performs RRM measurements [10, TS 38.133] over a bandwidth that is not within the active DL BWP for the UE. "

8 – AT&T GNS Belgium SPRL

Similarly to Q2, from the AT&T view, it is not desirable to specify new solutions this late in the Rel-17 "frozen" specifications.

9 – Classon Consulting

[for FUTUREWEI] not for rel-17. For rel-18, various options should be considered, with gaps may be more inclusive.

10 – Apple AB

Similar as Q2, it is too late for R17. For R18, we can keep all identified solutions on the table if group agrees to include this as part of R18 objective.

11 – Samsung Electronics Co.

According to our reply to Q1, No. it is not desirable to discuss such big feature at this very late stage in Rel-17.

12 – Qualcomm Incorporated

We are neutral regarding this option.

13 – Fujitsu Limited

Our position is No. At least, we shouldn't introduce multiple options to achieve the same goal. If companies want to do specify this option, it should be Rel-18.

14 – Beijing Xiaomi Mobile Software

Yes and from rel-18

15 – CATT

We do not think it is needed according to our comments above.

<p>16 – China Mobile Com. Corporation</p> <p>No. To support 6-1a, we already has CSI-RS based solution, and possibly NCD-SSB. For UE measure SSB outside active BWP, we have concern to introduce multiple UE capabilities, e.g. with or without gaps. Only one UE capability without gaps should be introduced if we decide to support measuring SSB outside active BWP.</p>
<p>17 – Orange</p> <p>No, as long as gapless SSB-based measurements outside BWP are specified.</p>
<p>18 – Telia Company AB</p> <p>No, gapless measurement solutions preferred.</p>
<p>19 – NEC Corporation</p> <p>Please refer to previous answer.</p>
<p>20 – Spreadtrum Communications</p> <p>Similar comments as Q3.</p> <p>According to RAN4's LS, it is not necessary to consider a measurement gap based solution in R17. We are also open to discuss and specify it in R18, if necessary.</p>
<p>21 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>Similar as the answer to Q2, more discussion in RAN4 is still needed in order to decide which way is the best way to go, and thus better address the issue in Rel-18. With more sufficient time we have more chance to develop good solution to make FG 6-1a more useful.</p>
<p>22 – VODAFONE Group Plc</p> <p>[as Vodafone] we don't object but prefer to do this with gapless measurements</p>
<p>23 – KPN N.V.</p> <p>No, gap-free measurements are preferred</p>
<p>24 – Intel Corporation (UK) Ltd</p> <p>We do not prefer such solution as the impact would be larger while the overall benefits still limited compared to the alternatives being considered.</p>
<p>25 – Ericsson LM</p> <p>Again, network impact should be minimized and then this option is out of question.</p>

Q4 Do you support that 3GPP should specify the ability for any UE to use the RedCap NCD SSB? If

yes, in Rel 17 or Rel 18? (Please indicate if your answer is dependent upon the outcome of the discussion on Q1/2/3)

Feedback Form 4:

1 – Nokia Corporation

No. This doesn't appear to add any value wrt. using CSI-RS within the active BWP, simply replacing one signal (CSI-RS) with another (NCD-SSB). When CSI-RS is something that should be supported by UEs with FG6-1a support already, introducing a parallel solution doesn't appear useful.

2 – Guangdong OPPO Mobile Telecom.

Please refer to previous answer

3 – Nordic Semiconductor ASA

If gNB transmits NCD-SSB for RedCap already, we see clear benefit in reusing it for eMBB UEs. In this case, gNB does not need to configure additional CSI-RS.

4 – Panasonic Corporation

Our view is no difference between RedCap UE and non-RedCap UE. It should be for Rel. 18.

5 – MediaTek Inc.

Yes and in Rel-18. NCD-SSB solution **ensures at least one RS in active BWP** and can be a **unified solution for both RedCap and non-RedCap UEs**. This will be the best solution for achieving maximum offloading benefits and UE power saving gains. Note that NCD-SSB periodicity can be optimized to minimize the system overhead.

6 – ZTE Corporation

General support for NCD-SSB (i.e. not only for RedCap UEs) can be considered in Rel18, if at least one solution (i.e. the one without the need for measurement gaps) to allow a UE to perform measurements on CD-SSB that is outside of the active BWP will be introduced in Rel17. Otherwise, general support for NCD-SSB (i.e. not only for RedCap UEs) should be considered already in Rel17 (as this would have very limited specification impact)

7 – vivo Mobile Communication (S)

We strongly support that 3GPP specifies the ability for any UE to use the RedCap NCD-SSB.

Since NCD-SSB is mandatory feature for RedCap UE, it should be supported by both UE and NW. As NW anyway needs to provide NCD-SSB as long as it is configured for one connected RedCap UE in a cell, there is no additional overhead for NW to configure non-RedCap UEs to use NCD-SSB.

RAN4 RRM requirements for RedCap UE are specified for 2Rx UEs. The requirements for NCD-SSB and CD-SSB are basically the same. Thus, existing requirements for non-RedCap UEs can also be extended to NCD-SSB by introducing applicability in a similar way as for RedCap. Minimum normative work is expected to support NCD-SSB for any UE.

If NCD-SSB is supported for any UE with full functionality, it can at least be supported in Rel-18. There could be work in RAN1/RAN2/RAN4, but the specification impacts are small as most of the work is relevant to specifying applicability of CD-SSB functionality to NCD-SSB.

<p>If NCD-SSB is supported for BM/RLM/BFD measurements only for any UE, it can even be supported from Rel-17.</p>
<p>8 – AT&T GNS Belgium SPRL</p> <p>Generally, it is not desirable to specify new solutions this late in the Rel-17 "frozen" specifications. This may be the path of least resistance if there is consensus to do so.</p>
<p>9 – Classon Consulting</p> <p>[for FUTUREWEI] again, not in rel-17, open to discuss more the options for rel-18.</p>
<p>10 – Apple AB</p> <p>Similar as Q2, it is too late for R17. For R18, we can keep all identified solutions on the table if group agrees to include BWP without restriction as part of R18 objective.</p>
<p>11 – Samsung Electronics Co.</p> <p>No. Agree with Nokia's comment</p>
<p>12 – Qualcomm Incorporated</p> <p>We are neutral regarding this option.</p>
<p>13 – Fujitsu Limited</p> <p>There might be operators who are not interested in RedCap, then there is no need to introduce NCD-SSB for such a network. We support Nokia that this just increases the number of options to achieve the same goal, which should be avoided in 3GPP.</p>
<p>14 – Beijing Xiaomi Mobile Software</p> <p>Yes and from rel-18</p>
<p>15 – CATT</p> <p>We do not think it is needed according to our comments above.</p>
<p>16 – China Mobile Com. Corporation</p> <p>If network transmits NCD-SSB, we see benefits to let legacy UE measure NCD-SSB within active BWP to avoid the lack of RS situation. However, since RedCap introduces some enhancements on NCD-SSB, e.g. inter and intra frequency measurement definitions are changed. More discussion may be needed on NCD-SSB measurement for legacy UEs. Rel-18 seems more appropriate.</p>
<p>17 – Orange</p> <p>Not necessarily as long as SSB based measurements outside BWP is specified</p>

<p>18 – Telia Company AB</p> <p>No. Developing too many options for the same purpose should be avoided.</p>
<p>19 – NEC Corporation</p> <p>Please refer to previous answer.</p>
<p>20 – Spreadtrum Communications</p> <p>Yes, we support that 3GPP should specify the ability for any UE to use the RedCap NCD-SSB, as there is no additional overhead for NW. In addition, it is a kind of resource utilization improvement if the NCD-SSB can be used by any UE for measurement.</p> <p>We are open to specify it in Rel.17. Our answer is independent upon the outcome of the discussion on Q1/2/3.</p>
<p>21 – HUAWEI TECHNOLOGIES Co. Ltd.</p> <p>As answer to Q1, we see no chance to develop additional solution in Rel-17. If we will address the issue in Rel-18, we think NCD SSB based measurement is a good solution to consider, especially for the cases where NCD-SSB needs to be transmitted for Redcap, then reusing NCD-SSB for eMBB UE would avoid unnecessary overhead thus improve the system performance.</p>
<p>22 – VODAFONE Group Plc</p> <p>[as Vodafone] This may be useful to do in Rel 18.</p>
<p>23 – Intel Corporation (UK) Ltd</p> <p>Yes, we are supportive of introducing NCD-SSB for non-RedCap UEs as well, at least for Rel-18.</p>
<p>24 – Ericsson LM</p> <p>A Rel-15 UE can already be configured to use NCD-SSB for RRM measurements without the UE needing to know that the SSB are NCD. We see no need to specify RLM/BM/BFR based on NCD-SSB for non-RedCap UEs.</p>

3.2 Moderator’s summary of Round 1

In the responses to question1, no company has indicated that the standards for CSI-RS based BM/RLM/BFD measurements have technical faults, but there are divergent views on whether they are widely deployed and in use.

From the responses to question 1, it seems that there is considerable interest – but not consensus -on developing additional solutions beside CSI-RS based BM/RLM/BFD measurements. Given where we are on the timeline of Rel 17, it seems unlikely that the companies opposing additional solutions would agree to any

changes to Release 17.

With regard to doing Release 18 work on one or more additional solutions, the responses to Q2, 3, 4 show that a large majority of companies have expressed interest in one or more than one of the 3 solutions – however there is a divergence of views on:

- Gapless vs gap-based measurement of the SSB outside the active BWP
- Whether specifying NCD-SSB for all UEs really brings benefits.

A small number of companies have commented about the use of gapless measurement for RRM measurements (of neighbouring cells) but the conclusion on this issue is not clear.

A potential Way Forward is to work on this topic in Release 18, with the aim that solution(s) could be ‘early implementable’ e.g. by updating the Rel 18 RAN 4 WID NR_RRM_enh3.

4 Second Round

4.1 Questions

Q5: Please comment on the Way Forward of “work on this topic in Release 18, with the aim that solution(s) could be ‘early implementable’ e.g. by updating the Rel 18 RAN 4 WID NR_RRM_enh3.”

Feedback Form 5:

1 – Apple AB

We support the proposal to work on this in R18 by updating R18 RRM WID.

However, it is unclear what “early implementable” means. Is it something like release independent? if yes, the typical procedure is to define the feature and corresponding requirements first, if agreeable, and discuss potential release independent issues after that.

2 – Fujitsu Limited

Question for clarification. Does this way forward intend that down-selection of the solution(s) will be performed under RAN plenary level discussion, and the updated WID is aimed at approval in RAN#98e (i.e. RAN4 is not tasked to perform down-selection) ? Then, the way forward looks OK.

3 – Guangdong OPPO Mobile Telecom.

we are general fine with the way forward apart from the early implementation. Company are fine to do it in Rel18 mainly because CSI-RS based solution is available both in spec and market i.e. it is not urgent. So it makes sense to start it from Rel18 with something new.

4 – CATT

Given the strong interests from companies, we are fine to work on this topic in Release 18. We expect the work should be tasked to RAN4. However, given that RAN4 is already fully loaded or even overloaded, and many items are supposed to be completed in Q4, we suggest to start the work from Q1 2023 in RAN4 and request RAN4 to report the progress to RAN so that RAN can decide whether to take further actions in future meetings.

5 – Qualcomm Incorporated

We can accept the proposal as a compromise but only if it comes together with a commitment to make it early implementable. We believe this is a concept well understood in RAN2, so RAN2 can be clearly tasked to introduce the necessary changes in an early implementable fashion.

6 – Intel Corporation (UK) Ltd

We are fine to focus on this for Rel-18 only.

We understand this is a difficult situation, but we think further clarifications would be beneficial to the proposed way forward.

First, instead of using “e.g.,” RAN should clearly task RAN4 as the leading WG if that is the intention, including the RAN4 WID to be updated.

The scope itself would benefit from further guidance. Based on work so far in RAN1 and RAN4, several potential solutions have been identified with their pros/cons, with some options clearly having very limited impact to specifications compared to others. We should try to at least down-select to a smaller subset of options to work further on. In our view, at least solutions with significant spec efforts should be precluded.

Thus, we propose that RAN provides guidance to RAN4 to focus on the following options as candidates for further consideration:

- **Option 1:** Mandating that a UE supporting FG 6-1a should also support CSI-RS-based RLM/BM/BFD
- **Option 2:** Relying on UE’s capability to operate using larger BW covering SSB outside active BWP, or a UE that is equipped with a separate RF chain
- **Option 3:** NCD-SSB approach which would work with existing UE hardware architectures (FG6-1) and be compatible with existing RAN4 specifications for BM/RLM/BFD.

We do not think there is sufficient justification to pursue the option requiring new discussions and spec efforts to specify use of MGs/interruptions to receive SSB outside active DL BWP at this stage, especially in context of enabling “early implementations”.

7 – Panasonic Corporation

We think the way forward, “work on this topic in Release 18, with the aim that solution(s) could be ‘early implementable’”, could be interpreted differently. ”This topic” can mean ”BWP without restriction” based on the title of this discussion or ”the handling of the active BWP which does not contain SSB nor CSI-RS”. Depending on the understanding on ”this”, what ”solution(s)” are scope is not clear. What ”solution(s)” are in the scope?

8 – China Mobile Com. Corporation

We have some concern on Rel-18 RAN4 RRM workload. We did a lot of efforts on downscoping when Rel-18 RAN4 package approved. With this general WF, all the possible solutions will be discussed in RAN4. However, the workload and spec changes caused by different solutions are quite different. Our original comments was to only consider the gapless solution in TEI, which can be handled in one quarter. But adding this new objective with multiple possible solutions to be discussed will heavily increase RAN4 RRM workload. Also, according to RAN chair guidance, there is no handling of new proposals to upscope the existing R18 items.

9 – Nokia Corporation

The proposed way forward agreeable, but is very generic and as such means more and repeated debates downstream will be needed. In that respect we share CMCC's concern that we are risking of generating a lot of additional work when there would not necessarily need to be that much if RAN could provide narrower boundaries to the WGs. Intel's suggestion could be a step to that direction.

10 – Beijing Xiaomi Mobile Software

We are ok with the way forward to work on this in release 18. Perhaps RAN could also down select the solutions or have some guidance to reduce the work in RAN4.

11 – Samsung Electronics Co.

Thanks a lot for Moderator's great effort. We support the proposal by Moderator, i.e., to work on this topic in Rel-18. However, it is unclear on what "early implementable" means. Could you please elaborate on it?

12 – Samsung Electronics Co.

Thanks a lot for Moderator's great effort. We support the proposal by Moderator, i.e., to work on this topic in Rel-18. However, it is unclear on what "early implementable" means. Could you please elaborate on it?

13 – vivo Mobile Communication (S)

We think it would be reasonable way forward to continue discussion and normative work on this topic in Rel-18 considering current situation. We are supportive of the way forward in principle.

The way forward proposal may need to be polished to at least make the solution(s) and potential scope clearer. Are all solutions provided in RAN4 LS considered? Is down-selection needed and is it to be made in RAN Plenary or in WG meetings if it is needed?

We understand the scope is quite large considering different solutions. These solutions also have impacts on multiple working groups. Thus, a separate WI dedicated for this topic can also be considered.

We also support to make the feature early implementable, at least for some solutions if not all solutions can be deemed so.

14 – ZTE Corporation

Considering the situation we can support the principle of the proposed WF (i.e. a new early implementable solution specified in Rel-18). However, similarly to others, we think we should already provide some hints in the WF about the direction to go (e.g. "no gaps" vs "with gaps" vs NCD-SSB based solution, etc.). And we definitely prefer to consider a solution not requiring additional gaps, as a solution "with gaps"

on one hand would require much more RAN4 effort, and on the other hand would probably not be really implemented on the network side at the end (because of the additional scheduling impacts).

15 – ZTE Corporation

Considering the situation we can support the principle of the proposed WF (i.e. a new early implementable solution specified in Rel-18). However, similarly to others, we think we should already provide some hints in the WF about the direction to go (e.g. "no gaps" vs "with gaps" vs NCD-SSB based solution, etc.). And we definitely prefer to consider a solution not requiring additional gaps, as a solution "with gaps" on one hand would require much more RAN4 effort, and on the other hand would probably not be really implemented on the network side at the end (because of the additional scheduling impacts).

16 – Ericsson LM

We are strongly against adding additional work to an already overloaded RAN4 in order to provide alternatives to a functionality that was already mandatory in Rel-15. Even if CSI-RS based measurements are not implemented by all UEs at this time, implementing it now will still solve the problem. Rather than looking for new functionality, we should always utilize already standardized functionality. From a deployment perspective, we would anyway never configure measurements with gaps or NCD-SSB, if introduced, but for UEs not supporting CSI-RS based measurements configure the UE BWP wide enough to always contain CD-SSB.

17 – HUAWEI TECHNOLOGIES Co. Ltd.

Thank you very much for the great effort from the moderator, and we agree to address the issue in Rel-18. Looking at the inputs from companies above, two suggestions from us as are below:

1. We agree that it is better to list the candidate solutions to further work on in Rel-18, in order to avoid too broad discussion. In our view, the candidate solutions given in the RAN4 reply LS should be taken, since any further modification looks like impossible to achieve consensus in RAN plenary here.
2. Since companies still have concern on "early implementable" at this stage, maybe we can prioritize defining the feature and the corresponding requirements first, and then discuss whether/how to achieve "early implementable" in RAN2 and RAN4 later.

Based on the above, we suggest modify the WF as below:

Work on the candidate solutions given in RP-22191 for this topic in Release 18, with the aim that solution(s) could be 'early implementable' e.g. by updating the Rel 18 RAN 4 WID NR_RRM_enh3

- **Whether/how to achieve early implementation can be discussed in RAN2 and RAN4**
- **The impact on UEs in the market should be avoided**

18 – VODAFONE Group Plc

[as moderator] By "early implementable", I mean that the specification changes are agreed and UEs can implement the solution before the current ASN.1 freeze date for Rel 18.

I agree that any 'scope reduction' that this RAN plenary can do would be useful - unfortunately the responses in round 1 were rather evenly split between the 3 approaches. Perhaps one potential approach for downscoping might be to consider synergies with RRM measurements?

19 – BT plc

BT support the way forward but we would clarify a bit the objective “*A potential Way Forward is to work on alternative solutions considering gapless measurements for an active BWP without SSB in addition to CSI-RS based BM/RLM/BFD measurements in Release 18, with the aim that solution(s) could be ‘early implementable’ e.g. by updating the Rel 18 RAN 4 WID NR_RRM_enh3. Extension of NCD-SSB for non-RedCap UEs may be considered as an alternative*”

We are fine to continue the discussion in this RAN Plenary meeting and try down scope the work.

From RAN2 point of view, it is clear what an early implementation means so there is no need for further clarification

20 – MediaTek Inc.

- **We don’t agree to “early implementable”** and it should be removed from the WF proposal. The reasons are as follows:
 - o CSI-RS based L1 measurement is the solution to make FG6-1a work as of Rel-17 (confirmed by both RAN1 and RAN4). CSI-RS are already deployed in field (mentioned by E/// and CMCC). **We don’t see the urgency for supporting other solutions.**
 - o **Given the above bullet, there is no need for “early implementable” for any other solution.**
 - o Similar to CATT, we think RAN4 is overloaded. If this topic is agreed to be discussed, it should **not start earlier than 2023.**

- **We support RAN4 should be the leading WG.** As to which WID, **Meas_Gap_Enh is suggested** for the following reason:
 - o **Meas_Gap_Enh WI already specified gap-less and (small-)gap-based L3 measurements. Additional work for extension to L1 measurements can be minimized.** It is also beneficial to achieve consistent conclusions between L3 and L1 measurements.

- To clarify what *this topic* is, we assume it is “How to support L1 measurements in an active BWP with neither CD-SSB nor CSI-RS”.

- As to the potential solutions to *this topic*, we think **the following solutions should be considered together (led by RAN4):**
 - o Using NCD-SSB within the BWP (with potential coordination with RAN1)

- With SSB outside BWP (candidate solutions as per RAN4 reply LS)

21 – Spreadtrum Communications

Firstly, we agree that it should be discussed in RAN4. Secondly, we want to clarify what benefits can UE or network achieve?

- For RedCap UEs, it can rely on the NCD-SSB for any type of measurement, so the spec does not lead to more than one CD-SSB in a carrier, and network vendor do not need to worry about the seriously large overhead due to RedCap UE.

- For non-RedCap UEs, without assistance of the NCD-SSB, it needs to supports FG 6-1a, and the benefit is at network side to have more flexibility of BWP configurations (no need to cover CD-SSB), but the drawback is at UE side to have higher complexity or power consumption.

Anyway, we are basically fine with FL's proposal to let RAN4 study or specify in R18.

22 – Classon Consulting

[for FUTUREWEI] agree to Rel-18, more important is wide adoption rather than early implementable. Should discuss more the right home for the study of the options.

4.2 Moderator's summary of round 2

4.2.1 Introduction

While the proposed Way Forward from the end of round 1 needs some refinement, it has attracted broad support. However it does have the disadvantage of not scoping down the future work.

For Wednesday's GTW session, perhaps we can address the following points:

4.2.2 Any chance of downscoping?

Does discussion on the following issues help with scoping/downscoping?

a) does work on gapless measurements of the serving cell's SSB (outside the active BWP) provide useful synergies with RRM measurements of neighbour cells' SSBs that are outside of the active BWP?

b) while "NCD-SSB for all UE" feels attractive, does it actually bring value over CSI-RS based measurements?

4.2.3 Is RAN 4 the right group to lead the work?

4.2.4 Is the Rel 18 RAN 4 WID NR_RRM_enh3 the logical RAN 4 WID to use?

4.2.5 Editorial update of WF

In terms of editorial refinement, the following Way Forward is proposed

Work on the candidate solutions given in RAN 4's answer to Q2 in RP-221911 for the "BWP without Restriction" topic in Release 18 by updating the Rel 18 RAN 4 WID NR_RRM_enh3.

- Whether/how to achieve early implementation can be discussed in RAN2 and RAN4*
- The impact on UEs in the market should be avoided*

4.2.6 Can we try to agree update to R4 WID in this meeting?

5 Third Round

5.1 Questions

5.2 Moderator's summary of round 3