**3GPP TSG-RAN WG4 Meeting # 107 R4-2309958**

**Incheon, KR, May 22nd – May 26th, 2023**

**Agenda item:** 8.11.3

**Source:** Moderator (vivo)

**Title:** Topic summary for [107][213] NR\_BWP\_wor

**Document for:** Information

# Introduction

This topic summary covers following agenda for WI completion of specification support for bandwidth part operation without restriction.

8.11 Completion of specification support for bandwidth part operation without restriction in NR [NR\_BWP\_wor]

8.11.1 General and work plan

8.11.2 RRM core requirements

8.11.2.1 Impact of Option A

8.11.2.2 Impact of Option B-1-1

8.11.2.3 Impact of Option C

8.11.2.4 Impact of Option B-1-2

# Topic #1: General

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307640 | Apple | Proposal 1: RAN4 shall focus on existing scope according to WID RP-230805. Potential enhancement such as L3 related gap-less measurement can be further studied in future release. |
| R4-2307722 | vivo, Vodafone Italia SpA, Huawei | **Proposal 1: To handle L3 related requirements impact for all the options for supporting BWP operation without restriction,**  **Alt 1: Continue the discussions in RAN4 directly from Q3 with current allocated TU budget.**  **Alt 2: Send LS to RAN plenary on RAN4 agreements on L3** **related requirements impact for all the options,** **and ask RAN plenary to include L3 related requirements in the WI objectives.** |
| R4-2307723 | vivo, Vodafone Italia SpA | LS on L3 related requirements for the options for BWP operation without restriction |
| R4-2309567 | MediaTek inc. | **Proposal 1: RAN4 shall request from RAN plenary to add the following to the current WID: (i) UE L3 measurement behaviour, if related, can be discussed and (ii) The corresponding requirements can be specified, if necessary.**  **Proposal 2: RAN4 shall discuss the following scenario: If the UE is operating in an active BWP with no NCD-SSB, and no CD-SSB but WITH CSI-RS, then would the UE perform the measurements based on Option B-1-1 or Option A (CSI-RS).**  **Proposal 3: RAN4 shall discuss the following scenario: If-else the UE is operating in an active BWP with no NCD-SSB, no CD-SSB and NO CSI-RS, then would the UE perform the measurements based on Option B-1-1 or Option B-1-2.** |
| R4-2307410 | CATT | **Proposal 5: No need to define requirements for supporting multiple options.**  **Proposal 6: RAN4 can continue the discussions on L3 impact from Q3 directly with the current WID and allocated TU budget.** |
| R4-2307583 | CMCC | **Proposal 2:**  **For UE supporting both option B-1-1 and C, clarification on UE behaviour can be considered, for example: SSB within the active BWP should be used for L1 measurements, either CD-SSB or NCD-SSB.**  **For UE supporting both option B-1-1 and A, it is not necessary to specify new requirements.** |
| R4-2307726 | vivo | **Proposal 4: It is beneficial to support handover to a BWP without CD-SSB directly for UE supporting option A, B-1-1 and option B-1-2.**  **Proposal 5: If UE supports both option B-1-1 and C, the UE works with option B-1-1 or option C mutually exclusively, and the UE meets the requirements based on option B-1-1 or option C for BM/RLM/BFD, respectively.**  **Proposal 6: If the UE is configured with NCD-SSB within the active DL BWP, the UE works and meets the requirements based on Option C i.e., NCD-SSB for BM/RLM/BFD; Otherwise, the UE works and meets the requirements based on Option B-1-1.**  **Proposal 7: If UE working with option A and option B-1-1 simultaneously is supported, UE behaviour/conditions for RLM/BM/BFD measurements should be defined.**  **Proposal 8: UE working with option A and option C simultaneously should be supported and UE behaviour/conditions for RLM/BM/BFD measurements should be defined.** |
| R4-2308675 | Huawei, HiSilicon | **Proposal 4: RAN4 not to define additional requirements for UE supporting multiple options.** |
| R4-2308769 | Nokia, Nokia Shanghai Bell | 1. Whether RAN4 should define requirements for a UE supporting multiple options should be discussed later. |
| R4-2309647 | Ericsson | **Requirements for supporting multiple options:**   * **Observation #4**: NCD-SSB or CSI-RS transmission involves additional overheads and increases the BS transmission power. * **Observation #5**: If the UE supports both option B-1-1 and option C and the network configures the NCD-SSB within the active DL BWP then it is obvious that the UE will use option C for the BM/RLM/BFD. * **Proposal #3**: No clarification is needed no clarification is needed regarding UE behaviour if the UE supports option B-1-1 and option C. * **Observation #6**: Option A is mandatory for the UE. * **Proposal #4**: No clarification is needed no clarification is needed regarding UE behaviour if the UE supports option B-1-1 and option A. |
| R4-2307725 | vivo | **Proposal 3: It is beneficial to support handover to a BWP with NCD-SSB directly for UE supporting option C.** |
| R4-2308676 | Huawei, HiSilicon | **Proposal 4: Subject to RANP approval, RAN4 to support HO scenarios involving NCD-SSB and re-use the same requirements from RedCap.** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1: General

*Sub-topic description: Background.*

*In the RAN4#106-bis-e meeting, following agreements were made for L3 measurements requirements for options C, option B-1-1 and option B-1-2.*

**<Agreement >:**

* It is a common RAN4 understanding that L3 measurements requirements impact for options B-1-1 and B-1-2 are not explicitly included in the WI objectives.
* RAN4 work will focus on enabling L1 measurements for options B-1-1 and B-1-2 in Q2’2023.
* In RAN4#107 RAN4 can continue discussion on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2.

**<Agreement >:**

* It is a common RAN4 understanding that support of L3 measurements based on NCD-SSB for Option C can be beneficial, but it is not explicitly included in the WI objectives. Whether to support L3 measurements based on NCD-SSB is up to RAN decision.
* RAN4 work will focus on enabling L1 measurements based on NCD-SSB in Q2’2023.

*Open issues and candidate options before f2f meeting:*

**Issue 1-1: How to handle L3 related requirements impact**

* Proposals
  + Option 1: (vivo, Vodafone, Huawei, CATT)
    - Continue the discussions in RAN4 directly from Q3 with current allocated TU budget.
  + Option 2: (vivo, Vodafone, Huawei)
    - Send LS to RAN plenary on RAN4 agreements on L3 related requirements impact for all the options, and ask RAN plenary to include L3 related requirements in the WI objectives.
  + Option 3: (MTK)
    - RAN4 shall request from RAN plenary to add the following to the current WID: (i) UE L3 measurement behaviour, if related, can be discussed and (ii) The corresponding requirements can be specified, if necessary.
  + Option 4: (Apple)
    - RAN4 shall focus on existing scope according to WID RP-230805. Potential enhancement such as L3 related gap-less measurement can be further studied in future release.
* Recommended WF
  + Further discussion.

**Issue 1-2: Requirements for handover for Option A, C, B-1-1 and B-1-2**

*All other L3 related issues, except on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2, are only for information in principle. Since handover is new issue, it is up to session chair if the issue can be discussed.*

* Proposals
  + Option 1: (vivo)
    - It is beneficial to support handover to a BWP without CD-SSB directly for UE supporting option A, B-1-1 and option B-1-2.
    - It is beneficial to support handover to a BWP with NCD-SSB directly for UE supporting option C.
  + Option 2: (Huawei)
    - Subject to RANP approval, RAN4 to support HO scenarios involving NCD-SSB and re-use the same requirements from RedCap.
* Recommended WF
  + TBA.

### Sub-topic 1-2: Requirements for combined options

*Sub-topic description: Background.*

*It was raised in the RAN4#106-bis-e meeting that if UE behavior and/or requirements should be defined if UE supports multiple options for BWP operation without restriction.*

*Open issues and candidate options before f2f meeting:*

**Issue 1-3: Requirements/UE behaviour for UE supporting both option B-1-1 and C**

* Proposals
  + Option 2: (vivo)
    - If UE supports both option B-1-1 and C, the UE works with option B-1-1 or option C mutually exclusively, and the UE meets the requirements based on option B-1-1 or option C for BM/RLM/BFD, respectively.
    - If the UE is configured with NCD-SSB within the active DL BWP, the UE works and meets the requirements based on Option C i.e., NCD-SSB for BM/RLM/BFD; Otherwise, the UE works and meets the requirements based on Option B-1-1.
  + Option 3: (CMCC)
    - For UE supporting both option B-1-1 and C, clarification on UE behaviour can be considered, for example: SSB within the active BWP should be used for L1 measurements, either CD-SSB or NCD-SSB
  + Option 4: (Huawei, CATT, E///, MTK)
    - RAN4 not to define additional requirements for UE supporting multiple options.
  + Option 5: (Nokia)
    - Whether RAN4 should define requirements for a UE supporting multiple options should be discussed later.
* Recommended WF
  + Further discussion.

**Issue 1-4: Requirements/UE behaviour for UE supporting both option B-1-1 and A**

* Proposals
  + Option 1: (MTK)
    - RAN4 shall discuss the following scenario: If the UE is operating in an active BWP with no NCD-SSB, and no CD-SSB but WITH CSI-RS, then would the UE perform the measurements based on Option B-1-1 or Option A (CSI-RS).
  + Option 2: (vivo)
    - If UE working with option A and option B-1-1 simultaneously is supported, UE behaviour/conditions for RLM/BM/BFD measurements should be defined.
  + Option 3: (CMCC, Huawei, CATT, E///)
    - For UE supporting both option B-1-1 and A, it is not necessary to specify new requirements.
  + Option 4: (Nokia)
    - Whether RAN4 should define requirements for a UE supporting multiple options should be discussed later.
* Recommended WF
  + Further discussion.

**Issue 1-5: Requirements/UE behaviour for UE supporting both option C and A**

* Proposals
  + Option 1: (vivo)
    - UE working with option A and option C simultaneously should be supported and UE behaviour/conditions for RLM/BM/BFD measurements should be defined.
  + Option 2: (Huawei, CATT)
    - RAN4 not to define additional requirements for UE supporting multiple options.
  + Option 3: (Nokia)
    - Whether RAN4 should define requirements for a UE supporting multiple options should be discussed later.
* Recommended WF
  + Further discussion.

**Issue 1-6: Requirements/UE behaviour for UE supporting both option B-1-1 and B-1-2**

* Proposals
  + Option 1: (MTK)
    - RAN4 shall discuss the following scenario: If-else the UE is operating in an active BWP with no NCD-SSB, no CD-SSB and NO CSI-RS, then would the UE perform the measurements based on Option B-1-1 or Option B-1-2.
  + Option 2: (Huawei, CATT)
    - RAN4 not to define additional requirements for UE supporting multiple options.
  + Option 3: (Nokia)
    - Whether RAN4 should define requirements for a UE supporting multiple options should be discussed later.
* Recommended WF
  + Further discussion.

# Topic #2: Impact of Option A

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307410 | CATT | **Proposal 1: No additional clarification is needed for timing requirements for option A and B-1-1.** |
| R4-2307582 | CMCC | **Proposal: No clarifications on existing timing requirements are needed.** |
| R4-2307641 | Apple | Observation 1: for option A, UE anyway needs to measure serving cell, e.g. with legacy MG, NCSG or NeedForGaps. UE has chance to measure CD-SSB. RAN4 spec won’t be broken without further clarification. |
| R4-2307724 | vivo | **Proposal 1: Existing requirements for FR2 CSI-RS based RLM/BFD/CBD/BM measurements in clauses 8.1, 8.5, 9.5 and 9.8 should be updated by taking intra-frequency measurement with GAP into consideration for UE supporting option A.**  **Proposal 2: When CD-SSB is outside active BWP, the sharing factor P for FR2 CSI-RS based RLM/BFD/CBD/BM measurements is defined as below.**  **For FR2 when UE CD-SSB is outside active BWP and UE is not supporting option B-1-1 and option B-1-2,**  **- , when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs are overlapping with some but not all occasions of the CSI-RS; and**  **- P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS.**  **Proposal 3: It is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.**  **Proposal 4: A note is added for timing requirements that when SSB is outside active BWP, availability of SSB is at least relevant to configuration of measurement gap, number of measurement objects and gap sharing factor.**  **Proposal 5: It is beneficial to support handover to a BWP without CD-SSB directly for UE supporting option A, B-1-1 and option B-1-2. Whether to support the feature needs RAN plenary guidance.** |
| R4-2308674 | Huawei, HiSilicon | **Proposal 1: RAN4 not to make further clarification for FR2 CSI-RS base RLM requirements for option A.**  **Proposal 2: RAN4 to confirm that spec support for option A is complete, and no additional RAN4 work is needed.** |
| R4-2308768 | Nokia, Nokia Shanghai Bell | 1. There is no impact on existing FR2 CSI-RS base RLM requirements due to Option A. 2. No clarification on existing timing requirements when CD-SSB is outside active BWP is needed. |
| R4-2309568 | MediaTek inc. | Observation 1: Current Section 7.1.2 is general enough to cover both cases when SSB is within and outside the active BWP.   1. **No further clarification** **on existing timing requirements in TS38.133 is needed for Option A.** |
| R4-2309646 | Ericsson | This paper has further analyzed the applicability of the UE transmission timing requirements for the UE performing BM/RLM/BFD based on option A i.e. when the CSI-RS is within the active BWP. The following are the observations and proposals:   * **Observation #1**: The SSB (i.e. CD-SSB) is always available in the serving cell since the UE performs at least the SSB based measurements on the serving cell. * **Observation #2**: If the SSB is outside the active BWP then the measurement gaps will be provided by the network to enable the UE to perform the SSB based measurements on at least the serving cell. * **Observation #3**: Even if the SSB is outside the active BWP, the UE will be able to measure the SSB within the measurement gaps and acquire the timing from the serving/reference cell. * **Observation #4**: Regardless of the measurement configuration (e.g. gaps, number of frequency layers etc) the SSB of the serving/reference cell should be provided by the network at the UE at least once every e.g. 160 ms for SCS ≤ 120 kHz. Otherwise, the UE is not expected to meet the UE transmission timing error requirements.   **Proposal #1**: Option 1 is preferred but option 2 can be compromise solution:   * + **Option 1:**      - The condition to configure gaps to meet the existing UE transmission timing error requirements in clause 7.1 of TS 38.133, when the UE is performing BM/RLM/BFD based on option A, is NOT needed.   + **Option 2**:     - A possible compromise is to clarify in clause 7.1.2 of TS 38.133, that the availability of the SSB at the UE is for the purpose of acquiring the timing of the reference cell as shown below:   + *When the UL SCS is 120 kHz or smaller, the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE for acquiring the frame timing of the reference cell during the last 160 ms. When the UL SCS is 480 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE for acquiring the frame timing of the reference cell in the last 80 ms. When the UL SCS is 960 kHz the UE shall meet the Te requirement for an initial transmission provided that at least one SSB is available at the UE for acquiring the frame timing of the reference cell in the last 40 ms.* |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1: Specification impact of Option A

*Sub-topic description: Background.*

*Open issues and candidate options before f2f meeting:*

**Issue 2-1: Any clarification on FR2 CSI-RS based RLM/BFD/BM requirements for Option A**

* Proposals
  + Option 1: (Huawei, Nokia)
    - No specification impact on FR2 CSI-RS based RLM/BFD/BM requirements for option A
  + Option 2: (vivo)
    - Existing requirements for FR2 CSI-RS based RLM/BFD/CBD/BM measurements in clauses 8.1, 8.5, 9.5 and 9.8 should be updated by taking intra-frequency measurement with GAP into consideration for UE supporting option A.
    - When CD-SSB is outside active BWP, the sharing factor P for FR2 CSI-RS based RLM/BFD/CBD/BM measurements is defined as below.
      * For FR2 when UE CD-SSB is outside active BWP and UE is not supporting option B-1-1 and option B-1-2,
        + P=1/(1-T\_(CSI-RS)/xRP), when in the monitored cell there are GAPs configured for intra-frequency, inter-frequency or inter-RAT measurements, and these GAPs are overlapping with some but not all occasions of the CSI-RS; and
        + P=1 when in the monitored cell there are no GAPs overlapping with any occasion of the CSI-RS
* Recommended WF
  + Further discussion.

**Issue 2-2: Any clarification on existing timing requirements when CD-SSB is outside active BWP**

* Proposals
  + Option 1: (Ericsson, Apple, Nokia, Huawei, CMCC, CATT, MediaTek)
    - No clarifications on existing timing requirements are needed.
  + Option 2: (vivo)
    - It is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.
    - A note is added for timing requirements that when SSB is outside active BWP, availability of SSB is at least relevant to configuration of measurement gap, number of measurement objects and gap sharing factor.
  + Option 3: (Ericsson)
    - The condition to configure gaps to meet the existing UE transmission timing error requirements in clause 7.1 of TS 38.133, when the UE is performing BM/RLM/BFD based on option A, is NOT needed.
    - A possible compromise is to clarify in clause 7.1.2 of TS 38.133, that the availability of the SSB at the UE is for the purpose of acquiring the timing of the reference cell
* Recommended WF
  + Further discussion.

# Topic #3: Impact of Option B-1-1

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307410 | CATT | **Proposal 1: No additional clarification is needed for timing requirements for option A and B-1-1.** |
| R4-2307583 | CMCC | **Proposal 1: No clarification on existing timing requirements for supporting Option B-1-1.**  **Proposal 3:**  **Do not introduce new UE and gNB behaviour for option B-1-1 in RAN4 spec. It is up to UE and gNB implementation how option B-1-1 is supported.**  **Do not introduce a new section for RRM requirements for option B-1-1.** |
| R4-2307642 | Apple | **Proposal 1: Support of option B-1-1 shall be a prerequisite for RAN4 existing RLM/BFD/BM requirement to apply when CD-SSB is outside the active BWP.**  **Proposal 2: as baseline, CD-SSB shall be contained within UE CBW.**  **Proposal 3: no clarification is needed on existing timing requirements.**  **Observation 1: if UE is willing to perform intra-frequency measurement w/o gap even when target SSB is outside active BWP, UE can indicate support of it via NeedForGaps or NCSG. Note that the support of NeedForGaps and NCSG are very flexible. UE can indicate support of it on intra-frequency only.**  **Proposal 4: RAN4 shall decouple support of BWP w/o restriction and gapless L3 measurement.** |
| R4-2307726 | vivo | **Proposal 1: UE is required to perform RLM/BM/BFD measurements based on CD-SSB outside active BWP if the UE supporting FG 53-1 and FG 53-2. Otherwise, RLM/BM/BFD measurements is performed based on SSB within active BWP.**  **Proposal 2: For supporting option B-1-1, it is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.**  **Proposal 3: It is beneficial to support intra-frequency measurement without gap based on SSB outside active BWP for UE supporting option B-1-1.**  **Observation 1: Update on existing intra-frequency measurement requirements is expected if intra-frequency measurement without gap based on CD-SSB outside active BWP is introduced for UE supporting option B-1-1.**  **Proposal 9: Do not introduce new UE and gNB behaviour for option B-1-1 in RAN4 spec. It is up to UE and gNB implementation how option B-1-1 is supported as long as requirements defined for option B-1-1 is satisfied.** |
| R4-2308675 | Huawei, HiSilicon | **Proposal 1: RAN4 waits for RAN1 conclusion before discussing the applicable condition for the L1 requirements for option B-1-1.**  **Proposal 2: RAN4 not to make further clarification on existing timing requirements for option B-1-1.**  **Proposal 3: Subject to RANP approval, RAN4 to define supporting option B-1-1 as one applicability condition for intra-frequency measurement without MG.**   * **FFS whether new UE capability is needed for L3 enhancements** * **FFS relation with NFG and NCSG capability** * **FFS on inter-frequency measurement without MG**   **Proposal 5: RAN4 not to introduce new UE and gNB behavior for option B-1-1 in RAN4 spec. It is up to UE and gNB implementation how option B-1-1 is supported.** |
| R4-2308769 | Nokia, Nokia Shanghai Bell | 1. RAN4 to have a definition of ‘Option B-1-1’. 2. RAN4 to firstly agree on how to refer to ‘Option B-1-1 capable UE’ and the text before going to CR phase. 3. No clarification on existing timing requirements when CD-SSB is outside active BWP is needed. 4. No clarification on existing inter-frequency measurement requirements when CD-SSB is outside active BWP is needed. 5. No new additional UE requirements would be needed for Option B-1-1. 6. RAN4 must update the conditions clarifying that a UE supporting Option B-1-1 can perform SSB-based RLM, BFD and BM, when the CD-SSB is not within the active BWP. 7. RAN4 to clarify that a UE supporting Option B-1-1 can perform SSB-based RLM, BFD and BM, on the CD-SSB not within the active BWP without causing interruptions. 8. RAN4 to clarify that a UE supporting Option B-1-1 can perform SSB-based intra-frequency L3 measurements without gaps when the CD-SSB is not within the active BWP. |
| R4-2309569 | MediaTek inc. | **Proposal 1: No further clarification is needed on existing timing requirements in TS38.133 for Option B-1-1.**  **Proposal 2: RAN4 to agree on the following: (i) Do not introduce new UE and gNB behaviour for option B-1-1 in RAN4 spec and it is up to UE implementation how option B-1-1 is supported; and (ii) Do not introduce a new section for RRM requirements for option B-1-1.** |
| R4-2309647 | Ericsson | **Applicable condition for option B-1-1:**   * **Observation #1**: According the RAN1 feature definition for option B-1-1, the UE performs RLM/BM/BFD measurements based on CD-SSB without interruptions, where the CD-SSB is outside active DL BWP but is within the bandwidth. * **Proposal #1**: The applicable condition is that the UE meets the requirements for supporting Option B-1-1 provided that the CD-SSB is within the bandwidth of the UE.   **Impact on UE timing requirements for option B-1-1:**   * **Observation #2**: In the existing UE transmit timing requirement in section 7.1 of TS 38.133, there is no condition that the CD-SSB should be within the active DL BWP. * **Observation #3**: The interpretation of the existing UE transmit timing requirement in section 7.1 of TS 38.133 is that UE transmit timing requirement applies regardless of whether the SSB is within or outside the active DL BWP. * **Proposal #2**: No clarification is needed for the UE to meet the existing UE transmit timing requirements (section 7.1 of TS 38.133) when performing BM/RLM/BFD according to option B-1-1. |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 3-1: Specification impact of Option B-1-1

*Sub-topic description: Background.*

*Following agreements were made in the last RAN4 meeting.*

* RAN4 work will focus on enabling L1 measurements for options B-1-1 and B-1-2 in Q2’2023.
* In RAN4#107 RAN4 can continue discussion on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2.

*Open issues and candidate options before f2f meeting:*

**Issue 3-1: Applicable conditions of existing RLM/BFD/BM requirements for Option B-1-1**

* Proposals
  + Option 1:
    - Support of option B-1-1 shall be a prerequisite for RAN4 existing RLM/BFD/BM requirement to apply when CD-SSB is outside the active BWP.
    - CD-SSB shall be contained within UE CBW.
  + Option 2:
    - UE is required to perform RLM/BM/BFD measurements based on CD-SSB outside active BWP if the UE supporting FG 53-1 and FG 53-2. Otherwise, RLM/BM/BFD measurements is performed based on SSB within active BWP.
  + Option 3:
    - RAN4 waits for RAN1 conclusion before discussing the applicable condition for the L1 requirements for option B-1-1.
  + Option 4:
    - RAN4 to have a definition of ‘Option B-1-1’.
    - RAN4 to firstly agree on how to refer to ‘Option B-1-1 capable UE’ and the text before going to CR phase.
    - RAN4 to clarify that a UE supporting Option B-1-1 can perform SSB-based RLM, BFD and BM, on the CD-SSB not within the active BWP without causing interruptions.
  + Option 5:
    - The applicable condition is that the UE meets the requirements for supporting Option B-1-1 provided that the CD-SSB is within the bandwidth of the UE.
* Recommended WF
  + Further discussion

**Issue 3-3: Clarification on existing timing requirements for supporting Option B-1-1**

* Proposals
  + Option 1: (vivo)
    - It is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.
  + Option 2: (Ericsson, Apple, Nokia, Huawei, CATT, MediaTek)
    - No clarification on existing timing requirements
* Recommended WF
  + Needs further discussion.

**Issue 3-4: Clarification/modification on intra-frequency measurement requirements for supporting option B-1-1**

*It was agreed in the last meeting that in RAN4#107 RAN4 can continue discussion on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2.*

* Proposals
  + Option 1:
    - RAN4 shall decouple support of BWP w/o restriction and gapless L3 measurement.
  + Option 2:
    - It is beneficial to support intra-frequency measurement without gap based on SSB outside active BWP for UE supporting option B-1-1.
    - Update on existing intra-frequency measurement requirements is expected if intra-frequency measurement without gap based on CD-SSB outside active BWP is introduced for UE supporting option B-1-1.
  + Option 3:
    - Subject to RANP approval, RAN4 to define supporting option B-1-1 as one applicability condition for intra-frequency measurement without MG.
      * FFS whether new UE capability is needed for L3 enhancements
      * FFS relation with NFG and NCSG capability
      * FFS on inter-frequency measurement without MG.
  + Option 4:
    - RAN4 to clarify that a UE supporting Option B-1-1 can perform SSB-based intra-frequency L3 measurements without gaps when the CD-SSB is not within the active BWP.
* Recommended WF
  + It is confirmed that specification change is needed to support intra-frequency measurement without gap for option B-1-1.

**Issue 3-7: Whether to define additional requirements for supporting option B-1-1**

* Proposals
  + Option 1:
    - Do not introduce new UE and gNB behaviour for option B-1-1 in RAN4 spec. It is up to UE and gNB implementation how option B-1-1 is supported.
    - Do not introduce a new section for RRM requirements for option B-1-1.
  + Option 2: (Proposal from last meeting)
    - Introduce a section for RRM requirement for Option B-1-1 and describe the behaviour of UE and gNB like as below.
      * “The Option B-1-1 supporting UE can autonomously change carrier freq. and RF BW to access CD-SSB for BM/RLM/BFD without causing any interruption. The gNB is expected to configure UE specific active BWP considering the max. supportable CHBW of the UE in the specific band.”
* Recommended WF
  + Agree on option 1.

# Topic #4: Impact of Option C

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307410 | CATT | **Proposal 2: For option C, the current SSB-based timing requirement can be also applied to non-redCap UE with NCD-SSB support.** |
| R4-2307584 | CMCC | **Proposal: Clarify in the related sections that “the SSB and SMTC applies for both CD-SSB and NCD-SSB if it is not additional specified” for non-RedCap UE.** |
| R4-2307643 | Apple | **Proposal 1: The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-SSB support.**  **Proposal 2: It is clarified in the spec that existing timing requirements for non-RedCap UE shall be met provided at least one SSB is available during 160ms, which can also be NCD-SSB within active BWP if UE supports option C.** |
| R4-2307725 | vivo | **Proposal 1: In RLM/BFD/BM measurement requirements in clauses 8.1, 8.5, 9.5 and 9.8, it is clarified that the SSB and SMTC applies for CD-SSB and NCD-SSB if the UE supporting FG 53-3.**  **Proposal 2: It is clarified in the spec that existing timing requirements for non-RedCap UE shall be met provided at least one SSB is available during 160ms, which can be CD-SSB or NCD-SSB if UE supports FG 53-3.**  **Proposal 3: It is beneficial to support handover to a BWP with NCD-SSB directly for UE supporting option C.** |
| R4-2308676 | Huawei, HiSilicon | **Proposal 1: RAN4 waits for RAN1 conclusion before discussing the applicable condition for the L1 requirements for option C.**  **Proposal 2: RAN4 to include NCD-SSB in the applicability condition for timing requirements, same as timing requirement for RedCap.**  **Proposal 3: Subject to RANP approval, RAN4 to re-use the intra-/inter-frequency definition and requirements for transition between CD-SSB and NCD-SSB for L3 measurement from RedCap for UE supporting option C.**  **Proposal 4: Subject to RANP approval, RAN4 to support HO scenarios involving NCD-SSB and re-use the same requirements from RedCap.** |
| R4-2308770 | Nokia, Nokia Shanghai Bell | 1. No clarification is needed on existing timing requirements for Option C when NCD-SSB is within active BWP. 2. No clarification on existing inter-frequency measurement requirements when CD-SSB is outside active BWP is needed. 3. No need to define any additional L1 or L3 measurements for supporting Option C.   And based on observing:   1. UE cannot assume that Option C is supported by all networks or gNBs in the field.   We propose:   1. A UE supporting Option C must always additionally support at least on other options (A, B-1-1 or B-1-2). |
| R4-2309570 | MediaTek inc. | **Proposal 1: No further clarification is needed on existing timing requirements in TS38.133 for Option C.**  **Proposal 2: The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-SSB support.** |
| R4-2309648 | Ericsson | **Applicable condition for option C:**   * **Observation #1**: According the RAN1 feature definition for option option C, means the UE performs RLM/BM/BFD measurements based on NCD-SSB, where the NCD-SSB is within the active DL BWP. * **Observation #2**: Since, there is no difference between the CD-SSB and the NCD-SSB, therefore the UE supporting Option C should meet the RLM/BFD/BM requirements provided that at least one of the CD-SSB and the NCD-SSB is within the active BWP. * **Proposal #1**: The applicable condition is that the UE meets the requirements for supporting Option C provided that at least one of the CD-SSB and the NCD-SSB is within the active DL BWP.   **Impact on UE timing requirements for option C:**   * **Observation #3**: To meet the Te requirements by the UE capable of option C at least one of the CD-SSB and the NCD-SSB should be available at the UE during the last X ms; where X=160 ms for UL SCS≤ 120 kHz or X=80 ms for UL SCS=480 kHz or X=40 ms for UL SCS=960 kHz. * **Proposal #2**: Clarify in the existing UE transmit timing requirements (section 7.1 of TS 38.133) that:   + The UE capable of [Option C] shall meet the transmit timing error (Te) requirement for an initial transmission provided that at least one SSB (CD-SSB or NCD-SSB) is available at the UE for acquiring the frame timing of the reference cell during the last X ms; where X=160 ms for UL SCS≤ 120 kHz or X=80 ms for UL SCS=480 kHz or X=40 ms for UL SCS=960 kHz. |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 4-1: Specification impact of Option C

*Sub-topic description: Background.*

*Following agreements were made in the last RAN4 meeting.*

* RAN4 work will focus on enabling L1 measurements based on NCD-SSB in Q2’2023.

*Open issues and candidate options before f2f meeting:*

**Issue 4-1: Applicable conditions of existing RLM/BFD/BM requirements for Option C**

* Proposals
  + Option 1:
    - Clarify in the related sections that “the SSB and SMTC applies for both CD-SSB and NCD-SSB if it is not additional specified” for non-RedCap UE.
  + Option 2:
    - In RLM/BFD/BM measurement requirements in clauses 8.1, 8.5, 9.5 and 9.8, it is clarified that the SSB and SMTC applies for CD-SSB and NCD-SSB if the UE supporting FG 53-3.
  + Option 3:
    - RAN4 waits for RAN1 conclusion before discussing the applicable condition for the L1 requirements for option C.
  + Option 4:
    - The applicable condition is that the UE meets the requirements for supporting Option C provided that at least one of the CD-SSB and the NCD-SSB is within the active DL BWP.
* Recommended WF
  + Further discussion

**Issue 4-3: Clarification on existing timing requirements for supporting Option C**

* Proposals
  + Option 1: (CATT)
    - The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-CCB support.
  + Option 2: (CMCC)
    - Clarify in the related sections that “the SSB and SMTC applies for both CD-SSB and NCD-SSB if it is not additional specified” for non-RedCap UE.
  + Option 3: (Apple)
    - The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-CCB support.
    - It is clarified in the spec that existing timing requirements for non-RedCap UE shall be met provided at least one SSB is available during 160ms, which can also be NCD-SSB within active BWP if UE supports option C.
  + Option 4: (vivo)
    - It is clarified in the spec that existing timing requirements for non-RedCap UE shall be met provided at least one SSB is available during 160ms, which can be CD-SSB or NCD-SSB if UE supports FG 53-3.
  + Option 5: (Huawei)
    - RAN4 to include NCD-SSB in the applicability condition for timing requirements, same as timing requirement for RedCap.
  + Option 6: (Nokia)
    - No clarification is needed on existing timing requirements for Option C when NCD-SSB is within active BWP
  + Option 7: (MediaTek)
    - No further clarification is needed on existing timing requirements in TS38.133 for Option C.
    - The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-SSB support.
  + Option 8: (Ericsson)
    - Clarify in the existing UE transmit timing requirements (section 7.1 of TS 38.133) that:
    - The UE capable of [Option C] shall meet the transmit timing error (Te) requirement for an initial transmission provided that at least one SSB (CD-SSB or NCD-SSB) is available at the UE for acquiring the frame timing of the reference cell during the last X ms; where X=160 ms for UL SCS≤ 120 kHz or X=80 ms for UL SCS=480 kHz or X=40 ms for UL SCS=960 kHz.
* Recommended WF
  + The current SSB-based timing requirement can be also applied to non-redCap UE with NCD-CCB support.
  + Further discuss whether/what additional clarification are needed.

# Topic #5: Impact of Option B-1-2

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2307410 | CATT | **Proposal 3: For option B-1-2, existing SSB based BM/RLM/BFD measurement requirements apply and no additional measurement requirements are needed.**  **Proposal 4: For option B-1-2, the interruption requirements can be defined based on HARQ ACK/NACK loss framework with a maximum missed ACK/NACK rate up to [0.5%]. And the length for each interruption shall not exceed the RF retuning time (0.5ms for FR1 and 0.25ms for FR2).** |
| R4-2307273 | Qualcomm Incorporated | **Interruption length**  **Proposal 1: For Option B-1-2, interruption length upon L1 measurement/evaluation based on SSB outside UE active BWP is defined as 2 times RF retuning time before and after the L1 measurement/evaluation, i.e. wideband RF based L1 measurement/evaluation.**  **Interruption ratio**  **Proposal 2: For Option B-1-2, interruption ratio upon L1 measurement/evaluation based on SSB outside UE active BWP is subject to UE capability. The capability can be from 0.5% to [5]%, and the granularity of the capability can be decided based on NW vendors’ inputs, e.g. 0.5, 1, 2, and 5. FFS on whether and how to differentiate L1 measurement/evaluation period, e.g. DRX on/off, DRX cycle, periodicity of SSB, etc.** |
| R4-2307585 | CMCC | **Observation: Option B-1-2 was agreed as a compromised solution with low interruption ratio so that no additional network configuration is required.**  **Proposal: Define interruption ratio and interruption length for each interruption**   * + - * **For option B-1-2, the interruption requirements can be defined based on HARQ ACK/NACK loss framework with a maximum missed ACK/NACK rate up to 0.5%.**       * **And the length for each interruption shall not exceed the RF retuning time (0.5ms for FR1 and 0.25ms for FR2).** |
| R4-2307644 | Apple | Proposal 1: the following options can be considered to define interruption for option B-1-2:   1. **Option 1: define explicit interruption length without mentioning interruption ratio.** 2. **Option 2: X%=interruption length \* 2 / L1-RS periodicity, where X% is the interruption ratio, interruption length is [0.5ms] in FR1 and [0.25ms] in FR2, and L1-RS periodicity is the periodicity of SSB configured for BM/RLM/BFD** **after taking scaling factor P into account.** |
| R4-2307727 | vivo | **Proposal 1: When CD-SSB is outside the active BWP, the existing requirements for SSB-based RLM/BFD/BM are applicable for UE supporting option B-1-2 with interruptions to be defined additionally.**  **Proposal 2: Existing SSB based RLM/BFD/CBD/BM measurement requirements in clause 8.1, 8.5, 9.5 and 9.8 are to be made applicable for UE supporting option B-1-2.**  **Proposal 3: UE is required to perform RLM/BM/BFD measurements based on CD-SSB outside active BWP if the UE supporting FG 53-1 and FG 53-2. Otherwise, RLM/BM/BFD measurements is performed based on CD-SSB within active BWP.**  **Proposal 4: For UE supporting FG 53-2, the UE is allowed to cause interruptions to perform RLM/BM/BFD measurements if there is no CSI-RS, no NCD-SSB and no CD-SSB configured for RLM/BM/BFD measurement in the active BWP.**  **Proposal 5: For supporting option B-1-2, It is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.**  **Proposal 6: Intra-frequency measurement without gap based on SSB outside active BWP is not introduced for UE supporting option B-1-2.**  **Observation 1: Update on existing intra-frequency measurement requirements is expected if intra-frequency measurement without gap based on CD-SSB outside active BWP is introduced for UE supporting option B-1-2.**  **Proposal 7: It is beneficial to support handover to a BWP without CD-SSB directly for UE supporting option A, B-1-1 and option B-1-2.**  **Proposal 8: Interruption requirements for UE supporting option B-1-2 are specified with interruption ratio only or with interruption ratio and interruption length, where interruption ratio is the probability of missed ACK/NACK.**  **Proposal 9: For UE supporting option B-1-2, the probability of missed ACK/NACK is 1% for ALL RLM/BFM/BM(L1-RSRP/L1-SINR) measurements based on SSB outside active BWP.** |
| R4-2308677 | Huawei, HiSilicon | **Proposal 1: Define requirements on length of each interruption. Use the following values as baseline.**   * **FR1: 0.5ms** * **FR2: 0.25ms**   **Proposal 2: Support NW to control the interruption location. Interruption ratio are not defined.**  **Proposal 3: Subject to RANP approval, RAN4 to further discuss whether and how to introduce L3 measurements requirements based on option B-1-2 after RAN4 concludes on interruption requirements for L1 measurement.** |
| R4-2308771 | Nokia, Nokia Shanghai Bell | 1. Any interruption length shall not exceed [TBD]ms. 2. Probability of missed ACK/NACK for a UE supporting Option B-1-2, due to interruptions caused by BM/RLM/BFD measurements based on SSB outside the active BWP, shall not exceed [TBD]%. |
| R4-2309316 | Spreadtrum Communications | **Observation 1: In case of SSB based RLM, UE is required to access SSB per SSB periodicity(practically 20ms, 40ms) for the purpose of RLM, and it’s required to have 10 SSB samples during out of sync evaluation period, and to have 5 SSB samples during in sync evaluation period given UE of no DRX configuration.**  **Observation 2: Existing measurement sample requirements for RLM based on SSB and the relevant interruption due to RF retuning would impair the benefit of leverage the SSB outside the active BWP.**  **Proposal 1:** **it’s proposed to fit RLM based on SSB outside the active BWP into the NCSG, thus by applying the NCSG patterns of different VIPLs, the actual interruption could be adapted accordingly.** |
| R4-2309571 | MediaTek inc. | **Proposal 1: RAN4 shall leverage the interruption requirements (NCSG and NFG) from L3 measurements to define the interruption requirements for RLM/BFD/BM measurements.** |
| R4-2309649 | Ericsson | **Interruption due to RLM/LRP measurements:**   * **Observation #1**: According to TS 38.331, the following independent set of SSB resources are configured for various RLM and LRP procedures:   + *RadioLinkMonitoringRS*; same for both RLM and BFD   + *CandidateBeamRS*; for CBD   + *CSI-SSB-ResourceSet*; same for both L1-RSRP and L1-SINR measurements * **Observation #2**: UE will periodically sample/measure the SSB for the RLM/BFD/BM periodically depending on the periodicity of the configured SSB resources. * **Observation #3**: Due to the periodic sampling of the SSB for the RLM/BFD/BM it is important to define the maximum allowed interruption probability. * **Proposal #1**: Define the interruption requirements in terms of both:   + The maximum interruption probability and   + Maximum length of each interruption * **Proposal #2**: The maximum interruption probability on other active serving cells due to RLM/LRP measurements performed on the serving cell are defined using either option 1 or option 2; we prefer option 1:   + **Option 1**:     - The rate of ACK/NACK feedback loss on any other active serving cell resulting from RLM/BFD measurements on the serving cell shall not exceed 0.5 %.     - The rate of ACK/NACK feedback loss on any other active serving cell resulting from CBD measurements on the serving cell shall not exceed 0.5 %.     - The rate of ACK/NACK feedback loss on any other active serving cell resulting from L1-RSRP/L1-SINR measurements on the serving cell shall not exceed 0.5 %.   + **Option 2**:     - The rate of ACK/NACK feedback loss on any other active serving cell resulting from RLM/BFD, CBD and L1-RSRP/L1-SINR measurements on the serving cell shall not exceed 1 %. * **Proposal #3**: The maximum length of each interruption is defined as follows:   ***Interruption length in NR CA:***  **Table 2: Interruption due to RLM and RLP measurements on other active serving cell in inter-band NR CA**   |  |  |  |  | | --- | --- | --- | --- | |  | **NR Slot length (ms) of victim cell** | **Interruption length X2 (slots)** | | | 0 | 1 |  | 1 | | 1 | 0.5 |  | 1 | | 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 2 | |  |  | Either aggressor cell or victim cell is on FR1 | 3 | | 3 | 0.125 | Aggressor cell is on FR2 | 4 | |  |  | Aggressor cell is on FR1 | 5 | | 5 | 0.03125 | Aggressor cell is on FR1 | 17 | | 6 | 0.015625 | Aggressor cell is on FR1 | 33 |   **Table 3: Interruption due to RLM and RLP measurements on other active serving cell in intra-band NR CA**   |  |  |  | | --- | --- | --- | |  | **NR Slot length (ms)** | **Interruption length (slots)** | | 0 | 1 | 1 + NSSB | | 1 | 0.5 | 1 + NSSB | | 2 | 0.25 | 2 + NSSB | | 3 | 0.125 | 4 + NSSB | | 5 | 0.03125 | 16 + NSSB | | 6 | 0.015625 | 32 + NSSB | | NOTE: NSSB is the number of slots containing the configured SSB(s) for RLM/BFD, CBD or L1-RSRP/L1-SINR | | |   ***Interruption length in NR DC:***   * For synchronous inter-band NR-DC, the interruption length is the same as in table 2. * For asynchronous inter-band NR-DC, the interruption length is shown in table 4.   **Table 4: Interruption due to RLM and RLM on other active serving cell in asynchronous inter-band NR-DC**   |  |  |  |  | | --- | --- | --- | --- | |  | **NR Slot length (ms) of victim cell** | **Interruption length X2 (slots)** | | | 0 | 1 |  | 1 | | 1 | 0.5 |  | 1 | | 2 | 0.25 | Both aggressor cell and victim cell are on FR2 | 3 | |  |  | Either aggressor cell or victim cell is on FR1 | 4 | | 3 | 0.125 | Aggressor cell is on FR2 | 5 | |  |  | Aggressor cell is on FR1 | 6 | | 5 | 0.03125 | Aggressor cell is on FR1 | 18 | | 6 | 0.015625 | Aggressor cell is on FR1 | 34 |   ***Interruption length in EN-DC and NE-DC:***  For inter-band EN-DC, the interruption on the active LTE serving cell shall not exceed:   * 1 subframe for synchronous inter-band EN-DC or * 2 subframes for asynchronous inter-band EN-DC.   For synchronous intra-band EN-DC, the interruption shall not exceed:   * the duration of NSSB + 2 subframes.   For inter-band NE-DC, the interruption on the active LTE serving cell shall not exceed:   * 1 subframe for synchronous inter-band NE-DC or * 2 subframes for asynchronous inter-band NE-DC.   For synchronous intra-band NE-DC, the interruption shall not exceed:   * the duration of NSSB + 2 subframes.   Where, NSSB is the number of slots containing the configured SSB(s) for RLM/BFD, CBD or L1-RSRP/L1-SINR.  **Proposal #4**: The interruption requirements in proposals # 2 and # 4 are allowed only under certain conditions wrt the DRX cycle:   * The interruption is allowed only when any of the following conditions are met:   + When no DRX cycle is used on the serving cell on which the RLM/LRP measurements are performed.   + When the DRX cycle used on the serving cell on which the RLM/LRP measurements are performed is shorter than or equal to 320 ms and the DRX ON duration is aligned with the SSB * Otherwise, no interruption is allowed in any of the following cases: * When the DRX cycle used on the serving cell on which the RLM/LRP measurements are performed is less than or equal to 320 ms and the DRX ON duration is misaligned with the SSB. * When the DRX cycle used on the serving cell on which the RLM/LRP measurements are performed is larger than 320 ms. |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

*Before f2f meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 5-1: Specification impact of Option B-1-2

*Sub-topic description: Background.*

*Following agreements were made in the last RAN4 meeting.*

* RAN4 work will focus on enabling L1 measurements for options B-1-1 and B-1-2 in Q2’2023.
* In RAN4#107 RAN4 can continue discussion on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2.

*Open issues and candidate options before f2f meeting:*

**Issue 5-2: Interruption requirements for supporting option B-1-2**

* Proposals
  + Option 1: (CATT, CMCC)
    - For option B-1-2, the interruption requirements can be defined based on HARQ ACK/NACK loss framework with a maximum missed ACK/NACK rate up to [0.5%].
    - And the length for each interruption shall not exceed the RF retuning time (0.5ms for FR1 and 0.25ms for FR2).
  + Option 2: (Qualcomm)
    - For Option B-1-2, interruption length upon L1 measurement/evaluation based on SSB outside UE active BWP is defined as 2 times RF retuning time before and after the L1 measurement/evaluation, i.e., wideband RF based L1 measurement/evaluation.
    - For Option B-1-2, interruption ratio upon L1 measurement/evaluation based on SSB outside UE active BWP is subject to UE capability. The capability can be from 0.5% to [5]%, and the granularity of the capability can be decided based on NW vendors’ inputs, e.g. 0.5, 1, 2, and 5.
    - FFS on whether and how to differentiate L1 measurement/evaluation period, e.g. DRX on/off, DRX cycle, periodicity of SSB, etc.
  + Option 3: (Apple)
    - X%=interruption length \* 2 / L1-RS periodicity, where X% is the interruption ratio, and L1-RS periodicity is the periodicity of SSB configured for BM/RLM/BFD after taking scaling factor P into account.
    - Interruption length is [0.5ms] in FR1 and [0.25ms] in FR2
  + Option 4: (vivo)
    - For UE supporting option B-1-2, the probability of missed ACK/NACK is 1% for ALL RLM/BFM/BM(L1-RSRP/L1-SINR) measurements based on SSB outside active BWP.
  + Option 5: (Huawei)
    - Define requirements on length of each interruption. Use the following values as baseline. FR1: 0.5ms, FR2: 0.25ms.
    - Support NW to control the interruption location. Interruption ratio are not defined.
  + Option 6: (Nokia)
    - Any interruption length shall not exceed [TBD]ms.
    - Probability of missed ACK/NACK for a UE supporting Option B-1-2, due to interruptions caused by BM/RLM/BFD measurements based on SSB outside the active BWP, shall not exceed [TBD]%.
  + Option 7: (Spreadtrum)
    - it’s proposed to fit RLM based on SSB outside the active BWP into the NCSG, thus by applying the NCSG patterns of different VIPLs, the actual interruption could be adapted accordingly.
  + Option 8: (MediaTek)
    - RAN4 shall leverage the interruption requirements (NCSG and NFG) from L3 measurements to define the interruption requirements for RLM/BFD/BM measurements.
  + Option 9: (Ericsson)
    - The rate of ACK/NACK feedback loss on any other active serving cell resulting from RLM/BFD, CBD and L1-RSRP/L1-SINR measurements on the serving cell shall not exceed 0.5 %.
    - Maximum length of each interruption is defined differently for CA/DC scenarios
* Recommended WF
  + Further discussion.

**Issue 5-4: Applicable of conclusions for Option B-1-1 to Option B-1-2**

* Proposals
  + Proposal 1:
    - When CD-SSB is outside the active BWP, the existing requirements for SSB-based RLM/BFD/BM are applicable for UE supporting option B-1-2 with interruptions to be defined additionally.
  + Proposal 2:
    - Existing SSB based RLM/BFD/CBD/BM measurement requirements in clause 8.1, 8.5, 9.5 and 9.8 are to be made applicable for UE supporting option B-1-2.
* Recommended WF
  + Agree on proposal 1 and proposal 2.

**Issue 5-5: Applicable conditions of existing RLM/BFD/BM requirements for Option B-1-2**

* Proposals
  + Option 1: (vivo)
    - UE is required to perform RLM/BM/BFD measurements based on CD-SSB outside active BWP if the UE supporting FG 53-1 and FG 53-2. Otherwise, RLM/BM/BFD measurements is performed based on CD-SSB within active BWP.
    - For UE supporting FG 53-2, the UE is allowed to cause interruptions to perform RLM/BM/BFD measurements if there is no CSI-RS, no NCD-SSB and no CD-SSB configured for RLM/BM/BFD measurement in the active BWP.
* Recommended WF
  + Further discussion

**Issue 5-6: Clarification on existing timing requirements for supporting Option B-1-2**

* Proposals
  + Option 1: (vivo)
    - For supporting option B-1-2, It is clarified in the spec that existing timing requirements for non-RedCap UE are applicable regardless of whether SSB is within active BWP or not.
* Recommended WF
  + Follow conclusion for option B-1-1.

**Issue 5-7: Clarification/modification on intra-frequency measurement requirements for supporting option B-1-2**

*It was agreed in the last meeting that in RAN4#107 RAN4 can continue discussion on whether any further clarifications are needed on intra-frequency measurements for UEs supporting options B-1-1 and B-1-2.*

* Proposals
  + Option 1: (vivo)
    - Intra-frequency measurement without gap based on SSB outside active BWP is not introduced for UE supporting option B-1-2.
      * Update on existing intra-frequency measurement requirements is expected if intra-frequency measurement without gap based on CD-SSB outside active BWP is introduced for UE supporting option B-1-2.
* Recommended WF
  + It is confirmed that specification change is needed to support intra-frequency measurement without gap for option B-1-2.
  + Further discuss whether intra-frequency measurement without gap based on SSB outside active BWP is introduced for UE supporting option B-1-2 or not.