**3GPP TSG-RAN WG4 Meeting # 110 R4-2401086**

**Athens, Greece, 26 February ‒ 1 March, 2024**

**Agenda item:** 8.10.7

**Source:** Man Hung Ng (Nokia)

**Title:** Topic summary for [110][127] NR\_FR1\_lessthan\_5MHz\_BW

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

Summary for contributions submitted under agenda items 8.10, 8.10.1 and 8.10.2 for NR support for dedicated spectrum less than 5MHz for FR1.

List of candidate target of discussion for 1st round and 2nd round:

* 1st round: Discussion and agreement on open issues listed below.
* 2nd round: Continue discussion and agreement on open issues listed below.

# Topic #1: System parameters

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

* R4-2400481, Proposals 2 and 4 of R4-2402809, R4-2402889 are moved from agenda item 8.10.4.
* R4-2402615 and R4-2402638 are moved from agenda item 8.10.2.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2400481 | Apple | Proposal 1:  **Answer to Question 1:** Yes, RAN4 acknowledges this backward compatibility issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value in the scenario described in RAN1 LS.  **Answer to Question 2:** RAN4 sincerely recommends RAN2 to define a scheme to avoid this backward compatibility issue.  Observation 1: |
| R4-2402237 | ZTE Corporation | Proposal 1:  **RAN4 response:** One of the motivations for designing a new sync raster for less than 5 MHz channel bandwidth is for legacy UE to differentiate the new GSCN values from the legacy GSCN values. And the offset between new sync-raster points and legacy sync-raster points is as large as possible. So the legacy UE not supporting the new GSCN design is not supposed to understand the new GSCN and its corresponding absolute SSB frequency corresponding to new GSCN. The new GSCN values are as follows:  **Table 5.4.3.1-2: GSCN parameters for the global frequency for 3 MHz channel bandwidth**   |  |  |  |  | | --- | --- | --- | --- | | **Range of frequencies (MHz)** | **SS block frequency position SSREF** | **GSCN** | **Range of GSCN** | | 0 – 1000 | N \* 600 kHz + M \* 50 kHz + 300 kHz,  N = 1:1665, M ϵ {1,3,5} (Note 1) | 26638+3N + (M-3)/2 | 26640 – 31634 | | NOTE 1: Only applicable for 15 PRB DCH transmission within 3 MHz channel bandwidth with punctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. | | | |   **Table 5.4.3.1-3: Additional GSCN parameters for band n100**   |  |  |  | | --- | --- | --- | | **SS Block frequency position SSREF**  **(MHz)** | **GSCN** | **Note** | | 920.73 | 41637 | Only applicable for 12 PRB transmission bandwidth configuration within 3 MHz channel with punctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. | | 921.45 | 41638 | Only applicable for 20 PRB transmission bandwidth configuration within 5 MHz channel with unpunctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. |   Observation 1: |
| R4-2402574 | Huawei Technologies France | Proposal 1:  Reply 1: Indeed this will cause a backward compatibility issue, meaning a legacy UE should not be able detect the SSB block for the ‘less than 5MHz’ dedicated cell. With the current version of the TS 38.331, a legacy UE will be able to detect and decode the new dedicated SSB block of the neighboring cell, because the SSB location is provided with ARFCN-ValueNR value and not via GSCN, directly.  Observation 1: The GSCN range of the legacy and new dedicated UEs are different to avoid detecting each other’s SSB blocks.  Observation 2: the IE InterFreqCarrierFreqInfo.dl-CarrierFreq, in SIB4, points to the center frequency of the SSB, hence it makes the dedicated SSB block, the UEs supporting “less than 5MHz”, visible to the legacy UEs which is against the RAN4 goal. |
| R4-2402615 | MediaTek Inc. | Revised in R4-2402638 |
| R4-2402616 | MediaTek Inc. | Proposal 1: A note is added after the maximum transmission bandwidth configuration table for each channel bandwidth indicating this guideline.  Observation 1: In RP-230781, RAN plenary gave a clear guideline to RAN4 that the less-than-5MHz WI in Rel-18 should consider single-carrier operation, excluding RedCap. And this is not reflected in the current Rel-18 RAN4 specs. |
| R4-2402638 | MediaTek Inc. | Proposal 1 A note is added after the maximum transmission bandwidth configuration table for each channel bandwidth indicating this guideline.  Observation 1: In RP-230781, RAN plenary gave a clear guideline to RAN4 that the less-than-5MHz WI in Rel-18 should consider single-carrier operation, excluding RedCap. And this is not reflected in the current Rel-18 RAN4 specs. |
| R4-2402737 | Qualcomm Inc. | Proposal 1: Remove term DCH, correct transmission to transmission bandwidth configuration to align the usage throughout the sync raster section.  Observation 1: In RAN4#109 R4-2318564 was agreed, however some of the changes were missed in the CR implementation. This CR corrects the implementation errors making the specification content as originally intended and agreed in R4-2318564. |
| R4-2402738 | Qualcomm Inc. | Proposal 1: Remove undefined term DCH.  Observation 1: In RAN4#109 R4-2318566 was agreed, however some of the changes were missed in the CR implementation. This CR corrects the implementation errors making the specification content as originally intended in R4-2318566. |
| R4-2402809 | Qualcomm Incorporated | Proposal 2: RAN4 send a reply LS to RAN1 acknowledging the compatibility issues for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value, raised by RAN1 in the LS R1-2312668.  Proposal 3: Send LS to RAN2 to introduce an additional InterFreqCarrierFreqList with ARFCN-ValueNR corresponding to the new sync raster points, separate from that of legacy sync raster points. |
| R4-2402889 | MediaTek inc. | Proposal 1: Answer to Q1: RAN4 should answer to RAN1 and inform them that RAN4 expect backward compatibility issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value.  Proposal 2: Answer to Q2: regarding how to define the signalling should be left to RAN2 experts.  Proposal 3: RAN4 shall discuss the issue of LTE with SIB24 at the same time with the issue of NR with SIB4.  Observation 1: Similar issue to that raised by RAN1 in their LS are happening in LTE with SIB24 for legacy UE that doesn’t support <5MHz. |

## Open issues summary

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

### Sub-topic 1-1

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 1-1: Reply LS to RAN1 LS in R4-2400012 (R4-2400481, R4-2402237, R4-2402574, R4-2402809, R4-2402889)**

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| R4-2400481  Proposal 1:  **Answer to Question 1:** Yes, RAN4 acknowledges this backward compatibility issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value in the scenario described in RAN1 LS.  **Answer to Question 2:** RAN4 sincerely recommends RAN2 to define a scheme to avoid this backward compatibility issue.  R4-2402237  Proposal 1:  **RAN4 response:** One of the motivations for designing a new sync raster for less than 5 MHz channel bandwidth is for legacy UE to differentiate the new GSCN values from the legacy GSCN values. And the offset between new sync-raster points and legacy sync-raster points is as large as possible. So the legacy UE not supporting the new GSCN design is not supposed to understand the new GSCN and its corresponding absolute SSB frequency corresponding to new GSCN. The new GSCN values are as follows:  **Table 5.4.3.1-2: GSCN parameters for the global frequency for 3 MHz channel bandwidth**   |  |  |  |  | | --- | --- | --- | --- | | **Range of frequencies (MHz)** | **SS block frequency position SSREF** | **GSCN** | **Range of GSCN** | | 0 – 1000 | N \* 600 kHz + M \* 50 kHz + 300 kHz,  N = 1:1665, M ϵ {1,3,5} (Note 1) | 26638+3N + (M-3)/2 | 26640 – 31634 | | NOTE 1: Only applicable for 15 PRB DCH transmission within 3 MHz channel bandwidth with punctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. | | | |   **Table 5.4.3.1-3: Additional GSCN parameters for band n100**   |  |  |  | | --- | --- | --- | | **SS Block frequency position SSREF**  **(MHz)** | **GSCN** | **Note** | | 920.73 | 41637 | Only applicable for 12 PRB transmission bandwidth configuration within 3 MHz channel with punctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. | | 921.45 | 41638 | Only applicable for 20 PRB transmission bandwidth configuration within 5 MHz channel with unpunctured PBCH defined in TS 38.211 [6] clause 7.4.3.1. |   R4-2402574  Proposal 1:  Reply 1: Indeed this will cause a backward compatibility issue, meaning a legacy UE should not be able detect the SSB block for the ‘less than 5MHz’ dedicated cell. With the current version of the TS 38.331, a legacy UE will be able to detect and decode the new dedicated SSB block of the neighboring cell, because the SSB location is provided with ARFCN-ValueNR value and not via GSCN, directly.  Observation 1: The GSCN range of the legacy and new dedicated UEs are different to avoid detecting each other’s SSB blocks.  Observation 2: the IE InterFreqCarrierFreqInfo.dl-CarrierFreq, in SIB4, points to the center frequency of the SSB, hence it makes the dedicated SSB block, the UEs supporting “less than 5MHz”, visible to the legacy UEs which is against the RAN4 goal.  R4-2402809  Proposal 2: RAN4 send a reply LS to RAN1 acknowledging the compatibility issues for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value, raised by RAN1 in the LS R1-2312668.  Proposal 3: Send LS to RAN2 to introduce an additional InterFreqCarrierFreqList with ARFCN-ValueNR corresponding to the new sync raster points, separate from that of legacy sync raster points.  R4-2402889  Proposal 1: Answer to Q1: RAN4 should answer to RAN1 and inform them that RAN4 expect backward compatibility issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value.  Proposal 2: Answer to Q2: regarding how to define the signalling should be left to RAN2 experts.  Proposal 3: RAN4 shall discuss the issue of LTE with SIB24 at the same time with the issue of NR with SIB4.  Observation 1: Similar issue to that raised by RAN1 in their LS are happening in LTE with SIB24 for legacy UE that doesn’t support <5MHz. |

* Proposals
  + Option 1: Revise R4-2400481.
  + Option 2: Revise R4-2402237.
  + Option 3: Revise R4-2402574.
* Recommended WF
  + Option 1: Revise R4-2400481.
  + Agreements:
    - RAN4 agree that there would be backward compatibility issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value.
    - RAN4 agree that there would be similar issue for LTE with SIB24 as NR with SIB4.
    - RAN4 suggest RAN2 to handle this in RAN2 specifications. No change required in RAN4 specifications.

Qualcomm: Generally agree with the big picture. On the last bullet, RAN2 may suggest a change in RAN4 spec.

Huawei: from our side, current wording is fine without change of RAN4.

Mediatek: main concern is on the first bullet. I wonder if it can be called as backward compatibility issue.

Apple: Check with Qualcomm what the change is exactly.

Intel: we agree with Mediatek. We should not call it backward compatibility issue. To Qualcomm, we honestly do not see how RAN4 can solve the problem. It is up to RAN2 discussion.

Moderator: The problem is not initial access rather than handover.

Huawei: better to mention backward compatibility.

Intel: there is two types of UE.

Agreements:

* RAN4 agree that there would be issue for a UE not supporting less than 5MHz but provided with a neighbour cell with SSB on the new GSCN value in the handover scenario.
* RAN4 agree that there would be similar issue for LTE with SIB24 as NR with SIB4.
* RAN4 suggest RAN2 to handle this in RAN2 specifications.

### Sub-topic 1-2

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-2: CR in R4-2402638 (Revision of R4-2402615)**

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| Proposal 1 A note is added after the maximum transmission bandwidth configuration table for each channel bandwidth indicating this guideline.  Observation 1: In RP-230781, RAN plenary gave a clear guideline to RAN4 that the less-than-5MHz WI in Rel-18 should consider single-carrier operation, excluding RedCap. And this is not reflected in the current Rel-18 RAN4 specs. |

* Proposals
  + Option 1: Agree the CR
  + Option 2: Revise the CR
  + Option 3: Note the CR
* Recommended WF
  + Option 2: Revise the CR to include the phrase ‘in the current release’ as usually done.

*Ericsson: put the restriction in the general part.*

*Qualcomm: Ericsson comment is aligned with the single operation for redcap.*

*Agreement:* Revise the CR to include the phrase ‘in the current release’ as usually done.

### Sub-topic 1-3

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 1-3: CR in R4-2402616**

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| Proposal 1: A note is added after the maximum transmission bandwidth configuration table for each channel bandwidth indicating this guideline.  Observation 1: In RP-230781, RAN plenary gave a clear guideline to RAN4 that the less-than-5MHz WI in Rel-18 should consider single-carrier operation, excluding RedCap. And this is not reflected in the current Rel-18 RAN4 specs. |

* Proposals
  + Option 1: Agree the CR
  + Option 2: Revise the CR
  + Option 3: Note the CR
* Recommended WF
  + Option 2: Revise the CR to include the phrase ‘in the current release’ as usually done.

*Agreement:* Revise the CR to include the phrase ‘in the current release’ as usually done.

### Sub-topic 1-4

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-4: CR in R4-2402737**

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| Proposal 1: Remove term DCH, correct transmission to transmission bandwidth configuration to align the usage throughout the sync raster section.  Observation 1: In RAN4#109 R4-2318564 was agreed, however some of the changes were missed in the CR implementation. This CR corrects the implementation errors making the specification content as originally intended and agreed in R4-2318564. |

* Proposals
  + Option 1: Agree the CR
  + Option 2: Revise the CR
  + Option 3: Note the CR
* Recommended WF
  + Option 1: Agree the CR

### Sub-topic 1-5

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-5: CR in R4-2402738**

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| Proposal 1: Remove undefined term DCH.  Observation 1: In RAN4#109 R4-2318566 was agreed, however some of the changes were missed in the CR implementation. This CR corrects the implementation errors making the specification content as originally intended in R4-2318566. |

* Proposals
  + Option 1: Agree the CR
  + Option 2: Revise the CR
  + Option 3: Note the CR
* Recommended WF
  + Option 1: Agree the CR

# Topic #2: UE RF requirements

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2400595 | Anritsu Limited | Withdrawn |
| R4-2401386 | Anritsu Limited | Proposal 1: Addition of a row for CBW=3MHz in Table F.5.3-1 with the parameter values for EVM window length for normal CP for NR, FR1, 15 kHz SCS.  Observation 1: Following the newly introduced 3MHz channel BW in Rel-18, Table F.5.3-1 EVM window length needs to be updated. Parameters will be proposed based on the LTE specs (36.101), but ratio of W to CP should be aligned to legacy definitions in NR spec (50%). |
| R4-2402406 | Nokia, Nokia Shanghai Bell, Skyworks Solutions Inc. | Proposal 1: It is proposed to add 3 MHz channel bandwidth for NS\_17 in the NR spec.  Observation 1: NS\_17 emission requirement can be fulfilled without A-MPR or RB restriction for NR band n28 3 MHz operation in Japan. |
| R4-2402407 | Nokia, Nokia Shanghai Bell, Skyworks Solutions Inc. | Revised in R4-2402935 |
| R4-2402935 | Nokia, Nokia Shanghai Bell, Skyworks Solutions Inc. | Proposal 1: 3 MHz channel bandwidth for NS\_17 is only specified at 715-718 MHz.  Observation 1: NS\_17 for 3 MHz channel bandwidth in band n28 operation for Japan is not properly specified. It needs to be aligned with E-UTRA requirement, i.e., 3 MHz channel bandwidth for uplink only at 715-718 MHz without A-MPR. |

## Open issues summary

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

### Sub-topic 2-1

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1: CR in R4-2401386**

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| Proposal 1: Addition of a row for CBW=3MHz in Table F.5.3-1 with the parameter values for EVM window length for normal CP for NR, FR1, 15 kHz SCS.  Observation 1: Following the newly introduced 3MHz channel BW in Rel-18, Table F.5.3-1 EVM window length needs to be updated. Parameters will be proposed based on the LTE specs (36.101), but ratio of W to CP should be aligned to legacy definitions in NR spec (50%). |

* Proposals
  + Option 1: Agree the CR
  + Option 2: Revise the CR
  + Option 3: Note the CR
* Recommended WF
  + Option 1: Agree the CR

### Sub-topic 2-2

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-2: Proposal in R4-2402406 and CR in R4-2402935 (Revision of R4-2402407)**

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| R4-2402406  Proposal 1: It is proposed to add 3 MHz channel bandwidth for NS\_17 in the NR spec.  Observation 1: NS\_17 emission requirement can be fulfilled without A-MPR or RB restriction for NR band n28 3 MHz operation in Japan.  R4-2402935  Proposal 1: 3 MHz channel bandwidth for NS\_17 is only specified at 715-718 MHz.  Observation 1: NS\_17 for 3 MHz channel bandwidth in band n28 operation for Japan is not properly specified. It needs to be aligned with E-UTRA requirement, i.e., 3 MHz channel bandwidth for uplink only at 715-718 MHz without A-MPR. |

* Proposals
  + Option 1: Approve proposal in R4-2402406 and agree CR in R4-2402935.
  + Option 2: Approve proposal in R4-2402406 and revise CR in R4-2402935.
  + Option 3: Note proposal in R4-2402406 and note CR in R4-2402935.
* Recommended WF
  + Option 1: Approve proposal in R4-2402406 and agree CR in R4-2402935.

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