**3GPP TSG RAN WG1 Meeting #101-e R1-200xxxx**

**May 25th – June 5th, 2020**

**Agenda item: 7.2.2.1.1**

**Source: Moderator (Qualcomm Incorporated)**

**Title: FL summary for initial access signals and channels for NR-U**

**Document for: Discussion and Decision**

# Introduction

This paper summarizes the text proposals submitted to agenda item 7.2.2.1.1.

# SSB and Type0-PDCCH monitoring

**Issue 2.1. Type0-PDCCH monitoring**

[2], [3], and [6] discussed enhancements to Type0-PDCCH monitoring by focusing on M=1/2 and support Type0-PDCCH monitoring in the same slot as SSB only.

In [2], it is proposed to keep M=1/2 for Type0-PDCCH monitoring only.

In [3], it was proposed to add the entries with M=1/2 for Type0-PDCCH configuration

In [6], M=1 or M=2 entries are replaced with M=1/3 entries.

The proposals and TPs are captured below:

**Proposal in [2]: For NR-U, only configuration parameter M = 1/2 in Table 13-11 in 3GPP TS 38.213 should be supported to let SS/PBCH block and its associated Type-0 PDCCH in the same slot, and the following TP#1 can be considered.**

-------------------------------------------- < Start of text proposal #1 for 38.213 [1]> -------------------------------------------

13 UE procedure for monitoring Type0-PDCCH CSS sets

< Unchanged parts are omitted >

Table 13-11A: Parameters for PDCCH monitoring occasions for Type0-PDCCH CSS set - SS/PBCH block and CORESET multiplexing pattern 1 and FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index |  | Number of search space sets per slot |  | **First symbol index** |
| 0 | 0 | 1 | 1/2 | 0 |
| 1 | 0 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
|  |  |  |  |  |
|  |  |  |  |  |
| 2 | 5 | 1 | 1/2 | 0 |
| 3 | 5 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
|  |  |  |  |  |
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| 4-15 | / | / | / | / |

< Unchanged parts are omitted >

--------------------------------------------------- < End of text proposal #1> -----------------------------------------------------

**Proposal in [3]: The entries in Table 1 should be included in pdcch-ConfigSIB1in MIB in order to support:**

* + - **SSB and RMSI CORESET in the same slot with odd SFN,**
		- **DRS with 8 beams and one SSB per slot.**

Table 1 PDCCH monitoring occasions for Type0-PDCCH CSS set - SS/PBCH block and CORESET multiplexing pattern 1 in unlicensed band

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index |  | Number of search space sets per slot |  | **First symbol index** |
| New | 0 | 1 | 1/2 | 0 |
| 1 | 0 | 2 | 1/2 | {0, if  is even}, {, if  is odd}  |
| New | 5 | 1 | 1/2 | 0 |
| 5 | 5 | 2 | 1/2 | {0, if  is even}, {, if  is odd}  |
| New | 10 | 1 | 1/2 | 0 |
| New  | 10 | 2 | 1/2 | {0, if  is even}, {, if  is odd}  |
| New | 15 | 1 | 1/2 | 0 |
| New  | 15 | 2 | 1/2 | {0, if  is even}, {, if  is odd}  |

**Proposal in [6]: In the table 13-11 in 38.213, remove M=2, and replace M=1 with M=1/2 in the table, and reserve last 8 rows for new band (e.g. 6GHz)**

------------------------------------------------------ Start of Text Proposal ----------------------------------------------------------

13 UE procedure for monitoring Type0-PDCCH CSS sets

------------------------------------------------------ Unchanged parts omitted ------------------------------------------------------

For operation with shared spectrum channel access and for the SS/PBCH block and CORESET multiplexing pattern 1, a UE monitors PDCCH in the Type0-PDCCH CSS set over slots that include Type0-PDCCH monitoring occasions associated with SS/PBCH blocks that are quasi co-located with the SS/PBCH block that provides a CORESET for Type0-PDCCH CSS set with respect to average gain, QCL-TypeA, and QCL-TypeD properties, when applicable [6, TS 38.214]. For a candidate SS/PBCH block index , where , two consecutive slots starting from slot include the associated Type0-PDCCH monitoring occasions. The UE determines an index of slot as that is in a frame with system frame number (SFN) satisfying if , or in a frame with SFN satisfying if . and are provided by Table 13-11A, and based on the SCS for PDCCH receptions in the CORESET [4, TS 38.211]. The index for the first symbol of the CORESET in slots and is the first symbol index provided by Table 13-11. The UE does not expect to be configured with , or with , when .

------------------------------------------------------ Unchanged parts omitted ------------------------------------------------------

Table 13-11A: Parameters for PDCCH monitoring occasions for Type0-PDCCH CSS set - SS/PBCH block and CORESET multiplexing pattern 1 and FR1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Index |  | Number of search space sets per slot |  | **First symbol index** |
| 0 | 0 | 1 | 1/2 | 0 |
| 1 | 0 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
| 2 | 2 | 1 | 1/2 | 0 |
| 3 | 2 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
| 4 | 5 | 1 | 1/2 | 0 |
| 5 | 5 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
| 6 | 7 | 1 | 1/2 | 0 |
| 7 | 7 | 2 | 1/2 | {0, if  is even}, {, if  is odd} |
| 8 |  |  |  |  |
| 9 |  |  |  |  |
| 10 |  |  |  |  |
| 11 |  |  |  |  |
| 12 |  |  |  |  |
| 13 |  |  |  |  |
| 14 |  |  |  |  |
| 15 |  |  |  |  |

-------------------------------------------------------- End of Text Proposal --------------------------------------------------------

**Issue 2.2: Default PDSCH table**

[2], [3], and [6] discussed the default PDSCH table. Both [2] and [3] believe there is no need to support a new entry with (S=7, L=7) for default A table for PDSCH SLIV. In [6], it is proposed to add (7,7) entry) with proposal and TP below:

**Proposal in [6]: Replace row 10 with an entry with (S=7, L=7) for default A table for PDSCH SLIV for normal CP, and consider to adopt the TP in Appendix 9.3.**

------------------------------------------------------ Start of Text Proposal ----------------------------------------------------------

------------------------------------------------------ Unchanged parts omitted ------------------------------------------------------

5.1.2.1.1 Determination of the resource allocation table to be used for PDSCH

For operation with shared spectrum channel access, as described in [16, TS 37.213], UE reinterprets *S* and *L* in row 9 of Table 5.1.2.1.1-2 as *S=6* and *L=7,* and UE reinterprets *S* and *L* in row 10 of Table 5.1.2.1.1-2 as *S=7* and *L=7*.

-------------------------------------------------------- End of Text Proposal --------------------------------------------------------

**Issue 2.3: PDSCH rate matching**

[8] discussed PDSCH rate matching SSB enhancement with rate matching bits in DCI 1\_1. Basically supporting rate matching into SSB when indicated by the bit in DCI 1\_1.

***Proposal 6: When DCI format 1\_1 contains rate matching indication and at least one configured rate-match pattern overlaps the REs of candidate SSB, UE shall perform the rate-matching around candidate SSB for PDSCH reception based on rate matching indication; otherwise, UE shall perform the rate-matching around candidate SSB for PDSCH reception based on ssb-PositionsInBurst.***

---------------------------------------------------- TP3 38.214 ---------------------------------------------------------------

5.1.4 PDSCH resource mapping

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 0, the UE shall assume that no SS/PBCH block is transmitted in REs used by the UE for a reception of the PDSCH.

When receiving the PDSCH scheduled with SI-RNTI and the system information indicator in DCI is set to 1, RA-RNTI, MsgB-RNTI, P-RNTI or TC-RNTI, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst*, and if the PDSCH resource allocation overlaps with PRBs containing candidate SS/PBCH block transmission resources the UE shall assume that the PRBs containing candidate SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where candidate SS/PBCH block ~~is~~ may be transmitted.

A UE expects a configuration provided by *ssb-PositionsInBurst* in *ServingCellConfigCommon* to be same as a configuration provided by *ssb-PositionsInBurst* in *SIB1*.

When receiving PDSCH scheduled by PDCCH with CRC scrambled by C-RNTI, MCS-C-RNTI, CS-RNTI, or PDSCHs with SPS, the REs corresponding to the configured or dynamically indicated resources in Clauses 5.1.4.1, 5.1.4.2 are not available for PDSCH. Furthermore, if the Rate matching indicator field is not present in the DCI format carried by the PDCCH, or the RateMatchPattern(s), as described in Clause 5.1.4.1, do not overlap with the PRBs containing candidate SS/PBCH block transmission resources, the UE assumes SS/PBCH block transmission according to *ssb-PositionsInBurst* if the PDSCH resource allocation overlaps with PRBs containing candidate SS/PBCH block transmission resources, the UE shall assume that the PRBs containing candidate SS/PBCH block transmission resources are not available for PDSCH in the OFDM symbols where candidate SS/PBCH block ~~is~~ may be transmitted.

A UE is not expected to handle the case where PDSCH DM-RS REs are overlapping, even partially, with any RE(s) not available for PDSCH*.*

**<Unchanged parts are omitted>**

--------------------------------------------------------- END -----------------------------------------------------------

**Issue 2.4: MIB interpretation of overlapping frequency bands**

[4], [7], [8], and [9] consider the problem that a part of 6GHz band can be either licensed or unlicensed band depending on region.

[9] believes the discussion is not in scope of Rel.16 and can be solved in RAN2 ro RAN4 in the future.

In [4], the following options and proposals are provided:

Option 1) The UE attempts SIB1 reception during initial access based on two different hypotheses on the MIB content (legacy content, and new content including Q). Once SIB1 is successfully decoded, the UE will know if shared/licensed spectrum channel access shall be used on the accessed carrier.

Option 2) A PBCH CRC scrambling, similar as for PDCCH, can be introduced, where the scrambling would be different depending on if the new MIB or legacy MIB interpretation should be used.

Option 3) RAN4 can define non-overlapping GSCN points depending on which channel access requirements that apply to the band.

**Proposal in [4]. RAN1 should discuss the MIB interpretation ambiguity issue for overlapping frequency bands and agree on if and how the issue should be resolved.**

In [7], another option of using a MIB bit to differentiate licensed and unlicensed is proposed.

**Proposal in [7]: MIB 1 bit indicates whether MIB is interpreted as a way for operation without shared spectrum channel access or for operation with shared spectrum channel access, in order to resolve the ambiguity on MIB interpretations for 6 GHz operation.**

In [8], option 3 is preferred

**Proposal in [8]: The MIB interpretation ambiguity issue for overlapping frequency bands should be resolved. Different sync raster point are defined for licensed and unlicensed operation.**

TP to indicate allowed sync raster

------------------------------------------------------TP1 TS 38.213 --------------------------------------------------------

13 UE procedure for monitoring Type0-PDCCH CSS sets

**<Unchanged parts are omitted>**

If a UE detects a first SS/PBCH block and determines that a CORESET for Type0-PDCCH CSS set is not present, for operation without shared spectrum channel access, and for  for FR1 or for  for FR2, the UE may determine the nearest (in the corresponding frequency direction) global synchronization channel number (GSCN) of a second SS/PBCH block having a CORESET for an associated Type0-PDCCH CSS set as .  is the GSCN of the first SS/PBCH block and  is a GSCN offset provided by Table 13-16 for FR1 and Table 13-17 for FR2. For operation with shared spectrum channel access, and for  for FR1, the UE may determine the nearest (in the corresponding frequency direction) allowed global synchronization channel number (GSCN) of a second SS/PBCH block having a CORESET for an associated Type0-PDCCH CSS set as.  is the GSCN of the first SS/PBCH block and  is a GSCN offset provided by Table 13-16 for FR1. UE assumes the GSCN offset refers to the nearest allowed GSCN as defined in [8-1, TS 38.101-1] for FR1. If the GSCN offset refers to a GSCN which is not allowed in [8-1, TS 38.101-1] for FR1, UE may ignore the information related to GSCN of SS/PBCH locations in performing cell search. If the UE detects the second SS/PBCH block and the second SS/PBCH block does not provide a CORESET for Type0-PDCCH CSS set, as described in Clause 4.1, the UE may ignore the information related to GSCN of SS/PBCH block locations for performing cell search.

If a UE detects a SS/PBCH block and determines that a CORESET for Type0-PDCCH CSS set is not present, and for  for FR1 or for  for FR2, the UE determines that there is no SS/PBCH block having an associated Type0-PDCCH CSS set within a GSCN range . and  are respectively determined by *controlResourceSetZero* and *searchSpaceZero* in *pdcch-ConfigSIB1*. If the GSCN range is , the UE determines that there is no information for a second SS/PBCH block with a CORESET for an associated Type0-PDCCH CSS set on the detected SS/PBCH block.

If a UE does not detect any SS/PBCH block providing a CORESET for Type0-PDCCH CSS set, as described in Clause 4.1, within a time period determined by the UE, the UE may ignore the information related to GSCN of SS/PBCH locations in performing cell search.

Table 13-16: Mapping between the combination of  and *controlResourceSetZero* and *searchSpaceZero* in *pdcch-ConfigSIB1* to  for FR1

|  |  |  |
| --- | --- | --- |
|  | *16×controlResourceSetZero +searchSpaceZero* |  |
| 24 | 0, 1, …, 255 | 1, 2, …, 256 |
| 25 | 0, 1, …, 255 | 257, 258, …, 512 |
| 26 | 0, 1, …, 255 | 513, 514, …., 768 |
| 27 | 0, 1, …, 255 | -1, -2, …, -256 |
| 28 | 0, 1, …, 255 | -257, -258, …, -512 |
| 29 | 0, 1, …, 255 | -513, -514, …., -768 |
| 30 | 0, 1, …, 255 | Reserved, Reserved, …, Reserved |

Table 13-17: Mapping between the combination of  and *controlResourceSetZero* and *searchSpaceZero* in *pdcch-ConfigSIB1* to  for FR2

|  |  |  |
| --- | --- | --- |
|  | *16×controlResourceSetZero +searchSpaceZero* |  |
| 12 | 0, 1, …, 255 | 1, 2, …, 256 |
| 13 | 0, 1, …, 255 | -1, -2, …, -256 |
| 14 | 0, 1, …, 255 | Reserved, Reserved, …, Reserved |

**<Unchanged parts are omitted>**

--------------------------------------------------------- END -----------------------------------------------------------

# CSI-RS enhancements in DRS

**Issue 3.1: On CSI-RS configuration enhancements:**

[1], [2], [3], [5], and [8] discussed CSI-RS configurations in NR-U.

In [1] and [2], [3], CSI-RS configuration enhancement not needed

In [5], the following enhancement is proposed:

**Proposal in [5]: At least for RLM, NR-U shall support the following enhancement to CSI-RS as part of discovery burst:**

* **UE assumes a CSI-RS resource has at least one transmission occasions in a discovery burst transmission window, wherein the slot index of the transmission occasion has the same value of ;**
* **The initial condition for generating the CSI-RS sequence in a discovery burst transmission window is the same in at least one transmission occasions and according to**

**.**

============================== Start of TP for TS 38.213 =================================

5 Radio Link Monitoring

============================= Unchanged Texts Omitted =================================

For operation with shared spectrum channel access, when a UE is provided a SS/PBCH block index by *ssb-Index*, the UE is expected to perform radio link monitoring using SS/PBCH block(s) in the discovery burst transmission window as described in Clause 4.1.

For operation with shared spectrum channel access, when a UE is provided a CSI-RS resource configuration index by *csi-RS-Index*, and the CSI-RS resource is configured in the discovery burst transmission window, the UE assumes the CSI-RS resource can be transmitted in one of the occasions in the discovery burst transmission window with slot index having the same value of , where is the slot index within the discovery burst transmission window.

============================= Unchanged Texts Omitted =================================

============================== End of TP for TS 38.213 =================================

============================== Start of TP for TS 38.211 =================================

7.4.1.5.2 Sequence generation

The UE shall assume the reference-signal sequence  is defined by



where the pseudo-random sequence  is defined in clause 5.2.1. The pseudo-random sequence generator shall be initialised with

at the start of each OFDM symbol where and is the slot index within the discovery burst transmission window, if the CSI-RS resource is configured within a discovery burst transmission window for radio link monitoring and for operation with shared spectrum channel access, and is the slot number within a radio frame otherwise,  is the OFDM symbol number within a slot, and  equals the higher-layer parameter s*cramblingID* or *sequenceGenerationConfig*.

============================== End of TP for TS 38.211 =================================

In [8], it is proposed to have different rules for CSI-RS QCL association inside and outside DRS window.

**Proposal in [8]: For the CSI-RS outside DRS window, the associated SSB index should be the SSB index, for the CSI-RS inside DRS window, the associated SSB should be the candidate SSB index.**

**Issue 3.2: On CSI-RS validation in DRS**

[1], [3], and [6] discussed CSI-RS validation in DRS

In [1], using SSB detection to validate configured CSI-RS in the same slot with the same QCL is proposed

**Proposal in [1]: If the configured CSI-RS is located in the same slot as the QCLed SSB, UE will assume the CSI-RS is transmitted when the SSB is detected.**

In [3], using SSB detection to validate the closest CSI-RS with same QCL is proposed

**Proposal in [3]: the valid CSI-RS resource in a DRS window is the one closest to the detected SSB and with TCI state associating with the same SSB index.**

In [6], outside COT, the CSI-RS is proposed to be validated with SSB and Type0-PDCCH.

**Proposal 5 in [6]: Outside the COT informed by DCI format 2-0, if UE does not detect a SSB or a Type0-PDCCH overlapping with a periodic or semi-persistent CSI-RS, UE should cancel the reception of the CSI-RS.**

**Proposal 6 in [6]:: Outside the COT informed by DCI format 2-0, if UE does not detect a SSB or a Type0-PDCCH before a periodic or semi-persistent CSI-RS with time gap of X symbol(s), UE should cancel the reception of the CSI-RS.**

**Proposal 7 in [6]:: Outside the COT informed by DCI format 2-0, if UE does not detect a DCI format to schedule PDSCH overlapping with a periodic or semi-persistent CSI-RS, UE should cancel the reception of the CSI-RS.**

**Proposal 8 in [6]:: Outside the COT informed by DCI format 2-0, if a periodic or semi-persistent CSI-RS is not confined in initial active DL BWP, UE should cancel the reception of the CSI-RS.**

**Issue 3.3: On CSI-RS transmission in different slots within DRS with the same QCL**

In [3], it is further proposed to assume only one CSI-RS with the same QCL is transmitted in DRS window

**Proposal in [3]: Once gNB transmits CSI-RS on a CSI-RS resource together with its corresponding SSB on a candidate SSB position, gNB can stop transmitting CSI-RS on the following CSI-RS resources corresponding to other candidate SSB positions with same SSB index in the same DRS window.**

# PRACH enhancements

**Issue 4.1: LBT gap between PRACH**

In [1] and [5], it is proposed to add an LBT gap between PRACH with even or odd only RO being valid.

Proposal in [1]: To reduce the PRACH delay caused by the blockage issue, LBT gap between RACH occasions should be supported, i.e. only even or odd numbered time domain RACH occasions in a RACH slot are used based on existing PRACH configurations.

----------------------------------------TP1: Start TP for Section 8.1 of TS 38.213 -------------------------------------

For unpaired spectrum,

- if a UE is not provided *tdd-UL-DL-ConfigurationCommon*, a PRACH occasion in a PRACH slot is valid if it does not precede a SS/PBCH block in the PRACH slot and starts at least  symbols after a last SS/PBCH block reception symbol, where  is provided in Table 8.1-2.

- the index of the SS/PBCH block is provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*

- If a UE is provided *tdd-UL-DL-ConfigurationCommon*, a PRACH occasion in a PRACH slot is valid if

- it is within UL symbols, or

- it does not precede a SS/PBCH block in the PRACH slot and starts at least  symbols after a last downlink symbol and at least  symbols after a last SS/PBCH block symbol, where  is provided in Table 8.1-2, and if *ChannelAccessType-r16* = *semistatic* is provided, does not overlap with a set of consecutive symbols before the start of a next channel occupancy time where there shall not be any transmissions, as described in [15, TS 37.213]

- the index of the SS/PBCH block is provided by *ssb-PositionsInBurst* in *SIB1* or in
*ServingCellConfigCommon*.

- if operating in shared spectrum access, only odd numbered RACH occasions within one slot in time domain based on higher layer configuration for PRACH transmission [4, TS 38.211] are valid.

----------------------------------------TP1: End TP for Section 8.1 of TS 38.213 -------------------------------------

**Proposal in [5]: NR-U shall support non-consecutive ROs within the same RACH slot, wherein the ROs with even/odd indexes are reserved for LBT gap.**

============================== Start of TP for TS 38.213 =================================

8.1 Random access preamble

============================= Unchanged Texts Omitted =================================

For unpaired spectrum,

- if a UE is not provided *tdd-UL-DL-ConfigurationCommon*, a PRACH occasion in a PRACH slot is valid if it does not precede a SS/PBCH block in the PRACH slot and starts at least symbols after a last SS/PBCH block reception symbol, where is provided in Table 8.1-2 and, if *ChannelAccessMode-r16* = *semistatic* is provided, does not overlap with a set of consecutive symbols before the start of a next channel occupancy time where the UE does not transmit [15, TS 37.213]

- the index of the SS/PBCH block is provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*

- If a UE is provided *tdd-UL-DL-ConfigurationCommon*, a PRACH occasion in a PRACH slot is valid if

- it is within UL symbols, or

- it does not precede a SS/PBCH block in the PRACH slot and starts at least symbols after a last downlink symbol and at least symbols after a last SS/PBCH block symbol, where is provided in Table 8.1-2, and if *ChannelAccessMode-r16* = *semistatic* is provided, does not overlap with a set of consecutive symbols before the start of a next channel occupancy time where there shall not be any transmissions, as described in [15, TS 37.213]

- the index of the SS/PBCH block is provided by *ssb-PositionsInBurst* in *SIB1* or in *ServingCellConfigCommon*.

For preamble format B4 [4, TS 38.211], .

Table 8.1-2: values for different preamble SCS

|  |  |
| --- | --- |
| Preamble SCS |  |
| 1.25 kHz or 5 kHz | 0 |
| 15 kHz or 30 kHz or 60 kHz or 120 kHz | 2 |

For both paired spectrum and unpaired spectrum, if operation with shared spectrum channel access, only the even numbered RO in a PRACH slot provided by higher layer configuration for PRACH transmission [4, TS 38.211] are available to be used.

============================= Unchanged Texts Omitted =================================

============================== End of TP for TS 38.213 =================================

**Issue 4.2: RO validation in FBE**

[8] and [9] discussed RO validation.

In [8], it is proposed to further validate RO with RMSI location

In [9], it is argued the UE should still consider RO valid even if in a slot with Type0-PDCCH CSS.

**Proposal in [9]: Unless means for validating gNB COT in FFP not containing DRS are introduced, UE shall validate ROs in a slot containing TYPE0 CSS.**

**Proposal 3 in [8]: If a PRACH occasion is overlapped (fully or partially) with a slot which contains RMSI, the PRACH occasion should be treated as invalid PRACH occasion.**

**Proposal 4 in [8]: If long PRACH sequence is configured, UE is not expected to be configured with FDMed PRACH occasions.**

------------------------------------------------------TP2 TS 38.213 --------------------------------------------------------

8.1 Random access preamble

**<Unchanged parts are omitted>**

For unpaired spectrum

if a UE is not provided tdd-UL-DL-ConfigurationCommon, a PRACH occasion in a PRACH slot is valid if it does not precede a SS/PBCH block in the PRACH slot and starts at least Ngap symbols after a last SS/PBCH block reception symbol, where Ngap is provided in Table 8.1-2

if a UE is not provided tdd-UL-DL-ConfigurationCommon, a PRACH occasion in a PRACH slot is valid if it is not in the Type0-PDCCH monitoring slot.

**<Unchanged parts are omitted>**

--------------------------------------------------------- END -----------------------------------------------------------

**Issue 4.3: LBT for 2-step RACH**

In [8], further clarification on PO LBT requirement in 2-step RACH is provided

***Proposal in [8]: In 2-step RACH, if a PO is within a COT initiated by a UE for PRACH transmission on an associated RO, for PUSCH transmission on the PO,***

* ***If the gap between the RO and the PO is smaller than 16, type 2C channel access procedure should be used.***
* ***If the gap between the RO and the PO is more than or equal to 16 but less than 25, type 2B channel access procedure should be used.***
* ***If the gap between the RO and the PO is more than or equal to 25, type 2A channel access procedure should be used.***

----------------------------------- TP4: Start of TP 37.213 section 4.2.1 ---------------------------------------------

4.2.1 Channel access procedures for uplink transmission(s)

<Unchanged parts are omitted>

A UE shall use Type 1 channel access procedure for transmissions related to random access procedure that initiate a channel occupancy with UL channel access priority class in Table 4.2.1-1.

In Type-2 random access procedure, a UE may transmit a PUSCH on a PUSCH occasion within a channel occupancy that the UE initiated for a PRACH transmission on an associated RACH occasion after a gap as follows:

- If the gap is up to, the UE can transmit the PUSCH on the channel after performing Type 2C UL channel access as described in subclause 4.2.1.2.3.

- If the gap is more than or equal to 16 but less than 25,the UE can transmit the PUSCH on the channel after performing Type 2B UL channel access as described in subclause 4.2.1.2.2.

- If the gap is more than or equal to 25, the UE can transmit the PUSCH on the channel after performing Type 2A UL channel access as described in subclause 4.2.1.2.1.

<Unchanged parts are omitted>

----------------------------------------End of TP 37.213 section 4.2.1 ---------------------------------------------

**Issue 4.4: Dynamic PRACH configuration switching with DCI**

In [3], it is proposed to allow dynamic switching of PRACH configuration with DCI

***Proposal in [3]: Dynamic scheduling of PRACH occasion via DCI and via DRS could be considered in NR-U.***

# Preparation phase discussion

In the preparation stage of the email discussion, we need to identify which issue(s) need further email discussion. Please provide your view below. Note that many (most) of the topics have been discussed before without any conclusion. Please take that into consideration as well. Given the email discussion thread limited, it is very unlikely we will have more than 1 email thread for this agenda item, each company please provide the top 2 issues you are interested in.

Table 1. View on priority

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Company | 2.1 | 2.2 | 2.3 | 2.4 | 3.1 | 3.2 | 3.3 | 4.1 | 4.2 | 4.3 | 4.4 |
| Samsung |  |  |  |  | Yes |  |  | Yes |  |  |  |
| Sharp |  |  |  | Yes |  | Yes |  |  |  |  |  |
| Nokia, NSB |  |  |  |  |  |  |  |  | Yes |  | Yes |
| OPPO |  |  |  |  | Yes |  |  |  | Yes |  |  |
| Spreadtrum | Yes |  |  |  |  | Yes |  |  |  |  |  |
| Ericsson |  |  |  | Yes |  |  |  |  |  |  |  |
| LG Electronics |  |  |  | Yes |  |  |  |  |  | Yes |  |
| ZTE | Yes |  |  |  |  |  |  |  |  |  |  |
| vivo |  |  |  |  |  | Yes |  | Yes |  |  |  |
| Huawei, HiSilicon | Yes |  |  |  |  | Yes |  |  |  |  |  |
| Charter Communications |  |  |  | Yes |  | Yes |  |  |  |  |  |

Please provide additional view below:

|  |  |
| --- | --- |
| Company | Comments |
| Samsung | For 2.3, the proposal is not needed. The only difference between Rel-15 and Rel-16 is to replace SSB indicated by ssb-PositionsInBurst by candidate SSB derived from ssb-PositionsInBurst, and it has been correctly captured in current spec. For 2.4, it is not clear whether a licensed band around 6 GHz will be introduced in Rel-16, so the discussion here may be still preliminary considering the spec impact. Regarding the proposals for resolving the issue, Option 2 in [4] should not be supported, since it actually also needs a blind detection, which is similar to Option 1 but with much more spec impact (although complexity is a little bit smaller but may not worth it). Option 3 is a feasible solution (it’s very simple to avoid overlapped sync raster points in our view), but it does not essentially resolve the whole issue considering the location of SSB on SCell. Combination of Option 1 and Option 3 can resolve the issue (i.e., trying to avoid same sync raster point to resolve the issue for Pcell SSB overlapping, and using blind detection for Scell SSB overlapping. Since the ANR SSB is not typical, the complexity should be OK in our view). Another feasible solution is using one bit (e.g. reserved bit) to explicit indicate unlicensed or licensed band, as proposed in [7]. Anyway, there are feasible solutions on the table, and we can adopt one of them when the issue indeed happens, e.g. when the licensed band around 6 GHz is indeed introduced, no matter in Rel-16 (can propose a Rel-16 TEI to resolve this issue) or in later releases. We also didn’t see a difference to discuss/support any of the proposals now or in the future. For 3.1, strictly speaking, our proposal is not on the enhancement to the CSI-RS configuration, since we don’t intend to change any of current configurations. Our proposal is for CSI-RS for RLM, where at most 4 RLM-RS resources can be configured, so the comments in [1][2][3] do not hold. By the restriction of the number of RS for RLM, we didn’t see any implementation using Rel-15 CSI-RS framework can work well for unlicensed spectrum due to LBT, and other companies’ feedback on this issue is appreciated. For 4.1, this topic is related to the PRACH-PUSCH gap discussion under 7.2.2.2. There, we didn’t find benefit of supporting N<2 for the case of multiple Ros in a PRACH slot. But if we can support LBT gap between Ros, it has higher chance to guarantee a successful LBT before the last RO in a PRACH slot, which makes the proposal of N<2 more beneficial. Without the proposal of LBT gap between Ros, the benefit of N<2 is really minor. For 4.3, we believe the wording “A UE shall use Type 1 channel access procedure for transmissions related to random access procedure” refers to both RACH types, so 2-step RACH has been clearly covered by current specification and no further clarification is needed. For 4.4, both proposals were covered in the SI, but no further discussion within the WI, so we believe there is a default conclusion to not to support within this release, although we can see the technical merit of the proposals.  |
| Sharp | Issue 2.1: We share the view that it’s technically an issue. However, in the late stage of the CR, NR-U can work without change.Issue 2.2: We share the view that it’s technically an issue. However, in the late stage of the CR, NR-U can work without change.Issue 2.3: We don’t think it as an issue.Issue 2.4: We support to discuss it in this meeting although we objected at the last meeting. NR-U WI scope is below 7 GHz. Issue 3.1: We don’t see it as an issue. For example, in Figure 2 in [5], 2 CSI-RS resources with a periodicity of NQCLSSB slots can work.Issue 3.2: Can be discussed at this meeting.Issue 4.1: We share the view that it’s technically an issue. However, in the late stage of the CR, NR-U can work without change.Issue 4.2: Can be discussed in future meeting.Issue 4.3: Should we wait for decision on gap between PRACH and PUSCH potentially discussed in 7.2.2.2.5?Issue 4.4: We share the view that it’s technically an issue. However, in the late stage of the CR, NR-U can work without change. |
| Nokia, NSB | Our views from last meeting do not change, for new issues2.3 spec is clear on how to interpret ssb-PositionInBurst in NR-U and which SSB should be rate-matched4.2 (RO validation in FBE) and 4.4 (Switching between long and short PRACH) we think that these topics would deserve discussion, as has never been discussed before. |
| Spreadtrum | For issue 2.1, in our view, M>1/2 is problematic. For example, if M=1, according to , the starting slot of Type0-PDCCH monitoring occasions is 20, when due to LBT failures. There are 15 slots between the transmitted SSB and the associated Type0-PDCCH, in which the SSB and the Type0-PDCCH are in two separate COT, and the association relationship seems infeasible. This is more severe for O>0 and M>1/2. If some companies thought M=1 is useful for some cases, maybe we can **remove O>0 and M>1/2** in the table.

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| --- | --- | --- | --- |
| Index |  | Number of search space sets per slot |  |
| 0 | 0 | 1 | 1 |
| 1 | 0 | 2 | 1/2 |
| 2 |  |  |  |
| 3 | 2 | 2 | 1/2 |
| 4 |  |  |  |
| 5 | 5 | 2 | 1/2 |
| 6 |  |  |  |
| 7 | 7 | 2 | 1/2 |
| 8 | 0 | 1 | 2 |
| 9 |  |  |  |
| 10 | 0 | 1 | 1 |
| 11 | 0 | 1 | 1 |
| 12 |  |  |  |
| 13 |  |  |  |
| 14 |  |  |  |
| 15 |  |  |  |

We do not know the use case for O>0 and M>1/2, in which there is huge gap b/w the SSB and the associated Type0-PDCCH. Can any company provide an example on the use case for O>0 and M>1/2?For issue 3.2, we have discussed the validation of CSI-RS in DRS in DL topic in the previous e-meeting, but some companies did not accept to discuss the validation of CSI-RS in DRS in DL topic with some reasons, e.g. time limit, or the validation of CSI-RS in DRS is irrelevant to the legacy discussion in DL topic. We are confused where to discuss the validation of CSI-RS in DRS, or UE definitely cannot validate the CSI-RS in DRS. If it is the later one in the majority view, we suggest removing the CSI-RS in DRS for clear implementation for UE:

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| Transmission(s) initiated by a gNB that includes at least an SS/PBCH block consisting of a primary synchronization signal (PSS), secondary synchronization signal (SSS), physical broadcast channel (PBCH) with associated demodulation reference signal (DM-RS) and may also include CORESET for PDCCH scheduling PDSCH with SIB1, and PDSCH carrying SIB1. |

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| Ericsson | Issues that have been discussed before (sometimes extensively) without consensus, should not be prioritized for discussion. Many of the issues in Table 1 fall into that category. The guidance to choose “top 2” may not provide a fully accurate view of what should be discussed in this meeting. It was already clear in the last meeting that this AI was close to completion. |
| LG Electronics | For issue 2.3, it seems necessary to clarify that unavailable PDSCH resources are determined based on “candidate” SSB index in TS 38.214, but editorial.For issue 2.4, it would be better to consume RAN1 discussion time now, not in the future, since we already have several options on the table. We agree with Samsung that sync raster differentiation or MIB 1 bit can be a feasible option. Can we make a decision either of them (or both as alternatives) and inform to the corresponding WG(s)? Then, RAN1 won’t have to waste time no longer on that issue.For issue 3.1, CSI-RS based RLM can be an optional feature. Furthermore, a CSI-RS resource can be configured with multiple slots where each slot includes the same SSB index, then UE can assess quality based on one of them within a RLM window. Even in case we introduce a method to enhance configuration of CSI-RS for RLM as Samsung suggested, do we need to change sequence generation? RLM is for serving cell, which means UE tries to detect a CSI-RS for RLM just according to serving cell timing. It should be noted that the change of sequence generation for CSI-RS in LAA was introduced to reduce UE’s burden for neighbour cell RRM measurement.For issue 4.1, it is not agreeable. Since if only even Ros are used, the RO capacity will be decreased (in other words, resource overhead to make gap will be increased). Rather, other alternatives can be considered (e.g., puncturing a part of RO to create gap).For issue 4.2, it is unclear why only the Type0-PDCCH monitoring requires a RO validation process.For issue 4.3, although we think the proposal in 4.3 seems to be essential and needs to be specified for UE’s LBT procedure in 2-step RACH, it should be clarified that applying the proposal in 4.3 is limited to the case where no gap transmission (e.g., with CP extension) between RO and PO is not allowed.For issue 4.4, it seems to be an optimization at this stage for Rel-16, and thus it could be discussed further during Rel-17. |
| ZTE | For Issue 2.4, we’d better discuss it in future when 6GHz is included in licensed band. We have several simple solutions to resolve this issue and it makes no difference whether we consider the proposal now or later. Besides, the discussion of 6GHz band in RAN4 seems still not completed yet, it’s more appropriate to wait for RAN4’s decision. |
| Qualcomm | Issue 2.1, 2.2, 3.1, 3.2, 3.3, 4.1, and 4.2 have been discussed before without consensus. May not worth additional effort in this meeting.Issue 2.3 is about additional rate matching behaviour (allow PDSCH to rate match into SSB if SSB is not transmitted). Though we understand the merit of the proposal, it might be too late for this change. Issue 2.4 is also discussed before. Though we are interested in this discussion, we understand there are companies with strong opinion that we don’t have licensed band in 6GHz yet and would prefer to delay the discussion. Issue 4.3 should be already captured by the spec.Issue 4.4 can provide additional flexibility, but might be too late. |
| Vivo | For issue 2.1, 2.2 and 2.3, it is not essential problem and NRU could also work well.For issue 2.4, agree that it is really a technical issue which is foreseen. However, it is not urgent since 6GHz band is not settled yet.For issue 3.1, it is a minor optimization and NRU works well without this enhancement as we stated in our paper. First, SSB-based RLM is mandatory feature and using it could guarantee NRU UE work well. Second, even for CSI-RS based RLM, I don’t see big problem with the limitation of 4 RLM-RS. Third as LG mentioned, even introducing CSI-RS configuration enhancement, there is no need to change the sequence generation.For issue 3.2, it is an essential issue to be solved otherwise how could UE assume the CSI-RS is present when it is located in DRS. For issue 3.3, not an essential issue.For issue 4.1, the main problem is back to back Ros will impact the initial access performance a lot, i.e. one UE’s RO block the other UE. The selected RO is informed by higher layer. If it is blocked, UE needs to wait for a long time to receive another RO, which will make the initial access latency performance very poor. For the solutions, one is invalidation of even/odd Ros as we proposed and the other could be puncturing part of the PRACH as LG mentioned. We are open to discuss which one is better to solve the above problem.For issue 4.2, it should be discussed but I am not sure whether IA procedure AI is a more feasible place. We also raise similar issue in IA procedure AI.For issue 4.3, we think current spec is clear and no need for clarification.For issue 4.4, not an essential issue. |
| Huawei, HiSilicon | Although issue 2.1 was on the list for several meeting, it is not treated at all. We think the benefit is clear as discussed WI phase.For 2.4, we think it is not urgent to discuss in Rel 16. For issue 3.2, the behavior should be clarified as it may impact UE complexity.  |

# Reference

[1] R1-2003367, Remaining issues on initial access signals and channles, vivo

[2] R1-2003447, Remaining issues on the initial access signals for NR-U, ZTE, Sanechips

[3] R1-2003509, Maintenance on the initial access signals and channels, Huawei, HiSilicon

[4] R1-2003839, Initial access signals and channels, Ericsson

[5] R1-2003857, Initial access signals and channels for NR-U, Samsung

[6] R1-2004000, Remaining issues on initial access signals, Spreadtrum Communications

[7] R1-2004010, Remaining issues of initial access signals and channels for NR-U, LG Electronics

[8] R1-2004082, Discussion on the remaining issues of initial access signal/channel, OPPO

[9] R1-2004254, Remaining issues on Initial Access Signals and Channels for NR-U, Nokia, Nokia Shanghai Bell