3GPP TSG-RAN WG1 Meeting #101-e R1-20xxxxx

e-Meeting, 25th May – 5th June, 2020

Agenda Item: 7.2.2.1.3

Source: Moderator (Ericsson)

Title: FL Summary for [101-e-NR-unlic-NRU-ULSignalsChannels-02] Email discussion/approval

Document for: Discussion, Decision

# 1 Introduction

Based on the conclusion of the e-meeting preparation phase [18] and the vice-Chairman’s guidance, the following e-mail discussion has been kicked-off:

[101-e-NR-unlic-NRU-ULSignalsChannels-02] Email discussion/approval on the following from R1-2003842 until 5/28 – Steve (Ericsson)

* Issue #8: Clarifications on UCI multiplexing in PUSCH accounting for LBT outcome
* Editorial issues #6, #7 and #11 (moderator to draft TPs for quick approval in Week #1):

The following topics are included in this email discussion:

|  |  |  |  |
| --- | --- | --- | --- |
| 8 | Clarifications on UCI multiplexing in PUSCH accounting for LBT outcome | R1-2003859: P3-P4 |  |
| 6 | Editorial correction to UL resource allocation Type 2 when transform precoding is enabled regarding lowest-indexed PRBsTP needed to 38.214 §6.1.2.2.3 | R1-2003859 | Editorial |
| 7 | Editorial corrections to PUCCH format description – interlace1 only applies to interlaced PF2/3TP needed to 38.213 §9.2.1 | R1-2003655: P1, TP1 | Editorial |
| 11 | Editorial correction to Type 2 resource allocation to avoid misinterpretation (Section 6.1.2.2.3 in 38.214):“The UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and the union of indicated set of RB sets and intra-cell guard bands defined in Clause 7 between the indicated RB sets, if any. TP needed to 38.214 §6.1.2.2.3 | R1-2003516: P4 | EditorialMoved from wideband AI |

# 2 Discussion

## 2.1 Issue #8: UCI multiplexing in PUSCH

**Description**:

In Section 9 of TS38.213, it is specified under which conditions the UE should multiplex UCI in a PUSCH:

If a UE

- would multiplex UCI in a PUCCH transmission that overlaps with a PUSCH transmission, and

- the PUSCH and PUCCH transmissions fulfill the conditions in Clause 9.2.5 for UCI multiplexing,

the UE

- multiplexes only HARQ-ACK information, if any, from the UCI in the PUSCH transmission and does not transmit the PUCCH if the UE multiplexes aperiodic or semi-persistent CSI reports in the PUSCH;

- multiplexes only HARQ-ACK information and CSI reports, if any, from the UCI in the PUSCH transmission and does not transmit the PUCCH if the UE does not multiplex aperiodic or semi-persistent CSI reports in the PUSCH.

\*\*\* Omitted text \*\*\*

If a UE transmits multiple PUSCHs in a slot on respective serving cells and the UE would multiplex UCI in one of the multiple PUSCHs and the UE does not multiplex aperiodic CSI in any of the multiple PUSCHs, the UE multiplexes the UCI in a PUSCH of the serving cell with the smallest *ServCellIndex* subject to the conditions in Clause 9.2.5 for UCI multiplexing being fulfilled. If the UE transmits more than one PUSCHs in the slot on the serving cell with the smallest *ServCellIndex* that fulfil the conditions in Clause 9.2.5 for UCI multiplexing, the UE multiplexes the UCI in the earliest PUSCH that the UE transmits in the slot.

Regarding the highlighted text, it is observed in [9] that it may not be clear how the UE should interpret “the earliest PUSCH that the UE transmists in the slot” in the case of unlicensed operation, and whether or not it should depend on LBT outcome.

1. Discuss whether or not a change is needed on how the UE should interpret “earliest PUSCH that the UE transmits in the slot” and whether or not it should depend on LBT outcome.

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| --- | --- |
| **Company** | **View/Position** |
| MediaTek | We prefer that UCI multiplexing behavior should not depend on LBT outcome since it will complicate UE implementation. However, according to current spec, UE shall multiplex the UCI in the first PUSCH in the slot that passes LBT since the PUSCH is the first one to be “transmitted“. Thus, spec change is needed if the serving cell with the smallest *ServCellIndex* operates in shared spectrum. |
| Sharp | In a reasonable implementation, UCI multiplexing procedure starts before LBT by taking the minimum processing timeline into account. Natural consequence is that UCI multplexing procedure doesn’t depend on LBT outcome. |
| WILUS | This change does not seem to be necessary because the current spec says the earliest PUSCH that the UE transmits in the slot which LBT outcome has been already reflected not mentioning scheduled(or configured) PUSCH. |
| Samsung | We want to clarify that not only ‘earliest PUSCH that the tranmsit in the slot‘ but also which serving cell with *smallest ServCellIndex* to multiplex UCI should be clarified. For exmaple, PUSCH1 on cell1, PUSCH 2 on cell2 and PUSCH3 on cell3, and if UE fails LBT on cell1 and succeeds LBT on cell2 &3, the current spec reads like UE multiplexs UCI on PUSCH2 on cell2, becasue cell 2 is with the smallest ServCellIndex among transmitted PUSCHs. Another exmaple, if only one UL cell, and PUCCH is overlapped with PUSCH 1&2 on this cell, UE fails LBT for PUSCH1 and succeeds LBT for PUSCH2, the current spec reads like UE multiplexs UCI on PUSCH2 because PUSCH2 is the earliest PUSCH UE transmits. Considering the preparing time for UCI multiplexing/PUSCH rate matching around UCI bits, for most cases, UE has to prepare UCI and PUSCH before the end of LBT. Therefore, which serving cell as well as which PUSCH within this cell to transmit UCI should not be determined accoriding to the scheduling information in DCI(for scheduled PUSCH) or configuration (for CG PUSCH). In short, UE multiplexes the UCI in a PUSCH of the serving cell with the smallest ServCellIndex among serving cells without LBT (e.g., licensed cell or unlicensed cell with type 2C LBT), if no such serving cell, UE multiplexes the UCI in a PUSCH of the serving cell with the smallest ServCellIndex according to scheduling/configuration information. If the UE transmits more than one PUSCHs in the slot on the serving cell, the UE multiplexes the UCI in the earliest PUSCH in the slot regarless of LBT outcome.  |
| Ericsson | I appreciate Samsung efforts to clarify the intention.Based on the input, I woud like to make few general comments first:* The LBT procedures should be considered as procedures that are performed right before transmisison. The timeline of LBT is not combined/included in any of the timelines discussed for prepariton of a transmission, includig multiplexing, and even cancellation described in the Core specificaitons (38.213, 38.214, etc).
* True that across core specifications, there are statements such as ´the first PUSCH UE transmits‘, etc. However, it should be well understood that all these statements are considered without impact of LBT. When a transmisison is ready to be transmitted based on any procedures in 38.213 or 38.214, etc, then due to operation on unlicesed, one has to consider the impact of LBT, if applicable as described to 37.213. The actuall transmission as all know is subject to the succerss of LBT.
* The point above is important in our view on how we understand the specifications. It should be understood that if operation is on unlicesed, any deployment, implementation, etc, should consider the LBT aspect when applicable. That means that it is well understood that if e.g. 38.214 states in a procedure that SRS is transmitted, that can not be considered as the end of story. One step furhter is needed and that it what happens with LBT.
* Not having this appraoch, and instead trying to make changes in Core specifications to account for impact of LBT, would make the Core specifications (38.213, 38.214) subject to many unnessary changes and also potential instability in the spec.

Secondly, with respect to the proposal under discusion here, the procedures in 9.2.5 is intended for resolving overlapping between PUCCH/PUSCH resources. The resources, are configured or scheduled resources that the UE `would transmit“ if there was no overlapping. The rules for resolving the overlapping is completely clarified. Please see for example the conclusion below made in Rel-15 to clarify better orders taken into account in the procedures:When the overlapping is resolved, the UE would transmit a PUSCH. However, as explained above, it is well understood that if that transmsison is subject to the LBT, the transmision does not occur unless LBT succeeds. If LBT fails, the UE doesnt transmit. Also, it does not mean that if LBT fails, the UE has to go back to procedure 9.2.5 and determine the next candidate for transmisison.That is not the way the spec should be interpreted, due to statements in Core specificaitons such as „first transmisison“, etc. We should also be mindful that such proposals create considerable complexity at UE and gNB.As a thought, based on this proposal and similar ones in other AI, maybe it is worthwhile to have a high level conclusion how to interpret Core specifcations for operation on unlicesed with addiiton of LBT spec (37.213).  |
| Huawei | We can clarity like this ” the earliest PUSCH that the UE would transmit in the slot” |
| Lenovo, Motorola Mobility | From UE implementation’s point of view, the UCI multiplexing on PUSCH should not be dependent on LBT outcome. The current spec seemingly implies the earliest PUSCH is the first PUSCH with successful LBT. Since the UE can’t know which PUSCH is the earliest PUSCH with successful LBT, the UE does not know which PUSCH the UCI should be multiplexed on. To simplify standardization effort and UE implementation, the earliest PUSCH should be the first PUSCH which is intended to be transmitted firstly. Hence, if the first PUSCH multiplexing the UCI is failed, the PUSCH as well as the UCI is dropped. To improve reliability of UCI transmission, one straightforward solution is to multiplex the UCI in the last PUSCH among PUSCHs in the same slot. This is because the last one usually has higher transmission opportunity than the first one. |

Regarding the highlighted text, it is proposed in [9] to discuss whether or not a new procedure is needed for the case of licensed assisted (i.e., non-stand alone) operation such that the “cell with smallest ServingCellIndex” corresponds to a licensed carrier. The moderator questions whether or not this can be achieved simply by gNB configuration?

1. Discuss whether or not a new procedure is needed for the case of license assisted (non-standalone) operation such that the “cell with the smallest ServingCellIndex” corresponds to a licensed carrier.

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| --- | --- |
| **Company** | **View/Position** |
| MedaiTek | Could be implemented by gNB. New procedure is not needed. |
| Sharp | We support solution without specification impact (i.e., gNB inplementation). |
| WILUS | It seems to be possibly configured by gNB that the smallest ServingCeillIndex is configured to the licensed carrier. |
| Samsung  | It could be implemented by gNB, but more flexibility is provided if we go with the same way as in LTE eLAA that UCI is multiplexed in the cell with the smallest servingcellindex corresponds to a licensed carrier for license assisted operation.  |
| Ericsson | LTE eLAA like procedures for UCI multiplexing regariding the licesed carrier is already achievabling with the existing procedures. gNB by proper configuration and scheduling can achieve the same procedure. In our view, NR/U has introduced dditonal flexibility as compared to LTE/eLAA. This implies that what that could be achieved by LTE can enabled by NR, and much more. Ther eis no need for addiitonal specificaiton for a special use case where it is aldeay supported. |
| Huawei | Coulde be implemented by gNB. No need to make correction. |
| ZTE | Implemented by gNB. No spec change is needed. |
| Lenovo, Motorola Mobility | We think it is gNB implementation issue. So no need to specify a new procedure. |

# 3 Editorial Corrections

## 3.1 Issue #6

**Description**:

In 38.214 Section 6.1.2.2.3 it is specified that for UL resource allocation Type 2 when transform precoding (DFT-s-OFDM) is configured for PUSCH, the number of transmitted PRBs must fulfil $M\_{RB}^{PUSCH}=2^{α\_{1}}∙2^{α\_{3}}∙2^{α\_{5}}$. Furthermore, the intention of the text in this section is that PUSCH should be transmitted on the lowest-indexed$M\_{RB}^{PUSCH}$ PRBs amongst the PRBs indicated by the frequency domain resource assignment information. This text is meant to cover the case if $M\_{RB}^{PUSCH} $happens to be smaller than the number of indicated PRBs.

In [8] is pointed out that the current text may be misinterpreted that the frequency resource assignment information directly indicates the lowest-indexed PRBs which is not the intention. To correct this the following is proposed.

1. Adopt text proposal TP#1 below

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| **Company** | **View/Position** |
| Moderator (Ericsson) | Support TP#1 |
| MediaTek | Support TP#1 |
| Sharp | Support TP#1 |
| WILUS | Support TP#1 |
| Samsung  | Support TP#1 |
| Ericsson | Support TP#1 |
| Huawei | Support TP#1 |
| ZTE | Support TP#1 |
| Lenovo, Motorola Mobility | Support TP#1 |

Reason for changes

Avoid misinterpretation that the frequency domain resource assignment information directly indicates the lowest-indexed PRBs which should be used for PUSCH when UL resource allocation Type 2 is used in combination with transform precoding (DFT-s-OFDM)

Summary of changes

Addtion of the text “amongst the PRBs” to avoid misinterpretation

Specs/Sections impacted

38.214 Section 6.1.2.2.3

Consequences if not approved

Possibile misinterpretation of which PRBs are allocated for PUSCH

-------------------------------- Text Proposal (TP#1) for 38.214, Section 6.1.2.2.3 ----------------------------------

\*\*\* Unchanged text omitted \*\*\*

If transform precoding is enabled according to the procedure in Clause 6.1.3, then the UE transmits PUSCH on the lowest-indexed $M\_{RB}^{PUSCH}$ PRBs amongst the PRBs indicated by the frequency domain resource assignment information. $M\_{RB}^{PUSCH}$ is the largest integer not greater than the number of RBs indicated by the frequency domain resource assignment information that fulfils the conditions in [4, TS 38.211 Clause 6.3.1.4].

\*\*\* Unchanged text omitted \*\*\*

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

## 3.2 Issue #7

**Description**:

In [4], the following issues are identified in the current CR for 38.213 Section 9.2.1 (see [19]) including alignment with 38.331:

1. *fomat* may provide new formats *PUCCH-format2-r16* or *PUCCH-format3-r16.* The redundant part in the current specification could be removed to avoid further change for it.
2. The index of a second interlace by *interlace1-r16* is provided only the *format* indicates *PUCCH-format2-r16* or *PUCCH-format3-r16*, instead of all PUCCH formats,which should be clarified in the specification.
3. *OCC-Length-r16* and *OCC-Index-r16* are provided only when *interlace1* is not provided,which should be captured in the specification.
4. Adopt text proposal TP#2 below

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| --- | --- |
| **Company** | **View/Position** |
| Moderator (Ericsson) | Support TP#2 |
| MediaTek  | Support TP#2 |
| Sharp | Support TP#2 |
| WILUS | The first change is not needed to be removed. We support the other changes on TP#2 |
| Samsung  | Support TP#2 |
| Ericsson | Support TP#2 |
| Huawei | Share similar view as WILUS, it has already clarified “if provided”, there is no need to make the first change. We are fine with other changes. |
| ZTE | Support TP#2 |
| Lenovo, Motorola Mobility | Support TP#2 |

Reason for changes

* To capture RAN1 agreement that an OCC length is only provided for interlaced PF2/3 if a 2nd interlace is not configured
* Alignment with 38.331

Summary of changes

* Addition of text to specify that OCC length is only provided for interlaced PF2/3 if a 2nd interlace is not configured
* Removal of text on what values the parameter *format* can take in order to align with 38.331 (format can take value *PUCCH-format2-r16*, not just *PUCCH-format2*)

Specs/Sections impacted

38.213 Section 9.2.1

Consequences if not approved

Misinterpretation that an OCC length can be provided if the 2nd interlace is configured, contrary to RAN1 agreement

------------------------------------ Text Proposal (TP#2) for 38.213, Section 9.2.1 ------------------------------------

\*\*\* Unchanged text omitted \*\*\*

A PUCCH resource includes the following parameters:

- a PUCCH resource index provided by *pucch-ResourceId*

- an index of the first PRB prior to frequency hopping or for no frequency hopping by *startingPRB*, if a UE is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

- an index of the first PRB after frequency hopping by *secondHopPRB*, if a UE is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

- an indication for intra-slot frequency hopping by *intraSlotFrequencyHopping*, if a UE is not provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

- an index of a first interlace by *interlace0*, if a UE is provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

~~- if provided, an index of a second interlace by~~ *~~interlace1~~*~~, if a UE is provided~~ *~~useInterlacePUCCH-PUSCH~~* ~~in~~ *~~BWP-UplinkDedicated~~*

- an index of an RB set by *rb-SetIndex*, if a UE is provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*

- a configuration for a PUCCH format~~, from PUCCH format 0 through PUCCH format 4,~~ provided by *format*

The UE expects that *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* are provided either in all UL BWPs or in none of the UL BWPs for a serving cell.

If a UE is provided *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated*, the UE determines available RBs for PUCCH transmissions within the active UL BWP as the intersection of RBs corresponding to an interlace index provided by *interlace0* and, if provided, *interlace1*, and RBs of an RB set provided by *rb-SetIndex*. The intersection results in $M\_{interlace,0}^{PUCCH}$ RBs in the first interlace and the UE expects that $M\_{interlace,0}^{PUCCH}$ is either 10 or 11. If *interlace1* is provided, the intersection results in $M\_{interlace,1}^{PUCCH}$ RBs in the second interlace and the UE expects that $M\_{interlace,1}^{PUCCH}$ is either 10 or 11.

If the *format* indicates *PUCCH-format0*,the PUCCH format configured for a PUCCH resource is PUCCH format 0, where the PUCCH resource also includes an index for an initial cyclic shift provided by *initialCyclicShift*, a number of symbols for a PUCCH transmission provided by *nrofSymbols*, a first symbol for the PUCCH transmission provided by *startingSymbolIndex*.

If the *format* indicates *PUCCH-format1*,the PUCCH format configured for a PUCCH resource is PUCCH format 1, where the PUCCH resource also includes an index for an initial cyclic shift provided by *initialCyclicShift*, a number of symbols for a PUCCH transmission provided by *nrofSymbols*, a first symbol for the PUCCH transmission provided by *startingSymbolIndex*, and an index for an orthogonal cover code by *timeDomainOCC*.

If the *format* indicates *PUCCH-format2* or *PUCCH-format3*,the PUCCH format configured for a PUCCH resource is PUCCH format 2 or PUCCH format 3, respectively, where the PUCCH resource also includes a number of PRBs provided by *nrofPRBs*, a number of symbols for a PUCCH transmission provided by *nrofSymbols*, and a first symbol for the PUCCH transmission provided by *startingSymbolIndex*. If a UE is provided by *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated,* and the *format* indicates *PUCCH-format2-r16* or *PUCCH-format3-r16*,the PUCCH resource also includes, if provided, an index of a second interlace by *interlace1*. If the *format* indicates *PUCCH-format2-r16* or *PUCCH-format3-r16* and *interlace1* is not provided, the PUCCH resource also includes, if provided, an orthogonal cover code length by *OCC-Length-r16* and an orthogonal cover code index by *OCC-Index-r16*. If the *format* indicates *PUCCH-format3-r16*, the UE assumes that the $M\_{RB}^{PUCCH,3}$ [4, TS38.211] PRBs with the lowest indexes within the first, and if configured, second interlace are used for PUCCH transmission.

\*\*\* Unchanged text omitted \*\*\*

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

## 3.3 Issue #11

**Description**:

In Section 6.1.2.2.3 of the current CR to 38.214 (see [21]) the resource mapping onto intra cell guard bands between two indicated adjacent RB sets is specified as follows:

The UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and the indicated set of RB sets and intra-cell guard bands defined in Clause 7 between the indicated RB sets, if any.

However, as pointed out in [4], the current text highlighted in yellow can be misinterpreted as a zero resource allocation, considering the mutual exclusion between intra-cell guard bands and RB sets according to the definitions in 38.214 Section 7. To correct this the following is proposed.

1. Adopt text proposal TP#3 below

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| **Company** | **View/Position** |
| Moderator (Ericsson) | Support TP#3 |
| MedaiTek | Support TP#3 |
| Sharp | Support TP#3 |
| WILUS | Support TP#3 |
| Samsung  | Support TP#3 |
| Ericsson | Support TP#3 |
| Huawei | Support TP#3 |
| ZTE | Support TP#3 |
| Lenovo, Motorola Mobility | Support TP#3 |

Reason for changes

Avoid misinterpretation that the frequency domain resource assignment for PUSCH allocated to two or more adjacent RB sets

Summary of changes

Addtion of the text “union of the” to avoid misinterpretation

Specs/Sections impacted

38.214 Section 6.1.2.2.3

Consequences if not approved

Possibile misinterpretation of which PRBs are allocated for PUSCH allocated to two or more adjacent RB sets

--------------------------------- Text Proposal (TP#3) for 38.214, Section 6.1.2.2.3 ----------------------------------

\*\*\* Unchanged text omitted \*\*\*

6.1.2.2.3 Uplink resource allocation type 2

In uplink resource allocation of type 2, the resource block assignment information defined in [5, TS 38.212] indicates to a UE a set of up to *M* interlace indices, and for DCI 0\_0 monitored in a UE-specific search space and DCI 0\_1 a set of up to $ N\_{RB-set,UL}^{BWP}$ contiguous RB sets, where *M* and interlace indexing are defined in Clause 4.4.4.6 in [4, TS 38.211]. For DCI 0\_0 monitored in a UE-specific search space and DCI 0\_1, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and the union of the indicated set of RB sets and intra-cell guard bands defined in Clause 7 between the indicated RB sets, if any. For DCI 0\_0 monitored in a common search space, the UE shall determine the resource allocation in frequency domain as an intersection of the resource blocks of the indicated interlaces and a single uplink RB set of the active UL BWP. The uplink RB set is the one that intersects with the downlink RB set of the active downlink BWP in which the UE detects the DCI 0\_0. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP.

\*\*\* Unchanged text omitted \*\*\*

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

# References

1. R1-2003369 Remaining issues on physical UL channel design in unlicensed spectrum vivo
2. R1-2003449 Remaining issues on the UL channels for NR-U ZTE, Sanechips
3. R1-2003511 Maintenance on uplink signals and channels Huawei, HiSilicon
4. R1-2003516 Maintenance on the wideband operation procedures Huawei, HiSilicon
5. R1-2003655 Remaining issues on UL signals and channels for NR-U MediaTek Inc.
6. R1-2003727 UL signals and channels for NR-unlicensed Intel Corporation
7. R1-2003822 Text proposals for UL signals and channels for NR-U Lenovo, Motorola Mobility
8. R1-2003841 UL signals and channels Ericsson
9. R1-2003859 UL signals and channels for NR-U Samsung
10. R1-2004003 Remaining issues in UL signals and channels for NR-U Spreadtrum Communications
11. R1-2004012 Remaining issues of UL signals and channels for NR-U LG Electronics
12. R1-2004041 Remaining issues on UL signals and channels for NR-U Fujitsu
13. R1-2004084 Discussion on the remaining issues of UL signals and channels OPPO
14. R1-2004274 Remaining Issues on UL Signals and Channels for NR-U Nokia, Nokia Shanghai Bell
15. R1-2004323 Remaining issues on UL signals/channels for NR-U Sharp
16. R1-2004442 TP for UL signals and channels for NR-U Qualcomm Incorporated
17. 3GPP TR 38.889, “Study on NR-based access to unlicensed spectrum,” v.16.0.0, December 2018.
18. 3GPP TS 38.331, “Radio Resource Control (RRC) protocol specification,” v.16.0.0, March 2020.
19. R1-2003842, “Feature lead summary for Maintenance of UL Signals and Channels,” Moderator (Ericsson), RAN1#101-e, May 2020.
20. R1-2003180, “Corrections on shared spectrum channel access (Editor CR to 38.213 v16.1.0),” Samsung, RAN1#100bis-e, April 2020.
21. R1-2003143, “Corrections on NR – U (Editor CR to 38.214 v16.1.0),” Nokia, NSB, RAN1#100bis-e, April 2020.