3GPP TSG-RAN WG1 Meeting #102-e R1-2007029

e-Meeting, 17th – 28th August, 2020

Agenda Item: 7.2.2.1.3

Source: Moderator (Ericsson)

Title: FL Summary for [102-e-NRU-unlic-NRU-ULSignalsChannels] Email discussion/approval

Document for: Discussion, Decision

# 1 Introduction

Based on the conclusion of the e-meeting preparation phase [11] and the vice-Chairman’s guidance, the following e-mail discussion has been kicked-off:

[102-e-NR-unlic-NRU-ULSignalsChannels] Email discussion/approval on the following from R1-2005913 until 8/19; if necessary, endorse remaining TPs by 8/25 – Steve (Ericsson)

* Issue #1: Corrections for frequency domain resource allocation for PUSCH scheduled by RAR UL grant and DCI 0\_0 addressed to TC-RNTI when UL resource allocation Type 2 (Interlacing) is configured
* Issue #3: Addition of UL Resource Allocation Type 2 to definition of special values in DCI 0\_1 for semi-persistent CSI deactivation
* Issue #5: Editorial corrections to 38.212, 38.213, 38.214
* Issue #9: Discuss clarifications on UCI multiplexing in PUSCH accounting for LBT outcome and whether or not a conclusion is needed

Company proposals regarding these issues are listed in the following table discussed in the preparation phase:

|  |  |  |
| --- | --- | --- |
| **Issue****#** | **Description** | **Tdoc****References** |
| 1 | Corrections for frequency domain resource allocation for PUSCH scheduled by RAR UL grant and DCI 0\_0 addressed to TC-RNTI when UL resource allocation Type 2 (Interlacing) is configured* VRB-to-PRB mapping
* UE assumptions on guard bands
 | R1-2005332, O1, P1R1-2006554, P1, P2 |
| 3 | Addition of UL Resource Allocation Type 2 to definition of special values in DCI 0\_1 for semi-persistent CSI deactivation | R1-2005332, P3 |
| 5 | Editorial corrections to 38.212, 38.213, 38.214 | R1-2006300, Section 2.2R1-2006094, P6R1-2005912, P2, P3 |
| 9 | Clarifications on UCI multiplexing in PUSCH accounting for LBT outcome | R1-2005826, P1, P2R1-2006094, P5 |

# 2 Issue #1-1 (VRB-to-PRB Mapping for PUSCH)

In [1], two valid issues are identified related to the virtual-to-physical resource block mapping procedure that is jointly specified between 38.214 and 38.211. The first issue is the following. For legacy (non-interlaced) PUSCH with UL resource allocation Type 0 and 1, the frequency domain resource allocation procedure in 38.214 Sections 6.1.2.2.1 and 6.1.2.2.2, respectively, is written in terms of allocating *virtual* resource blocks (VRBs). Then, in 38.211 Section 6.3.1.7 it is described how the virtual resource blocks are mapped to *physical* resource blocks (PRBs). For PUSCH, only non-interleaved VRB-to-PRB mapping is supported in 38.211. Note that this is in contrast to PDSCH where both interleaved and non-interleaved are supported. For the case of UL resource allocation Type 2 (interlaced PUSCH), 38.214 Section 6.1.2.2.3 does not mention anything about virtual resource blocks meaning the VRB-to-PRB mapping described in 38.211 becomes undefined for Type 2. This needs to be fixed, and the natural correction would be to define the frequency domain resource allocation in 38.214 Section 6.1.2.2.3 for Type 2 in terms of VRBs to be consistent with that for Type 0 and Type 1.

The second issue is that in 38.211 Section 6.3.1.7, the VRB-to-PRB mapping is defined to be different for PUSCH scheduled by a RAR UL grant or PUSCH scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI compared to the VRB-to-PRB mapping defined for PUSCH addressed to other RNTIs. For other RNTIs, the mapping is simply VRB *n* to PRB *n*. The problem with the different mapping defined for RAR and TC-RNTI is that if UL resource allocation Type 2 is configured, the allocation can step outside the active BWP when VRBs are mapped to PRBs. Clearly, this is unintended behavior (see example in [1]). A natural fix for this is to restrict the different mapping for RAR and TC-RNTI to the case when Type 0 and Type 1 are configured. When Type 2 is configured, then the mapping VRB *n* to PRB *n* fixes the problem.

TP#1 and #2 together fix both issues:

-------------------------------------- Text Proposal (TP#1) 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]. Within the active UL BWP, the assigned physical resource block $n$ is mapped to virtual resource block $n$. 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. For DCI 0\_0 monitored in a CSS with CRC scrambled by an RNTI other than TC-RNTI, the uplink RB set is the lowest indexed one amongst uplink RB set(s) that intersects the lowest-indexed CCE of the PDCCH in which the UE detects the DCI 0\_0 in the active downlink BWP. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 monitored in a CSS with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant.

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

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

-------------------------------------- Text Proposal (TP#2) for 38.211, Section 6.3.1.7 -------------------------------

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

6.3.1.7 Mapping from virtual to physical resource blocks

Virtual resource blocks shall be mapped to physical resource blocks according to non-interleaved mapping.

For non-interleaved VRB-to-PRB mapping for UL resource allocation type 0 and 1 [6, TS 38.214], virtual resource block $n$ is mapped to physical resource block $n$ except for PUSCH scheduled by RAR UL grant or PUSCH scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI in active uplink bandwidth part $i$ starting at $N\_{BWP,i}^{start}$, including all resource blocks of the initial uplink bandwidth part starting at $N\_{BWP,0}^{start}$, and having the same subcarrier spacing and cyclic prefix as the initial uplink bandwidth part, in which case virtual resource block $n$ is mapped to physical resource block $n+N\_{BWP,0}^{start}-N\_{BWP,i}^{start}$. For UL resource allocation type 2, virtual resource block *n* is mapped to physical resource block *n*.

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

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

## 2.1 <1st Round Comments>

Please provide your company view on TP#1 and TP#2 above.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Sharp | For TP#1, we are OK with the proposal.For TP#2, the update should be on the first paragraph as follows.For UL resource allocation type 0 and 1 [6, TS 38.214], v~~V~~irtual resource blocks shall be mapped to physical resource blocks according to non-interleaved mapping. |
| Qualcomm | Support the TPs. For the change from Sharp, it may not be necessary. Even for type 2 resource allocation, the VRB to PRB mapping is still non-interleaved. |
| vivo | For TP#1, okFor TP #2, fine with Sharp’s update. In addition, do we need to add reference for UL resource allocation type 2 in the same way as type 0 and 1? i.e., For UL resource allocation type 2 [6, TS 38.214] |
| Samsung | Support both TP1 &2.  |
| Huawei | Support the TPs. |
| ZTE | Fine with the two TPs |
| Lenovo, Motorola Mobility | TP#1 seems clearer than TP#2.We support TP#1. |
|  |  |
| Spreadtrum | Support the two TPs |
| WILUS | Support both TP1 and TP2 |
| OPPO | Fine with the TPs |
| Nokia, NSB | Ok with both TPs |

## 2.2 <Summary of 1st Round Comments>

* There is consensus to support TP#1
* On TP#2, two issues have been raised
	1. Sharp suggests that a qualifier should be added in the first sentence to restrict "non-interleaved" mapping to Type 0 and Type 1 only. Qualcomm points out that Type 2 is also non-interleaved mapping. The moderator agrees with Qualcomm's observation. Please note: non-interleaved does not mean "non-interlaced"
	2. Vivo suggests adding a reference to 38.214 for Type 2. This is fine and can easily be included.

**FL Proposal**

* Support TP#1 in Section 2
* Support TP#2a in Section 2.2 (includes reference to 38.214 as suggested by vivo)

------------------------------------- Text Proposal (TP#2a) for 38.211, Section 6.3.1.7 ------------------------------

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

6.3.1.7 Mapping from virtual to physical resource blocks

Virtual resource blocks shall be mapped to physical resource blocks according to non-interleaved mapping.

For non-interleaved VRB-to-PRB mapping for UL resource allocation type 0 and 1 [6, TS 38.214], virtual resource block $n$ is mapped to physical resource block $n$ except for PUSCH scheduled by RAR UL grant or PUSCH scheduled by DCI format 0\_0 with CRC scrambled by TC-RNTI in active uplink bandwidth part $i$ starting at $N\_{BWP,i}^{start}$, including all resource blocks of the initial uplink bandwidth part starting at $N\_{BWP,0}^{start}$, and having the same subcarrier spacing and cyclic prefix as the initial uplink bandwidth part, in which case virtual resource block $n$ is mapped to physical resource block $n+N\_{BWP,0}^{start}-N\_{BWP,i}^{start}$. For UL resource allocation type 2 [6, TS 38.214], virtual resource block *n* is mapped to physical resource block *n*.

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

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

## 2.3 <2nd Round Comments>

Please provide any further views or concerns on the FL Proposal in Section 2.2, particularly on TP#2a, since there seems to be consensus to support TP#1.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Nokia, NSB | OK with TP2a |
| Sharp | Qualcomm’s intention is understood. We are OK with FL proposal. |
| Lenovo, Motorola Mobility | We are OK with current TP2a. |
| vivo | We are OK with current TP2a. |
| Samsung | OK with TP2a |
| LGE | For TP #1 and TP #2a, we are fine with the proposal. |
| Huawei | OK with TP2a |
| Spreadtrum | OK with TP2a. |

# 3 Issue #1-2 (UE Assumptions on Intra-Cell Guard Bands)

As observed in [1], if two UEs are in contention during a RACH procedure (i.e., using the same RB set for PRACH transmission), and one UE is in IDLE and the other is in RRC\_CONNECTED with RRC configured intra-cell guard bands, then there may be an ambiguity at the gNB on exactly which RBs within the allocated interlace(s) are used for PUSCH scheduled by a RAR UL grant or by DCI 0\_0 addressed to TC-RNTI. This can happen, for example, if the UE in RRC\_CONNECTED is configured with a different size for the RB set compared to that assumed by the UE in IDLE mode based on the nominal intra-cell guard bands defined in 38.101-1. An easy fix for this is that both UEs should assume the RB set is defined according to the nominal guard bands.

As observed in [10], it is not currently captured in specifications that a UE in IDLE should assume the nominal guard bands. This issue is automatically fixed if the issue identified in [1] is corrected.

TP#3 and #4 fix these issues, and additionally an editorial change is proposed:

-------------------------------------- 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. For DCI 0\_0 monitored in a CSS with CRC scrambled by an RNTI other than TC-RNTI, the uplink RB set is the lowest indexed one amongst uplink RB set(s) that intersects the lowest-indexed CCE of the PDCCH in which the UE detects the DCI 0\_0 in the active downlink BWP. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 ~~monitored in a CSS~~ with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant. The UE assumes that the uplink RB set is defined as in Clause 7 for the case when the UE is not configured with *intraCellGuardBandUL-r16*.

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

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

----------------------------------------- Text Proposal (TP#4) for 38.213, Section 8.3 ---------------------------------

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

If *useInterlace-PUCCH-PUSCH* is provided by *BWP-UplinkCommon* or *BWP-UplinkDedicated*, the frequency domain resource allocation is by uplink resource allocation type 2 [6, TS 38.214]. A UE processes the frequency domain resource assignment field as follows

- truncate the frequency domain resource assignment field to the $X=6$ LSBs if $μ=0$, or to the $X=5$ LSBs if $μ=1$

- for interlace allocation of a PUSCH transmission, interpret the $X$ MSBs of the truncated frequency domain resource assignment field for the active UL BWP as for the $X$ MSBs of the frequency domain resource assignment field in DCI format 0\_0 [6, TS 38.214]

- for RB set allocation of a PUSCH transmission, the RB set of the active UL BWP is the RB set of the PRACH transmission associated with the RAR UL grant. The UE assumes that the uplink RB set is defined as in Clause 7 for the case when the UE is not configured with *intraCellGuardBandUL-r16*.

A UE determines whether or not to apply transform precoding as described in [6, TS 38.214].

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

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

## 3.1 <1st Round Comments>

Please provide your company view on TP#3 and TP#4 above.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Sharp | We are generally fine with FL proposal. To be clearer, the following update is prefered to cralify the behavior is only applied to DCI with TC-RNTI.If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant~~.~~, in which case t~~T~~he UE assumes that the uplink RB set is defined as in Clause 7 for the case when the UE is not configured with *intraCellGuardBandUL-r16*. |
| Qualcomm | Support the proposal |
| vivo | Agree with Sarp’s update. |
| Samsung  | Agree with Sarp’s update. |
| Huawei | Agree with Sharp’s update. |
| ZTE | Agree with Sarp’s update. |
| Lenovo, Motorola Mobility | Agree with Sarp’s update. |
| Spreadtrum | Agree with Sharp’s update. |
| WILUS | Agree with Sharp’s update |
| OPPO | We have two questions for clarification:Q1: here the ‘UE‘ is either active UE or idle UE, is it a right understanding? If not, I think the issue still exists. Q2: if the acitve UL BWP has different SCS from initial UL BWP, i assume that this default intra-cell guard band pattern is not applicable, is it a right understanding? |
| Nokia, NSB | ok with Sharp’s update |

## 3.2 <Summary of 1st Round Comments>

* There is consensus to support TP#4
* There is consensus to support TP#3 with the update proposed by Sharp to clarify that the behavior applies to DCI 0\_0 addressed to TC-RNTI and not PUSCHs addressed to other RNTIs. This is fine and can easily be adjusted.
* Addressing OPPO's questions
	1. Q1: As stated by the highlighted text in Section 3 above, there is primarily an ambiguity if the two UEs in contention are in different states (IDLE and RRC\_CONNECTED). If they are in the same state, it is the moderator's understanding that there is not an ambiguity issue on which RBs are used for PUSCH transmission. Even if there was a chance for ambiguity, e.g., by different configuration of the guard bands for the two users, the above TPs still fix this issue.
	2. Q2: Default intra-cell guard bands are specified in 38.101-1 for each different numerology. This is described in 38.214 Clause 7.

**FL Proposal**

* Support TP#4 in Section 3
* Support TP#3a in Section 3.2 (includes modification proposed by Sharp)

------------------------------------- Text Proposal (TP#3a) 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. For DCI 0\_0 monitored in a CSS with CRC scrambled by an RNTI other than TC-RNTI, the uplink RB set is the lowest indexed one amongst uplink RB set(s) that intersects the lowest-indexed CCE of the PDCCH in which the UE detects the DCI 0\_0 in the active downlink BWP. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 ~~monitored in a CSS~~ with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant~~.~~, in which case the UE assumes that the uplink RB set is defined as in Clause 7 for the case when the UE is not configured with *intraCellGuardBandUL-r16*.

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

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

## 3.3 <2nd Round Comments>

Please provide any further views or concerns on the FL Proposal in Section 3.2, particularly on TP#3a, since there seems to be consensus to support TP#4.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Nokia, NSB | ok with TP3a |
| Sharp | We are OK with TP3a. |
| Lenovo, Motorola Mobility | We are OK with current TP3a. |
| vivo | We are OK with current TP3a. |
| Samsung | Ok with TP3a |
| LGE | We think that the above proposal is necessary only for CBRA case. For CFRA case, such restriction is not necessary since the UE with CFRA operation indicated by gNB’s PDCCH order would be a connected mode UE, and the UE would perform RACH procedure without any contention with other idle/connected UEs. Thus in this case, the UE could effectively use the RB set based on the guard band configured by gNB (not based on nominal gaurd band) without any problem/complexity.For the above reason, the TP#4 should be limited in CBRA case as follows:(with modification of current wording “for the case when...“ since it could be misread as the condition to apply nominal gaurd band)TP#4For contention based random access procedure, ~~T~~the UE assumes that the uplink RB set is same ~~defined~~ as that in Clause 7 defined for the case when the UE is not configured with *intraCellGuardBandUL-r16*. By the way, on top of Msg. 3 PUSCH transmissions in 4-step RACH, Msg. A PUSCH transmissions in 2-step RACH would also be involved with this gaurd band issue, so it seems necessary to apply the same approach also for Msg. A PUSCH. |
| Huawei | OK with TP3a |
| Spreadtrum | OK with TP3a |

# 4 Issue #3 (Deactivation of SP-CSI Reporting)

As observed in [1], for validation of deactivation of semi-persistent CSI on PUSCH, special values of the resource block assignment field of DCI 0\_1/0\_2 are used to indicate the validation. This is captured for Ul resource allocation type 0 and type 1, but type 2 is missing.

TP#5 fixes this issue for DCI 0\_1, but not for DCI 0\_2, since the combination of type 2 and DCI 0\_2 is undefined, hence not supported in Rel-16.

-------------------------------------- Text Proposal (TP#5) for 38.214, Section 5.2.1.5.2 -----------------------------

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

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of semi-persistent CSI transmission on PUSCH, and the UE activates or deactivates a CSI Reporting Setting indicated by CSI request field in the DCI. If validation is not achieved, the UE considers the DCI format as having been detected with a non-matching CRC.

**Table 5.2.1.5.2-1: Special fields for semi-persistent CSI activation PDCCH validation**

|  |  |
| --- | --- |
|  | **DCI format 0\_1/0\_2**  |
| HARQ process number | set to all '0's |
| Redundancy version | set to all '0's |

**Table 5.2.1.5.2-2: Special fields for semi-persistent CSI deactivation PDCCH validation**

|  |  |
| --- | --- |
|  | **DCI format 0\_1/0\_2**  |
| HARQ process number | set to all '0's |
| Modulation and coding scheme | set to all '1's |
| Resource block assignment | If higher layer configures RA type 0 only, set to all '0's;If higher layer configures RA type 1 only, set to all '1's;If higher layer configures dynamic switch between RA type 0 and 1, then if MSB is'0', set to all '0's; else, set to all '1'sFor DCI 0\_1, if higher layer configures RA type 2:set X = 6 MSBs to all ‘1’s if *µ* = 0;set X = 5 MSBs to all ‘0’s if *µ* = 1;set Y LSBs to all '1's where Y is defined in Clause 6.1.2.2.3 |
| Redundancy version | set to all '0's |

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

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

## 4.1 <1st Round Comments>

Please provide your company view on TP#5 above.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Sharp | Setting all‘0’s for *µ* = 1 and set all’1’s for *µ* = 0 like SPS release should be fine? |
| Qualcomm | Support the proposal |
| vivo | Unifed solution between 213 (for CG) and 214 (for SP-CSI PUSCH) is preferred. There seems to be no issue to set all‘0’s for µ = 1 and set all’1’s for µ = 0. |
| Samsung | Same validation mechanism for CG release PDCCH and deactivation of semi-persistent CSI on PUSCH should be used, i.e. set to all '0's for FDRA Type 2 with $μ=1$, set to all '1's, otherwise.  |
| Huawei | Share similar view as Sharp, vivo and Samsung, no need to seperately consider the X MSBs and Y LSBs, set all '1's if µ = 0, set all '0's for µ = 1 is enough. |
| ZTE | We share the similar view as other companies to keep the special fields similar as CG release PDCCH, i.e. “set to all '0's for FDRA Type 2 with *µ* = 1; set to all '1's, otherwise“. |
| Lenovo, Motorola Mobility | We agree with setting all '1's if µ = 0 and setting all '0's for µ = 1 like SPS release. |
| Spreadtrum | Share the similar view as other companies, We prefer to unify the design of SP-CSI deactivation and SPS release. |
| WILUS | We support to have setting all '1's if µ = 0 and '0's if µ = 1 as same as SPS release |
| Nokia, NSB | all-0 or all-1 is ok |

## 4.2 <Summary of 1st Round Comments>

* There is consensus to align the contents of the frequency domain resource assignment field in DCI 0\_1 for signaling the following:
	+ Deactivation of semi-persistent CSI on PUSCH (specified in 38.214 Section 5.2.1.5.2)
	+ Release of configured grant Type 2 (specified in 38.213 Section 10.2)
* This makes sense and can be reflected in a modified TP

**FL Proposal**

* Support TP#5a in Section 4.2 (includes alignment with CG release PDCCH)

------------------------------------- Text Proposal (TP#5a) for 38.214, Section 5.2.1.5.2 ----------------------------

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

If validation is achieved, the UE considers the information in the DCI format as a valid activation or valid release of semi-persistent CSI transmission on PUSCH, and the UE activates or deactivates a CSI Reporting Setting indicated by CSI request field in the DCI. If validation is not achieved, the UE considers the DCI format as having been detected with a non-matching CRC.

**Table 5.2.1.5.2-1: Special fields for semi-persistent CSI activation PDCCH validation**

|  |  |
| --- | --- |
|  | **DCI format 0\_1/0\_2**  |
| HARQ process number | set to all '0's |
| Redundancy version | set to all '0's |

**Table 5.2.1.5.2-2: Special fields for semi-persistent CSI deactivation PDCCH validation**

|  |  |
| --- | --- |
|  | **DCI format 0\_1/0\_2**  |
| HARQ process number | set to all '0's |
| Modulation and coding scheme | set to all '1's |
| Resource block assignment | If higher layer configures RA type 0 only, set to all '0's;If higher layer configures RA type 1 only, set to all '1's;If higher layer configures dynamic switch between RA type 0 and 1, then if MSB is'0', set to all '0's; else, set to all '1'sFor DCI 0\_1, if higher layer configures RA type 2, set to all ‘1’s if *µ* = 0; set to all ‘0’s if *µ* = 1 |
| Redundancy version | set to all '0's |

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

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

## 4.3 <2nd Round Comments>

Please provide any further views or concerns on the FL Proposal in Section 4.2:

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Nokia, NSB | Support FL proposal |
| Sharp | We are OK with TP5a. |
| Lenovo, Motorola Mobility | We are OK with TP5a. |
| vivo | We are OK with TP5a. |
| Samsung | OK with TP5a |
| LGE | For TP #5a, we are fine with the proposal. |
| Huawei | OK with TP5a |
| Spreadtrum | OK with TP5a |

# 5 Issue #5 (Editorial Corrections)

In [5], it is identified that in 38.214 Section 6.1.2.2.3, a number of variables and equations have formatting errors. In [8], a formatting error is also identified. Some of the formatting can be directly corrected by the editor, and those are highlighted in TP#6 below with a note to the editor. Others are corrected explicitly in the TP. Note that similar formatting errors for Clause 7 of 38.214 are being discussed in the email thread for AI 7.2.2.2.5 (Wideband Operation).

Additionally, to be consistent with the style of notation used in 38.214 Section 7 and in 38.211, the starting RB-set index within the BWP should use the notation $N\_{RB-set,UL}^{start}$ instead of $RBset\_{START}.$

TP#6 fixes these issues:

------------------------------------- Text Proposal (TP#6) for 38.214, Section 6.1.2.2.3 ------------------------------

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

6.1.2.2.3 Uplink resource allocation type 2

Note to editor: to be consistent with other specs, e.g., 38.211, the subscripts/superscripts in the highlighted variables should be formatted so they are not italicized, e.g., $N\_{RB-set,UL}^{BWP} $should be $N\_{RB-set,UL}^{BWP}$ and $L\_{RBset}$ should be $L\_{RB-set}$.

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. For DCI 0\_0 monitored in a CSS with CRC scrambled by an RNTI other than TC-RNTI, the uplink RB set is the lowest indexed one amongst uplink RB set(s) that intersects the lowest-indexed CCE of the PDCCH in which the UE detects the DCI 0\_0 in the active downlink BWP. If there is no intersection, the uplink RB set is RB set 0 in the active uplink BWP. For DCI 0\_0 monitored in a CSS with CRC scrambled by TC-RNTI, the uplink RB set is the same one in which the UE transmits the PRACH associated with the RAR UL grant.

For µ=0, the X=6 MSBs of the resource block assignment information indicates to a UE a set of allocated interlace indices$ m\_{0}+l$ $m\_{0}+l$, where the indication consists of a resource indication value (*RIV*). For $0\leq RIV<M(M+1)/2$ , $l=0,1,\cdots L-1$ the resource indication value corresponds to the starting interlace index *m0* and the number of contiguous interlace indices  (). The resource indication value is defined by:

if $(L-1)\leq \left⌊M/2\right⌋ \left⌊M/2\right⌋^{}$ then

$$RIV=M(L L\_{}-1)+m\_{0}$$

else

$$RIV=M(M-L+1)+(M-1-m\_{0})$$

For $\geq M(M+1)/2$ , the resource indication value corresponds to the starting interlace index *m0* and the set of values  according to Table 6.1.2.2.3-1.

**Table 6.1.2.2.3-1: *m0* and  for** $RIV\geq M(M+1)/2$**.**

|  |  |  |
| --- | --- | --- |
| $$RIV-M(M+1)/2$$ | ***m0*** |  |
| 0 | 0 | {0, 5} |
| 1 | 0 | {0, 1, 5, 6} |
| 2 | 1 | {0, 5} |
| 3 | 1 | {0, 1, 2, 3, 5, 6, 7, 8} |
| 4 | 2 | {0, 5} |
| 5 | 2 | {0, 1, 2, 5, 6, 7} |
| 6 | 3 | {0, 5} |
| 7 | 4 | {0, 5} |

For µ=1, the X=5 MSBs of the resource block assignment information comprise a bitmap indicating the interlaces that are allocated to the scheduled UE. The bitmap is of size *M* bits with one bitmap bit per interlace such that each interlace is addressable, where *M* and interlace indexing is defined in Clause 4.4.4.6 in [4, TS 38.211]. The order of interlace bitmap is such that interlace 0 to interlace $M-1$ are mapped from MSB to LSB of the bitmap. An interlace is allocated to the UE if the corresponding bit value in the bitmap is 1; otherwise the interlace is not allocated to the UE.

For DCI 0\_0 monitored in a UE-specific search space and DC 0\_1 for both µ=0 and µ=1, the $Y=\left⌈log\_{2}log2\frac{N\_{RB-set,UL}^{BWP}\left(N\_{RB-set,UL}^{BWP}+1\right)}{2}\right⌉LSBs of $ the resource block assignment information indicate to a UE a set of contiguously allocated RB sets for PUSCH scheduled by DCI 0\_0 monitored in a UE-specific search space, DCI 0\_1 and Type 1 and Type 2 configured grant. The resource allocation field consists of a resource indication value (*RIVRBset*). For $0\leq RIV\_{RBset}<N\_{RB-set,UL}^{BWP}(N\_{RB-set,UL}^{BWP}+1)/2$ , $l=0,1,\cdots L\_{RBset}-1$ the resource indication value corresponds to the starting RB set index $N\_{RB-set,UL}^{start}$ ~~(~~$RBset\_{START}$~~)~~ and the number of contiguous RB sets $L\_{RBset} $. The resource indication value is defined by;

if $(L\_{RBset}-1)\leq \left⌊N\_{RB-set,UL}^{BWP}/2\right⌋$ then

$$RIV\_{RBset}=N\_{RB-set,UL}^{BWP}(L\_{RBset}-1)+N\_{RB-set,UL}^{start}RBset\_{START}$$

else

$RIV\_{RBset}=N\_{RB-set,UL}^{BWP}(N\_{RB-set,UL}^{BWP}-L\_{RBset}+1)+(N\_{RB-set,UL}^{BWP}-1-N\_{RB-set,UL}^{start}RBset\_{START})$

where $ N\_{RB-set,UL}^{start}RBset\_{START}=0,1,\cdots N\_{RB-set,UL}^{BWP}-1$, $L\_{RBset}\geq 1$ and shall not exceed $N\_{RB-set,UL}^{BWP}-N\_{RB-set,UL}^{start}RBset\_{START}$

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 Clause 6.3.1.4 of [4, TS 38.211].

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

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

In [7], it is observed that in 38.213 Section 9.1.2 an RRC parameter name is incorrect.

TP#7 fixes this issue:

---------------------------------------- Text Proposal (TP#7) for 38.213, Section 9.2.1 --------------------------------

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

If  and a UE is provided a PUCCH resource by *pucch-ResourceCommon* and is not provided *~~useInterlacePUCCHCommon-r16~~ useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon*

- the UE determines the PRB index of the PUCCH transmission in the first hop as  and the PRB index of the PUCCH transmission in the second hop as , where  is the total number of initial cyclic shift indexes in the set of initial cyclic shift indexes

- the UE determines the initial cyclic shift index in the set of initial cyclic shift indexes as 

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

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

In [5] it is identified that in 38.212 Section 7.3.1.1.1, Y is essentially defined twice. Also, it would be beneficial to clarify that the number of RB sets $N\_{RB-set,UL}^{BWP}$ used to determine the number of bits Y in the RB-set portion of the frequency domain resource assignment field corresponds to the *active* UL BWP. This may not be 100% clear in the current spec. Correcting these issues results in a more compact spec.

TP #8 fixes these issues.

----------------------------------- Text Proposal (TP#8) for 38.212, Section 7.3.1.1.1 --------------------------------

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

7.3.1.1.1 Format 0\_0

DCI format 0\_0 is used for the scheduling of PUSCH in one cell.

The following information is transmitted by means of the DCI format 0\_0 with CRC scrambled by C-RNTI or CS-RNTI or MCS-C-RNTI:

- Identifier for DCI formats – 1 bit

- The value of this bit field is always set to 0, indicating an UL DCI format

- Frequency domain resource assignment –  bits if neither of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured, where  is defined in clause 7.3.1.0.

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

- if any of the higher layer parameters *useInterlacePUCCH-PUSCH* in *BWP-UplinkCommon* and *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured

- 5+Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214$ $] if the subcarrier spacing for the active UL bandwidth part is 30 kHz ~~and the DCI format 0\_0 is monitored in a UE-specific search space. If the DCI 0\_0 is monitored in a common search space Y = 0~~.

- 6+Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 15 kHz ~~and the DCI format 0\_0 is monitored in a UE-specific search space. If the DCI 0\_0 is monitored in a common search space Y = 0~~.

 If the DCI format 0\_0 is monitored in a UE-specific search space, t~~T~~he value of Y is determined by $\left⌈log\_{2}\left(\frac{N\_{RB-set,UL}^{BWP}\left(N\_{RB-set,UL}^{BWP}+1\right)}{2}\right)\right⌉$ where $N\_{RB-set,UL}^{BWP}$ is the number of RB sets defined in contained in the active UL BWP as defined in clause 7 of [6, TS38.214]. If the DCI 0\_0 is monitored in a common search space Y = 0.

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

7.3.1.1.2 Format 0\_1

DCI format 0\_1 is used for the scheduling of one or multiple PUSCH in one cell, or indicating CG downlink feedback information (CG-DFI) to a UE.

The following information is transmitted by means of the DCI format 0\_1 with CRC scrambled by C-RNTI or CS-RNTI or SP-CSI-RNTI or MCS-C-RNTI:

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

- Frequency domain resource assignment – number of bits determined by the following, where  is the size of the active UL bandwidth part:

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

- If the higher layer parameter *useInterlacePUCCH-PUSCH* in *BWP-UplinkDedicated* is configured

- 5 + Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 30 kHz. The 5 MSBs provide the interlace allocation and the Y LSBs provide the RB set allocation.

- 6 + Y bits provide the frequency domain resource allocation according to Clause 6.1.2.2.3 of [6, TS 38.214] if the subcarrier spacing for the active UL bandwidth part is 15 kHz. The 6 MSBs provide the interlace allocation and the Y LSBs provide the RB set allocation.

The value of Y is determined by $\left⌈log\_{2}\left(\frac{N\_{RB-set,UL}^{BWP}\left(N\_{RB-set,UL}^{BWP}+1\right)}{2}\right)\right⌉ $ where $N\_{RB-set,UL}^{BWP}$ is the number of RB sets contained in the active UL BWP as defined in clause 7 of [6, TS38.214].

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

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

## 5.1 <1st Round Comments>

Please provide your company view on TP#6, TP#7, and TP#8 above.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Sharp | We are OK with these proposals. |
| Qualcomm | Support the proposal |
| vivo | ok |
| Samsung | Support the propsals |
| Huawei | Support the TPs |
| ZTE | Agree with the TPs |
| Lenovo, Motorola Mobility | Agree with the TPs. |
| Spreadtrum | Support the TPs |
| WILUS | Agree with the TPs |
| Nokia, NSB | ok with the TPs |

## 5.2 <Summary of 1st Round Comments>

* There is consensus to support TP#6, TP#7, and TP#8

**FL Proposal**

* Support TP#6, TP#7, and TP#8 in Section 5

## 5.3 <2nd Round Comments>

Please provide any further views or concerns on the FL Proposal in Section 5.2:

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Nokia, NSB | ok with the FL proposal |
| Sharp | We are OK with FL proposal. |
| Lenovo, Motorola Mobility | Agree with these TPs. |
| vivo | We are OK with FL proposal. |
| Samsung | OK with these TPs.  |
| LGE | For TP #6, #7, and #8, we are fine with the proposal. |
| Huawei | Support these TPs |
| Spreadtrum | OK with these TPs |

# 6 Issue #9 (UCI Multiplexing on PUSCH)

In RAN1#101-e, there was quite a lot of discussion on the below paragraph from Section 9 of TS38.213, where it is specified under which conditions the UE should multiplex UCI in a PUSCH. Please see [12] for a full summary of the discussion. Generally, it was agreed that that the UCI multiplexing should not depend on LBT outcome. Still there was some concern about how the UE should interpret the text highlighted in green. The view of some companies was that even if LBT fails for PUSCH, then the "earliest PUSCH that the UE transmits in the slot" is still interpreted as if the PUSCH transmission occurred, and that a generic conclusion could be written to capture this. Other companies' view was that a generic conclusion capturing how the UE should interpret any UL transmission in view of the LBT procedures specified in 37.213 could be written. Still other companies view was that no clarification is needed, and in this meeting several companies expressed the view that this is not an issue and should not be discussed.

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.

Clearly, there is a divergence in views, and further discussion is needed. As a first step, the following two alternatives are identified:

* **Alt-1**: Capture a generic conclusion (non-spec impacting) in chairman notes about how such cases of UL signals/channel transmissions that are subject to LBT should be treated. Wording of conclusion is TBD.
* **Alt-2**: No conclusion needed

## 6.1 <1st Round Comments>

Please provide your view on Alt-1 vs. Alt-2 above. If Alt-1 is preferred, please propose suitable wording of conclusion that is detailed enough that the context can be understood. If Alt-2 is preferred, please provide technical justification.

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Sharp | We slightly prefer Alt.1. Possible conclusion could be „Transmission(s) that do not occur since the UE fails to access the channel still count as a transmission“. |
| Qualcomm | Alt-1 seems to be cleaner. |
| vivo | Alt-1 is fine. Proposed conclusion could be: It is a common understanding that when UE performs UCI mulitplexing, the PUCCH/PUSCH transmission is the configured or scheduled transmission without consideration of channel access results if it is operated in shared spectrum. |
| Samsung  | The proposed conclusion from VIVO looks good to us. But, We still feel it would be necessary to capture a clear description in the spec rather than having a conclusion in the chairman notes as suggested in Alt-1. We can’t expect the spec readers who didn’t closely follow the discussion to check the chairman notes and then try to understand the underlying meaning. As proposed in our tdoc, the clarification for UCI multiplexing can be added in TS 38.213 section 9 as below.**9 UE procedure for reporting control information**…A UE does not expect to be scheduled to transmit a PUCCH or a PUSCH with smaller priority index that would overlap in time with a PUCCH of larger priority index with HARQ-ACK information only in response to a PDSCH reception without a corresponding PDCCH. A UE does not expect to be scheduled to transmit a PUCCH of smaller priority index that would overlap in time with a PUSCH of larger priority index with SP-CSI report(s) without a corresponding PDCCH.In the remaining of this Clause, a UE multiplexes UCIs in a PUSCH that the UE would transmit irrespective of whether the UE can access the channel for the PUSCH transmission according to the channel access procedures described in Subclause 4.2.1 in [15, TS 37.213]. |
| Huawei | Alt 1 is preferred. The LBT outcome does not impact the determination of PUSCH in which the UCI is multiplexed.  |
| ZTE | A generic conclusion is helpful to avoid further confusion, as long as companies have the same understanding that the cancelled transmission due to LBE failure is still counted as a transmission. |
| Lenovo, Motorola Mobility | We support Alt 1. A conclucion is required to avoid any misunderstanding on this issue.The baseline can be that we reached in previous meeting. |
| Spreadtrum | Support Alt 1. Vivo’s wording looks good to us |
| WILUS | We support Alt 1 with a generic conclusion in the chairma’s note to avoid misinterpretation of current spec text. |
| Ericsson | Alt-2. It is understood that UCI multiplexing is not dependent on outcome of LBT. Furthermore, there are multiple places in multiple specs where procedures related to the transmission of a certain signal/channel is specified. It is understood that before such transmission can take place, LBT must be successful. The purpose of having TS 37.213 is to clearly isolate the channel access procedures in one spec, so it is not necessary to litter the other specs (38.211, 212, 213, 214, etc.) with descriptions of LBT related procedures. |
| OPPO | In our proposal, we propose to replace ‘the earliest‘ with ‘the last‘ then it would completely resolve the issue.  |
| Nokia, NSB | ok with Alt 1 |

## 6.2 <Summary of 1st Round Comments>

Based on the responses so far, most companies prefer Alt-1, i.e., that a conclusion be captured in the chairman notes. Samsung prefers that a TP for 38.213. Ericsson prefers that no conclusion or TP is needed. vivo has provided a suggestion for wording of a conclusion that seems to be acceptable.

**FL Proposal**

* Capture the following conclusion in the chairman notes (modification of vivo's suggested wording):

"For operation with shared spectrum channel access, it is a common understanding that when UE performs UCI multiplexing on PUSCH [or PUCCH], that the multiplexing procedure is not dependent on the outcome of the channel access procedure corresponding to the PUSCH [or PUCCH] transmission."

## 6.3 < 2nd Round Comments >

Please provide any further views or comments on FL proposal in Section 6.2

|  |  |
| --- | --- |
| **Company** | **View/Position** |
| Nokia, NSB | ok with the FL proposal |
| Sharp | We are OK with FL proposal. We also support to remove square blackets for PUCCH. |
| Lenovo, Motorola Mobility | Generally OK. It could be better to remove PUCCH and the brackets as there is no such case that multple PUCCH occasions are configured for UCI multiplexing. |
| vivo | We are OK with FL proposal. We also support to remove square blackets for PUCCH. |
| Samsung | Ok with FL proposal and remove square blackets for PUCCH. We’re fine to only capture the conclusion in the chairman notes without spec revision, considering most companeis consider it sufficient. |
| LGE | We are fine with the proposal. |
| Huawei | OK with the proposal. |
| LGE | OK with the proposal |
| Spreadtrum | OK with the proposal |

# References

1. R1-2005332 Remaining issues on physical UL channel design in unlicensed spectrum vivo
2. R1-2005599 Remaining issues on the UL channels for NR-U ZTE, Sanechips
3. R1-2005808 Maintenance on UL signals and channels Huawei, HiSilicon
4. R1-2005826 Text proposals for UL signals and channels for NR-U Lenovo, Motorola Mobility
5. R1-2005912 UL signals and channels Ericsson
6. R1-2006019 Discussion on the remaining issues of UL signals and channels OPPO
7. R1-2006094 UL signals and channels for NR-U Samsung
8. R1-2006300 Remaining issues of UL signals and channels for NR-U LG Electronics
9. R1-2006371 Remaining Issues on UL Signals & Channels for NR-U Nokia, Nokia Shanghai Bell
10. R1-2006554 Remaining issues on UL signals/channels for NR-U Sharp
11. R1-2005913, "Feature lead summary for Maintenance of UL Signals and Channels," Moderator (Ericsson), RAN1#102-e, August 2020
12. R1-2004997 "FL Summary 2 for [101-e-NR-unlic-NRU-ULSignalsChannels-02] Email discussion/approval," Moderator (Ericsson), RAN1#101-e, May 2020.