[101-e-NR-5G\_V2X\_NRSL-PHYstructure-04] Email discussion/approval regarding remaining essential corrections for NR V2X as in {5A/B/C, 6A/B, 8A/B, 11B}by 5/29, with potential TP by 6/4 – Jeongho (Samsung)

The 2nd FL summary is R1-2003871.

This document has the following topics.

1. Initial value of scrambling sequence
	1. For PSCCH
	2. For SCI format 0-2
	3. For PSSCH
2. Frequency-domain OCC and DMRS c\_init of PSCCH
	1. Number of OCCs among [2 or 3 or 4]
	2. PSCCH DMRS initialization

8) Sequence/Resource mapping of SL CSI-RS and SL PT-RS

A. Sequence of PT-RS

B. Whether/how to puncture/rate-match around SCI format 0-1/0-2

11) Others

B. Limited buffer rate matching (LBRM)

# **5-A. What is c\_init for scrambling initialization of PSCCH?**

* Alt 1. fixed
	+ - 1. 1010, Supported by [Huawei, HiSilicon], [ZTE, HiSilicon], [Ericsson]
			2. 510, Supported by [Futurewei]
			3. 1024, Supported by [CATT]
			4. 0, Supported by [Samsung]
			5. Fixed, Supported by [Apple]
* Alt 2. Resource pool ID
	+ Supported by [vivo]
* Alt 3. PSCCH-DMRS\_scrambingID
	+ Supported by [OPPO], [Nokia, NSB], [LGE]
* Alt 4. Based on OCC for PSCCH
	+ Supported by [Intel]
* Alt 5. Pre-configured per resource pool
	+ Supported by [Intel], [Panasonic]

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson | We support Alt. 1 and are open to the exact value.  |
| Intel | We support Alt 4. The used OCC needs anyhow to be blindly detected, this information is available. This means for the case of colliding PSCCH transmission from different devices, they would only use the same c\_init if the same OCC was used. |
| Mitsubishi | Any value for Alt.1 is fine |
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# **5-B. What is c\_init for scrambling initialization of 2nd SCI**

* Alt 1. Determined by CRC of 1st SCI
	+ Supported by [Nokia, NSB], [Huawei, HiSilicon], [ZTE, HiSilicon], [CATT], [OPPO], [Ericsson], [Apple], [Qualcomm], [Samsung]
* Alt 2. Determined by CRC of 1st SCI and resource pool ID
	+ Supported by [vivo]
* Alt 3. Determined by CRC of 1st SCI and configured ID per resource pool
	+ Supported by [LGE]
* Alt 4. Determined by CRC of 1st SCI and slot index
	+ Supported by [Intel]
* Alt 5. Determined by destination ID
	+ Supported by [Futurewei]
* Alt 6. Determined by pre-configuration
	+ Supported by [Panasonic]

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson | In order to reuse PDSCH scrambling sequence generation, it is straight forward to reuse the decimal representation of CRC instead of n\_RNTI. Therefore, we support Alt. 1.  |
| Intel | We think Alt 4, provides as in the DL different c\_init for different slots, essentially randomizing a possible interference over time.  |
| Mitsubishi | Alt.5 since 2nd stage SCI is not supposed to be decoded by UEs not knowing the destination ID |
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# **5-C. What is c\_init for scrambling initialization of PSSCH**

* Alt 1. Determined by CRC of 1st SCI and slot index
	+ Supported by [Huawei, HiSilicon], [Intel]
* Alt 2. Determined by CRC of 1st SCI
	+ Supported by [Nokia, NSB], [ZTE, HiSilicon], [CATT], [Ericsson], [Samsung], [OPPO], [Qualcomm]
* Alt 3. Determined by destination ID and resource pool ID
	+ Supported by [vivo]
* Alt 4. Determined by destination ID
	+ Supported by [Futurewei], [Panasonic]
* Alt 5. Determined by CRC of 1st SCI and by CRC of 2nd SCI
	+ Supported by [Apple]
* Alt 6. Determined by source ID, destination ID
	+ Supported by [Sharp]

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson | In order to reuse PDSCH scrambling sequence generation, it is straight forward to reuse the decimal representation of CRC instead of n\_RNTI. Therefore, we support Alt. 1.  |
| Intel | We think Alt 1, provides as in the DL different c\_init for different slots, essentially randomizing a possible interference over time.  |
| Mitsubishi | Alt.4 since 2nd stage SCI is not supposed to be decoded by UEs not knowing the destination ID |
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# **6-A. Frequency domain OCC number for PSCCH**

This is to choose the number of frequency domain OCC for PSCCH among agreed sets [2 or 3 or 4]

* Alt 1. 2
	+ Supported by [Huawei, HiSilicon], [Futurewei]
* Alt 2. 3
	+ Supported by [Nokia, NSB], [vivo], [ZTE, Sanechips], [Intel], [OPPO], [Samsung]
* Alt 3. 4
	+ Supported by [LGE], [Ericsson]

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson  | We support Alt. 3. Orthogonalization of PSCCH DMRS has big impacts on system performance. LTE V2X has 4 orthogonal sequences for PSCCH DMRS and in our view NR V2X should have at least the same level of orthognalization. |
| Intel | We support Alt2. With the currently agreed values for the 1st stage PSCCH allocation in frequency direction in combination with the allocation of 3 DMRS per OFDM symbol, for the OCC values 2 and 4 the total amount of available DMRS is not for all cases an integer multiple of the 2 or 4. As an implementation using OCC with remaining DMRS not having an orthogonal OCC would lead to non-orthogonal DMRS at one end of the allocated 1st stage PSCCH resource, only OCC 3 can be used. |
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# **6-B. DMRS initialization for PSCCH**

C\_init for PSCCH DMRS initialization should be specified. One tdoc propose to use 𝑐init=(217(𝑁symbslot𝑛s,f𝜇+𝑙+1)(2𝑁ID+1)+2𝑁ID)mod231.

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson | We are supportive of reusing the formula for PDCCH with a modification, in particular we propose: the sequence generator of PSCCH DMRS makes use of the sequence generator of PDCCH DMRS with N\_{ID} replaced by an ID (pre)configured for each resource pool. |
| Intel | The PSCCH DMRS need to be initialized with a value that is known by each possible receiving devices. Our proposal is to make it dependent on OCC index cinit = (Nocc + 1) 2^11. |
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# **8-A. Sequence of SL PT-RS**

Which sequence is used for SL PT-RS should be specified.

One company propose to use NR Uu CP-OFDM UL PT-RS sequence.

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson | Ok with proposal to use NR Uu CP-OFDM UL PT-RS sequence. |
| Intel | OK to reuse CP-OFDM UL PTRS sequence and propose to replace the nPUSCH-Identity in the definition of cinit with the 1st stage PSCCH CRC in the same fashion as the PSSCH DMRS. |
| Mitsubishi | OK to use NR Uu CP-OFDM UL PT-RS sequence |
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# **8-B. Whether/how to puncture/rate-match around PSCCH / 2nd SCI**

For SL CSI-RS and PT-RS, how to map the RS’s should be determined, i.e., rate matching or puncturing for PSCCH.

For SL CSI-RS,

* Alt 1-1. Rate match around PSCCH
* Alt 1-2. Puncturing around PSCCH
* Alt 2-1. Rate match around 2nd SCI
* Alt 2-2. Puncturing around 2nd SCI

For SL PT-RS,

* Alt 3-1. Rate match around PSCCH
* Alt 3-2. Puncturing around PSCCH
* Alt 4-1. Rate match around 2nd SCI
* Alt 4-2. Puncturing around 2nd SCI

RAN1 needs to determine one of two alternatives Alt N-1 and Alt N-2 for N=1,2,3,4.

Please share your views for above topic. If there is other related issue for mapping 2nd SCI, please provide general comments.

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| **Company** | **Views** |
| Ericsson | This proposal needs clarification. What does rate-matching and puncturing around PSCCH means? |
| Intel | We support Alt.1-2 and Alt.2-2. As the presence of the CSI-RS is signaled in the 2nd stage PSCCH, in case that CSI-RS would be allocated in the resource used for the 2nd stage PSCCH it is not possible to consider allocated CSI-RS for the 1st and 2nd stage PSCCH. In that sense, the last PSSCH symbol has the least probability for collision with 1st stage and 2nd stage PSCCH.We support Alt 3-2 and Alt 4-1. As the density of the PT-RS is only known after the 1st stage PSCCH, no knowledge about it can be assumed for the 1st stage PSCCH.  |
| Mitsubishi | I agree with Ericsson that the wording of the proposals is not clear. Concerning PT-RS, in Uu link control channels and DM-RS carrying data symbols do not carry PTRS. In those cases, DMRS based channel estimation already absorbed the phase noise, inserting extra PTRS does not bring any performance gain and would further penalize throughput. It is the same for sidelink. **PSCCH should not contain PTRS** (because it does not make technical sense from performance point of view, and because PTRS positions are anyhow unknown when decoding PSCCH). This does not seem to correspond to either 3-1 or 3-2.PTRS is embedded in the PSCCH data. There is no reason to treat the 2nd SCI part any differently, since PTRS position is known before decoding 2nd SCI part. The closest way of expressing this is something like “ **2nd SCI is rate matched around PT-RS positions”**. Again, this does not seem to correspond to either 4-1 or 4-2.For CSI-RS, we think that **CSI-RS transmission should be dropped if colliding with PSCCH or 2nd stage SCI**, because CSI-RS positions/presence is not known before decoding 2nd stage SCI, and that CSI-RS transmission should not compromise SCI performance through any puncturing. I’m not sure whether any of the alternatives proposed (1-2 and 2-2 maybe?) is supposed to correspond to this case. We further need to confirm that dropping CSI-RS when it collides with DM-RS applies to sidelink, just as in Uu link. |
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# **11-B. LBRM**

The current specification of TS38.212 describes the rate matching of PSSCH as referring PDSCH, where limited buffer rate matching is used.

For PSSCH, there are the following alternatives.

* Alt 1. Use LBRM (Limited buffer rate matching) and define TBS\_LBRM
* Alt 2. Use FBRM (Full buffer rate matching)

Please share your views for above topic.

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| **Company** | **Views** |
| Ericsson  | We support Alt. 1 |
| Intel  | This aspect requires additional consideration. In general, the benefits of LBRM in sidelink scenarios with broadcast, groupcast and unicast communication support are FFS |
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