[103-e-NR-Rel-16-V2X-02] Email discussion/approval regarding location of PSFCH/PSSCH/PSCCH/2nd SCI mapping and PSCCH precoding

* Issue PS-2-1: To clarify starting symbol and location for PSFCH
* Issue PS-2-2: To clarify time-domain location of PSSCH
* Issue PS-2-3: To clarify time-domain and frequency-domain location of PSCCH

till 10/29, with a potential CR by 11/4 – Jeongho (Samsung)

# **Issue PS-2-1. To clarify starting symbol and location for PSFCH**

Six contributions [LGE], [Intel], [Sharp], [ASUSTek], [NTT DCM], [Qualcomm] discuss on this topic, which is related to the yellow-highlighted part below in TS38.211.

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| 8.3.4.2 PSFCH format 08.3.4.2.1 Sequence generationThe sequence $x\left(n\right)$ shall be generated according to$$x\left(n\right)=r\_{u,v}^{α,δ}\left(n\right)$$$$n=0,1,…,N\_{sc}^{RB}-1$$where $r\_{u,v}^{\left(α,δ\right)}(n)$ is given by clause 6.3.2.2 with the following exceptions:- $m\_{cs}$ is given by clause 16.3 of [5, TS 38.213]; - $m\_{0}$ is given by clause 16.3 of [5, TS 38.213];- $l$ is the OFDM symbol number in the PSFCH transmission where $l=0$ corresponds to the first OFDM symbol of the PSFCH transmission;- $l'$ is the index of the OFDM symbol in the slot that corresponds to the first OFDM symbol of the PSFCH transmission in the slot given by [5, TS 38.213];- $u=n\_{ID} mod 30$ and $v=0$ with $n\_{ID}$ given by the higher-layer parameter *sl-PSFCH-HopID* if configured; otherwise, $u=0$.- $c\_{init}=n\_{ID}$ with $n\_{ID}$ given by the higher-layer parameter *sl-PSFCH-HopID* if configured; otherwise, $c\_{init}=0$.8.3.4.2.2 Mapping to physical resourcesThe sequence $x\left(n\right)$ shall be multiplied with the amplitude scaling factor $β\_{PSFCH}$ in order to conform to the transmit power specified in [5, TS 38.213] and mapped in sequence starting with $x\left(0\right)$ to resource elements $\left(k,l\right)\_{p,μ}$ assigned for transmission according to clause 16.3 of [5, TS 38.213] in increasing order of first the index $k$ over the assigned physical resources, and then the index $l$ on antenna port$ p=5000$. The resource elements used for the PSFCH in the first OFDM symbol in the mapping operation above, including any DM-RS, PT-RS, or CSI-RS occurring in the first OFDM symbol, shall be duplicated in the immediately preceding OFDM symbol. |

* Alt 1. Describe PSFCH starting at symbol *startSLsymbols* + *lengthSLsymbols* - 2 in TS38.214 [LG]
* Alt 2. Describe as “The first OFDM symbol of the PSFCH transmission 𝑙′ is defined as 𝑙′ = startSLsymbols + *lengthSLsymbols* – 2.” in Clause 16.3 of TS38.213 [Intel], [ASUSTeK], [NTT DCM]
* Alt 3. Change the above yellow-highlighted to “$l'$ is the index of the OFDM symbol in the slot that corresponds to the last but one OFDM symbol available for SL transmission in the slot” in Clause 8.3.4.2.1 of TS38.211 [Sharp]
* Alt 4. Clarify that there is only one PSFCH symbol in Clause 8.2.1 of TS38.211 and describe as “In a slot with PSFCH transmission occasion, PSFCH resources are in the OFDM symbol that is two symbols after the last OFDM symbol with PSSCH resources in that slot.” in Clause 16.3 of TS38.213. [Qualcomm]

Please provide your views and reason.

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| **Company** | **Views** |
| LGE | ~~We are fine with Alt 1 and Alt 2.~~ [LGE2]Considering that mapping for AGC symbol will be done in TS38.211, TS38.213 needs to includes description for the mapping of PSFCH excluding AGC symbol. In this case, Alt 1 and Alt 2 may need to revise formula to indicate only the last symbol of the PSFCH. To be specific, the formula needs to modified into *startSLsymbols* + *lengthSLsymbols* – 3.Or, for simplicity, we can go to Alt 4.  |
| Huawei, HiSilicon | The ambiguity of the issue is the how many SL symbols are allocated for PSFCH. On PSFCH, based on the agreement of RAN1#99:RAN1#99 agreement: *Repetition of PSFCH format 0 (one-symbol PSFCH format agreed in RAN1#97) to two consecutive symbols is used.*o *This implies that, two consecutive symbols are always used for transmission of PSFCH format 0.* o *Note: The first symbol can be used for AGC training.*This is clear that two consecutive symbols are for transmission of PSFCH format 0. The note just an explanation of the usage of the first PSFCH symbol for AGC, but does not imply PSFCH has only one symbol. Hence, current specs only needs to capture starting location and length of PSFCH transmission as follows in our contribution R1-2007613:*A UE can be provided for use by PSFCH with two consecutive symbols immediately preceding the last symbol in a slot configured for sidelink, if PSFCH is configured in this slot.* |
| NTT DOCOMO | Alt 1 or Alt 2 or Alt 4.All alternatives seem on the same direction. Only difference would be which/how to specify it. Note that if Alt 1 is adopted, reference in the yellow part should be updated. |
| Ericsson | We are fine with Alt 2 or Alt 4 |
| Apple | We are generally fine with the direction of Alt 1 or Alt 2. One question about Alt 1 or Alt 2: We assume “lengthSLsymbols” has range of 0 to 14 (as given by “sl-LengthSymbols-r16” in IE of “SL-BWP-Generic-r16”) and “startSLsymbols” has range of 0 to 7 (as given by “sl-StratSymbol-r16” in IE of “SL-BWP-Generic-r16” ). Consider a simple case of full slot is for sidelink transmissions (i.e., lengthSLsymbols= 14 and startSLsymbols=0). Then, 𝑙′ = startSLsymbols + *lengthSLsymbols* – 2=12, which implies that the first PSFCH symbol is indexed as 12-th. However, PSFCH should occupy 11th and 12th symbols in this case, while the 13th symbol is GAP symbol. In other words, isn’t it 𝑙′ = startSLsymbols + *lengthSLsymbols* – 3? |
| Futurewei | Alt 2 appears to be the most straightforward way to correct the issue |
| Qualcomm | Alt 4. In our view value of $l$ should be explicitly set to 0 to avoid any possible confusion. |
| Samsung | Alt 4 but we agree only for adding sentence in Clause 16.3 of TS38.213. As HW commented, PSFCH has two OFDM symbols. So, the first part of Alt 4 is not necessary. |
| Sharp | The problem of Alt 4 is that it uses the last symbol of PSSCH to determine the first symbol of PSFCH, while in TS 38.214, it already specifies that PSSCH symbols are determined by excluding PSFCH symbols, i.e. cyclic dependency.Regarding the comments from Huawei, it is correct that two symbols will be used for PSFCH transmission, and this is done by duplication which is already specified in TS 38.211. The problem is that for the duplication part to work, steps before RE mapping should not involve the AGC symbol, i.e. the number of symbols involved in sub clause 8.3.4.2.1 of TS 38.211 should be exactly one, so in this regard we agree with Qualcomm that it should be clarified that there is only one “$l$” and $l=0$. (If we allow $l=0$ and $l=1$ respectively for the two symbols, then this is not “duplication” any more, see sub clause 6.3.2.2.2 where $l$ is used). |

# **Issue PS-2-2. To clarify time-domain location of PSSCH**

Two contributions [Sharp], [LG] discuss on this topic, which is related to the yellow-highlighted part below in TS38.214.

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| 8.1.2.1 Resource allocation in time domainThe UE shall transmit the PSSCH in the same slot as the associated PSCCH.The minimum resource allocation unit in the time domain is a slot.The UE shall transmit the PSSCH in consecutive symbols within the slot, subject to the following restrictions:- The UE shall not transmit PSSCH in symbols which are not configured for sidelink. A symbol is configured for sidelink, according to higher layer parameters *startSLsymbols* and *lengthSLsymbols*, where *startSLsymbols* is the symbol index of the first symbol of *lengthSLsymbols* consecutive symbols configured for sidelink.- Within the slot, PSSCH resource allocation starts at symbol *startSLsymbols+1.*- The UE shall not transmit PSSCH in symbols which are configured for use by PSFCH, if PSFCH is configured in this slot.- The UE shall not transmit PSSCH in the last symbol configured for sidelink.- The UE shall not transmit PSSCH in the symbol immediately preceding the symbols which are configured for use by PSFCH, if PSFCH is configured in this slot. |

* [LG] proposes to describe “The UE shall not transmit PSSCH in symbols which are configured for use by PSFCH starting at symbol *startSLsymbols* + *lengthSLsymbols* - 2, if PSFCH is configured in this slot” (Same as Alt 1 of Issue PS-2-1 above)
* [Sharp] proposes that, the last bullet is changed into “The UE shall not transmit PSSCH in the two consecutive symbols immediately preceding the symbol(s) which are configured for use by PSFCH, if PSFCH is configured in this slot.”

Please provide your views and reason including whether the change is needed or not.

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| **Company** | **Views** |
| LGE | If we go to Alt 2 in Issue PS-2-1, we do not need to have any change. In our understanding, the last bullet talk about TX-RX switching period between PSSCH and PSFCH. That is one symbol duration. [LGE2]Some clarification is needed on the meaning of “the symbol(s) which are configured for use by PSFCH”. If the description considers that PSFCH including AGC symbol, no spec change is needed. However, if the description considers that PSFCH excluding AGC symbol, we may need to consider “The UE shall not transmit PSSCH in the two consecutive symbols immediately preceding the symbol(s) which are configured for use by PSFCH.” To make it clear, it would be necessary to include “excluding or including the OFDM symbol duplicated as described in clauses 8.3.4.2.2 [TS38.211]”.  |
| Huawei, HiSilicon | With a clear definition on time domain on PSFCH in Issue PS-2-1, such two changes are not needed. |
| NTT DOCOMO | Same view with LGE and HW. Once PS-2-1 is solved, this update is unnecessary. The last yellow part is text for gap symbol right after PSSCH. |
| Ericsson | No changes needed |
| Apple | No changes are needed, if the issue PS-2-1 is addressed. |
| Futurewei | With PS-2-1 corrected, this issue is automatically solved |
| Qualcomm | No changes needed |
| Samsung | No changes needed assuming that PS-2-1 is addressed. |
| Sharp | Agree with [LGE2]. |

# **Issue PS-2-3. To clarify time-domain and frequency-domain location of PSCCH**

Two contributions [ZTE, Sanechips], [ASUSTeK] discuss on this topic, which is related to the yellow-highlighted part below in TS38.213.

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| 16.4 UE procedure for transmitting PSCCH A UE can be provided a number of symbols in a resource pool, by *timeResourcePSCCH*, starting from a second symbol that is available for SL transmissions in a slot, and a number of PRBs in the resource pool, by *frequencyResourcePSCCH*, for a PSCCH transmission with a SCI format 1-A. |

* [ZTE, Sanechips] proposes to change the above as
	+ A UE can be provided a number of symbols in a resource pool, by *timeResourcePSCCH*, starting from symbol *startSLsymbols+1* ~~a second symbol that is available for SL transmissions~~ in a slot, and a number of PRBs in the resource pool, by *frequencyResourcePSCCH,* starting from the lowest PRB of the lowest sub-channel of the associated PSSCH, for a PSCCH transmission with a SCI format 1-A.
* [ASUSTeK] proposes three options for the first symbol of PSCCH.
	+ Option 1: Add “The first OFDM symbol of a PSCCH is at the same symbol as the first OFDM symbol of its associated PSSCH” in Clause 8.2.1 of TS38.211.
	+ Option 2: Add “The first OFDM symbol of a PSCCH is the OFDM symbol immediately next to the OFDM symbol indicated by *sl-StartSymbol*.” in Clause 8.3.2.3 of TS38.211.
	+ Option 3: Add “The first OFDM symbol of a PSCCH is at symbol *sl-StartSymbol*+1.” in Clause 8.3.2.3 of TS38.211.

Please provide your views and reason including whether the change is needed or not.

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| **Company** | **Views** |
| LGE  | We are fine with ZTE’s proposal.  |
| Huawei, HiSilicon | No change is needed. On time-frequency domain for PSCCH, it can be derived according to current TS38.213 and TS38.214:o TS 38.213: *A UE can be provided a number of symbols in a resource pool, by timeResourcePSCCH, starting from a second symbol that is available for SL transmissions in a slot, and a number of PRBs in the resource pool, by frequencyResourcePSCCH, for a PSCCH transmission with a SCI format 1-A.*o TS 38.214: *The lowest sub-channel for sidelink transmission is the sub-channel on which the lowest PRB of the associated PSCCH is transmitted.* |
| NTT DOCOMO | For ZTE’s proposal, first one is unnecessary since the change does not change any. For second one, 214 describes it as HW’s comment; cut-paste might be good for better readability but would be unessential change.For ASUSTeK’s proposal, the above text in spec is enough. No update is necessary. |
| Apple | For the time resource of PSCCH, we think no change is needed.  |
| Futurewei | Our understanding is that there is no ambiguity, thus no need to change the spec text |
| Qualcomm | No changes needed. As pointed out by Huawei relevant details are already captured in 214 and 213. |
| Samsung | Agree with HW. No changes needed. |
| Sharp | No change is needed as explained by Huawei. |

Reference

1. R1-2007610 Correction on sidelink PT-RS sequence generation Huawei, HiSilicon
2. R1-2007772 Discussion on essential corrections in physical layer structure LG Electronics
3. R1-2007809 Remaining issues on physical layer structure for NR sidelink CATT
4. R1-2007921 Remaining issues of NR sidelink physical layer structure ZTE, Sanechips
5. R1-2007934 Remaining opens of sidelink physical structure for NR V2X design Intel Corporation
6. R1-2008129 Text Proposals on Physical Layer Structures for NR Sidelink Samsung
7. R1-2008230 Draft TP on physical structure for NR sidelink OPPO
8. R1-2008381 Remaining issue on physical layer structure and procedure for sidelink in NR V2X Panasonic Corporation
9. R1-2008387 Remaining issues on physical layer structure for NR sidelink Sharp
10. R1-2008429 Remaining Issue of Sidelink Physical Layer Structure Apple
11. R1-2008496 Maintenance for PSFCH and PSCCH symbol on NR sidelink ASUSTeK
12. R1-2008529 Maintenance for sidelink physical layer structure NTT DOCOMO, INC.
13. R1-2008604 Remaining Issues in Physical Layer Structure Qualcomm Incorporated
14. R1-2008665 Remaining issues on physical layer structure for NR sidelink vivo
15. R1-2008750 Discussion paper on the remaining issues in Rel. 16 for NR V2X Ericsson