**3GPP TSG-RAN WG1 #104-e R1-210xxxx**

**e-Meeting, January 25th – February 5th, 2020**

**Agenda item:** 7.2.4

**Source:** Moderator (Xiaomi)

**Title:** Summary of discussion/approval on the reply LS to R1-2100009 on sidelink switching priority

**Document for:** Discussion/Decision

# Introduction

In RAN1#104 meeting, a LS from RAN4 was received on sidelink switching priority [1]. Several contributionis on discussion and draft reply LS are also submitted [2-9]. As guided by the Chairman, in this document the summary of the submitted contributions, discussions and outcomes of the email discussion will be provided.

[104-e-NR-5G\_V2X-08]: Email discussion/approval of the reply LS to R1-2100009 (sidelink switching priority) till 1/29, to be handled under 7.2.4 (name TBD, Xiaomi)

# Discussion points (Phase 1 until 26th Jan.)

In [1], the following three questions are proposed for RAN1 to answer:

Question 1: Is there priority defined for LTE SL and NR SL?

Question 2: How does RAN WG1 define the priority of LTE SL and NR SL? For example, which parameter is used and how to determine the priority?

Question 3: Is it the case that there is no higher priority for LTE SL than NR SL?

Based on the submitted inputs [2]-[9], the following questions are devised in order to formulate potential answers to RAN4’s questions. Companies are encouraged to provide their inputs below.

## Question1 - Is there priority defined for LTE SL and NR SL

All the contributions [2-9] agree that there is priority defined for LTE SL, and there is priority defined for NR SL. Some contribution provide additional information including the number of levels of priority [2], how the priority information is carried [3], relation to PPPP/QoS flow [4], the reference of priority definition [9] and the ordering of priority values [9]. In [6], it is clarified that there is no priority defined per interface (i.e., a specific priority value associated with either LTE SL or NR SL).

Based on the above summary, for Question 1, the proposed reply answer is:

*Yes, there is priority defined for LTE SL, and there is priority definded for NR SL.*

**Question 1-1: Is the above proposed reply answer acceptable? If no, pls provide comment.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | No | From our reading, the question from RAN4 is asking whether there is a interface-specific priority defined for LTE and NR SL, and our understanding is no – the priority is defined per channel/signal in physical layer. |

**Question 1-2: For question1, is there any other information necessary to be included in the reply LS? If yes, pls provide comment.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes | As commented above, the LS reply should clarify that the priority is per channel/signal regardless of the interface, but not defined per interface. |

## Question2 - How does RAN WG1 define the priority of LTE SL and NR SL

In contributions [2-9], various aspects on priority of LTE SL and NR SL were discussed. From [1], the motivation for RAN4 to send LS to RAN1 is to clarify the priority issue between LTE SL and NR SL. Therefore, we may first need to decide which aspect(s) should be replied to RAN4.

**Question 2-1: Which of the following aspect(s) should be included in the reply LS:**

**A. determining the priority of SL signal(s)/channel(s), including LTE and NR PSCCH/PSSCH, NR S-SSB or LTE PSBCH/SSSS/PSSS, and NR PSFCH;**

**B. Priorization when overlap between LTE SL Tx and NR SL Tx, or between LTE SL Tx and NR SL Rx, or between LTE SL Rx and NR SL Tx, and priorities of both LTE and NR sidelink are known to both RATs prior to time of collision (subject to processing time restriction);**

**C. Cases when the prioritization between LTE and NR SL is up to UE implementation.**

**D. NR SL priority level and LTE SL priority level are directly comparable.**

**E. Others (pls provide the comment)**

|  |  |  |
| --- | --- | --- |
| Company | Answer | Comment |
| vivo | A, B | A and B should be enough, additional details can be provided with a reference to spec.  |

If A is selected, pls answer the following question:

**Quesiton 2-2: Do you agree, at least from RAN1 perspective, for both LTE SL and NR SL, the priority of a PSCCH/PSSCH is indicated in the SCI scheduling the transmission of PSCCH/PSSCH? If not, pls provide the comment.**

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| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes |  |

**Question 2-3: Do you agree, the priority of NR S-SSB or LTE PSBCH/SSSS/PSSS is determined by higher layer (pre)-configured parameter? If not, pls provide the comment.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Partially yes | The priorities for both NR and LTE can be configured by RRC. But according to the latest 36.331, the priority of LTE PSBCH/SSSS/PSSS **cannot be preconfigured,** but only applicable to connected mode UE. |

**Question 2-4: Do you agree, the priority of NR PSFCH is the same as the corresponding PSSCH? If not, pls provide the comment.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes |  |

If B is selected, pls answer the following question:

**Question 2-5: Do you agree to include the following description in the reply LS? If not, pls provide the comment.**

**For overlap between LTE SL Tx and NR SL Tx, or between LTE SL Tx and NR SL Rx, or between LTE SL Rx and NR SL Tx, if priorities of both LTE and NR sidelink signal(s)/channel(s) are known to both RATs prior to time of collision (subject to processing time restriction), the UE transmits or receives the signal/channel with higher priority between LTE and NR sidelink.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes |  |

**Question 2-6: Do you agree to include the following description in the reply LS? If not, pls provide the comment.**

**When NR multiple transmissions are overlapped with LTE SL TX/RX and if these NR multiple transmissions have different priorities (which are known in advance to the UE), the highest priority value of NR multiple transmissions is used for comparing that of LTE SL TX/RX and then SL operation with a higher relative priority is performed.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes |  |

If C is selected, pls answer the following question:

**Question 2-7: Do you agree to include the following description in the reply LS? If not, pls provide the comment.**

**For overlap between LTE SL Rx and NR SL Rx, it is up to UE implementation to manage receptions of LTE and NR sidelinks;**

**For overlap between LTE SL Tx and NR SL Tx, or between LTE SL Tx and NR SL Rx, or between LTE SL Rx and NR SL Tx, unless priorities of both LTE and NR sidelink signal(s)/channel(s) are known to both RATs prior to time of collision (subject to processing time restriction) and the priorities of LTE and NR SL transmissions are not the same, it is up to UE implementation to handle the overlap.**

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| --- | --- | --- |
| Company | Yes/No | Comment |
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If D is selected, pls answer the following question:

**Question 2-8: Do you agree to include the following description in the reply LS? If not, pls provide the comment.**

**NR SL priority level and LTE SL priority level are directly comparable**

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| --- | --- | --- |
| Company | Yes/No | Comment |
|  |  |  |

## Question3 - Is it the case that there is no higher priority for LTE SL than NR SL

Majority contributions [2][3][4][5][6][9] answer NO to the question. Some contributions clarified that LTE SL priority and NR SL priority are directly comparable [2][4][5][9], or LTE SL can have higher priority than NR SL [3][6], or there is no fixed priority between LTE SL and NR SL [8].

Based on the above summary, for Question 3, the proposed reply answer is:

*No. The LTE SL priority and NR SL priority are directly comparable, i.e. the same numerical value has the same meaning in both the RATs. It is possible that LTE SL has higher priority than NR SL.*

**Question 3-1: Is the above proposed reply answer acceptable? If no, pls provide comment.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comment |
| vivo | Yes | Editorial suggestions:*No. The LTE SL priority and NR SL priority are directly comparable, i.e. the same numerical value has the same meaning in both the RATs. It is possible that a LTE SL transmission has higher priority than a NR SL transmission.* |

# Proposed reply answers /outcome (Phase 2 until 29th Jan.)

# Summary of contribution inputs

In [1], the following three questions are proposed for RAN1 to answer:

Question 1: Is there priority defined for LTE SL and NR SL?

Question 2: How does RAN WG1 define the priority of LTE SL and NR SL? For example, which parameter is used and how to determine the priority?

Question 3: Is it the case that there is no higher priority for LTE SL than NR SL?

## Answer to Question1

In [2] the draft answer was provided as following:

*Yes, there are currently 8 levels of priority defined for both LTE SL and NR SL in Rel-16.*

In [3], the draft answer was provided as following:

*Yes, the priority is defined for both LTE SL and NR SL. The priority information is carried in SCI format 1 and SCI format 1-A for LTE SL and NR SL respectively.*

In [4], the draft answer was provided as following:

*Yes. The priority is defined for LTE SL as PPPP and NR SL as the Priority Level respectively for a QoS flow.*

In [5], the draft answer was provided as following:

*Yes*

In [6], the draft answer was provided as following:

*From RAN1 perspective, there is no priority defined per interface (i.e., a specific priority value associated with either LTE SL or NR SL). However, there is priority defined per channel/signal for transmission/reception in either LTE SL or NR SL. The details of priority handling are defined in section 16.2.4, TS38.213.*

In [7], the draft answer was provided as following:

*Yes*

In [8], the draft answer was provided as following:

*Yes, there are priorities defined for both LTE SL and NR SL transmissions*

In [9], the draft answer was provided as following:

*Yes, priority is defined for the LTE SL in clause 4.4.5.1 of TS 23.285 and for NR SL in clause 5.4.3.3 of TS 23.287. Priority values are ordered in decreasing order of priority, i.e. with 1 as the highest priority and 8 as the lowest priority*

## Answer to Question2

In [2] the draft answer was provided as following:

*Priority levels for LTE and NR sidelinks are defined by SA2 and specified in clause 5.4.3.3 of TS 23.287. In both LTE and NR, sidelink priority level for PSCCH/PSSCH transmission is determined by higher layer and parsed down to L1 and conveyed to other UEs as a ‘Priority’ parameter in SCI format 1A [TS 38.212].*

In [3], the draft answer was provided as following:

*For LTE SL, the priority carried in SCI format 1 is determined by the PPPP of V2X traffic QoS.*

*For NR SL, the message to be transmitted in SL includes not only V2X traffic but also PC5 signaling(e.g. SL-CSI feedback, and PC5-RRC, and etc..). When V2X traffic is transmitted in SL, the priority carried in SCI format 1-A is determined by the priority level of V2X traffic QoS. When PC5-signaling is transmitted in SL, the priority carried in SCI format 1-A is fixed as “1”.*

*Additionally, NR V2X priority level and LTE V2X PPPP are directly comparable i.e. the same numerical value has the same meaning in both the RATs[2].*

In [4], the draft answer was provided as following:

*In RAN WG1, the priority of PSSCH is determined by the field “Priority” in the related SCI format. For S-SSB in NR SL or SLSS/PSBCH in LTE SL, the related priority is indicated by higher layers. For PSFCH in NR, the related priority is equal to that of corresponding PSSCH. The above rules are specified in 16.2.4.1 in 3GPP TS 38.213.*

In [5], the draft answer was provided as following:

*The priority is determined by the SCI formats scheduling the transmissions of the channel(s)/signal(s), or, is indicated by higher layers in case of a S-SS/PSBCH block or a sidelink synchronization signal using E-UTRA radio access, or, is equal to the priority of the corresponding PSSCH in case of PSFCH.*

*When NR multiple transmissions are overlapped with LTE SL TX/RX and if these NR multiple transmissions have different priorities (which are known in advance to the UE), the highest priority value of NR multiple transmissions is used for comparing that of LTE SL TX/RX and then SL operation with a higher relative priority is performed.*

In [6], the draft answer was provided as following:

*For transmission/reception of each channel/signal associated with a TB, the priority is defined according to the logical channel priority defined in TS38.321. Especially, the priority of MAC CE is fixed to ‘1’ as defined in TS38.321. For NR S-SSB or LTE PSBCH/SSSS/PSSS, the priority is configured by higher layer parameter sl-SSB-PriorityNR-r16 and sl-SSB-PriorityEUTRA-r16, respectively.*

In [7], the draft answer was provided as following:

* *Between LTE SL Tx and NR SL Tx, or between LTE SL Tx and NR SL Rx, or between LTE SL Rx and NR SL Tx, if a UE has enough processing time (< 4ms) to know a priority value, the UE transmits or receives the signal/channel with higher priority between LTE and NR sidelink and the priority is decided for each signal/channel by*
	+ *LTE and NR PSSCH: the value in SCI*
	+ *NR PSFCH: same as corresponding PSSCH*
	+ *NR S-SS/PSBCH: higher layer parameter sl-SSB-PriorityNR-r16*
	+ *LTE PSSS/SSSS/PSBCH: higher layer parameter LTESidelinkSSBPriority*
* *Between LTE SL Rx and NR SL Rx, or if the priority is the same, or if the UE does not have enough processing time to know the priority value, the prioritization between LTE and NR sidelink is up to UE implementation.*

In [8], the draft answer was provided as following:

*For the case of NR SL*

* *For outgoing transmissions of, the priority value is provided by higher layers.*
* *For incoming PSSCH transmissions, a priority value is signalled in the associated PSCCH.*
* *For some transmissions, a priority value if provided by a (pre-)configuration:*
	+ *A priority of an S-SS/PSBCH block is provided by sl-SSB-PriorityNR.*
	+ *A priority of a PSFCH is same as the priority of the corresponding incoming PSSCH, which is signalled in the associated PSCCH.*
* *For the case of incoming transmissions, a priority of a PSSCH according to NR radio access or according to E-UTRA radio access is indicated by a priority field in a respective scheduling SCI format.*

*For the case of LTE SL*

* *For outgoing transmissions of, the priority value is provided by higher layers.*
* *For incoming PSSCH transmissions, a priority value is signalled in the associated PSCCH.*
* *For some transmissions, a priority value if provided by a (pre-)configuration:*
	+ *A priority of a PSSS/SSSS/PSBCH according to E-UTRA radio access is provided by sl-SSB-PriorityEUTRA.*

*The priority value is used for sensing and resource allocation in Mode 2, for resolving intra-RAT conflicts (e.g., if a UE is scheduled to perform simultaneous UL and SL transmissions for a given RAT, but it is not capable of doing so), and for resolving inter-RAT conflicts. (e.g., if a UE is scheduled to perform simultaneous transmissions but it is not capable of doing so). Regarding this latter case, the following agreements made by RAN1 define how the priorities are used:*

|  |
| --- |
| Working assumption:* For Tx/Tx overlap,
	+ If packet priorities of both LTE and NR sidelink transmissions are known to both RATs prior to time of transmission subject to processing time restriction, then the packet with a higher relative priority is transmitted
		- In case the priorities of LTE and NR SL transmissions are the same, then it is up to UE implementation as to which transmission is chosen (e.g., taking into account congestion, etc.)
	+ If packet priorities of both LTE and NR sidelink transmissions are not known to both RATs prior to time of transmission subject to processing time restriction, then it is up to UE implementation to manage Tx/Tx overlaps (e.g., LTE transmissions are always prioritized, etc.)
	+ RAN1 does not assume any impact to LTE physical layer specifications

Agreements:* For Tx/Tx overlap,
	+ Confirm the working assumption made in RAN1#96bis
	+ UE capability is defined for short-term time-scale TDM for in-device coexistence

Agreements:* For Rx/Rx overlap,
	+ Up to UE implementation to manage receptions of LTE and NR sidelinks.

Agreements**:**Unless packet priorities of both LTE and NR sidelink are known to both RATs prior to time of collision (subject to processing time restriction), then1. It is up to UE implementation to handle LTE Tx/NR Rx overlap.
2. It is up to UE implementation to handle NR Tx and LTE Rx overlap.

Agreements:* RAN1 understand that NR V2X priority field and PPPP are directly comparable i.e. the same numerical value has the same meaning in both the RATs.
	+ Ask SA2 to confirm the understanding. If understanding is incorrect, please provide solution.

Final LS in R1-1909876 Agreements:* For Tx/Rx overlap,
	+ If packet priorities of both LTE and NR sidelinks are known to both RATs prior to time of transmission/reception (subject to processing time restrictions), then the packet with a higher relative priority is transmitted/received
		- In case the priorities of LTE and NR sidelink packets are the same, then it is up to UE implementation as to which packet is transmitted/received

Agreements:* + For sidelink synchronization signal/channel (including S-SSB and LTE SLSS/PSBCH) priority for a UE is (pre)-configured per UE
		- The (pre)-configured priority is used in the same way as the priority for other channel/signals w.r.t. prioritization for handling in-device co-existence
		- Note: it is understood that the same priority (pre)-configuration is intended for all the related UEs
	+ The priority of PSFCH is set as the priority of the corresponding PSSCH.

Agreements:1. When NR multiple transmissions (if supported) are overlapped with LTE SL TX/RX and if these NR multiple transmissions have different priorities (which are known in advance to the UE), the highest priority value of NR multiple transmissions is used for comparing that of LTE SL TX/RX and then SL operation with a higher relative priority is performed.
 |

*The priority value is indicated in PPPP Prose per Packet Priority.*

*Moreover, from one of the agreements in RAN1:*

*In case the priorities of the transmissions are not known, then it is up to UE implementation which transmission to prioritize if both NR SL and LTE SL have to be transmitted.*

Agreements:

* RAN1 understand that NR V2X priority field and PPPP are directly comparable i.e. the same numerical value has the same meaning in both the RATs.

In [9], the draft answer was provided as following:

*RAN1 does not define the priority of a service; refer to the specifications cited in the answer to Question 1. In RAN1, priority of a PSSCH transmission is indicated in the “Priority” field of an SCI format 1 in LTE, or SCI format 1-A in NR, after being set for the transport block by higher layers. A PSFCH transmission or reception has a priority equal to the associated PSSCH. A S-SS/PSBCH block or a sidelink synchronization signal using E-UTRA radio access has a priority indicated by higher layer (pre-)configuration. Prioritization among sidelink transmissions/receptions is according to TS 38.213 clauses 16.2.41 and 16.2.4.2.*

## Answer to Question3

In [2], the draft answer was provided as following:

*As mentioned in the answer for Q1, there are currently 8 levels of priority defined for both LTE SL and NR SL in Rel-16, and they are directly comparable to each other as they have the same format and meaning [TS 23.287]. Therefore, there is no higher priority for LTE SL than NR SL.*

In [3], the draft answer was provided as following:

*No, the priority of V2X traffic is determined by application layer. From RAN1 understanding, LTE SL could have higher priority than NR SL.*

In [4], the draft answer was provided as following:

*No. The priority value of LTE SL channel/signal can be directly compared with that of NR SL channel/signal. The corresponding agreements were reached in RAN WG1 #98 meeting [1]:*

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| --- |
| Agreements:* RAN1 understand that NR V2X priority field and PPPP are directly comparable i.e. the same numerical value has the same meaning in both the RATs.
	+ Ask SA2 to confirm the understanding. If understanding is incorrect, please provide solution.

Draft LS in **R1-1909818** (Sudhir, QC), which is approved (with the update “in-device”) with final LS in R1-1909876 |

*And the above agreements were confirmed by SA2 in SA WG2 Meeting #135 [2]:*

|  |
| --- |
| SA2 would like to confirm that the RAN1 assumption is correct. As defined in TS 23.287 clause 5.4.3.3, the Priority Level of the NR V2X PC5 QoS characteristics has the same format and meaning of that of the PPPP:*The Priority Level has the same format and meaning as that of the ProSe Per-Packet Priority (PPPP) defined in TS 23.285 [8].* *NOTE: Using the same format for Priority Level and PPPP provides better backward compatibility.* This means that the same numerical value of Priority Level and PPPP has the same meaning in NR V2X and LTE V2X. |

*Which RAT has higher priority is based on the comparison of values of priorities if priorities of both LTE and NR sidelinks, i.e. PPPP and Priority Level are known to both RATs at a UE prior to time of transmission (subject to processing time restrictions), as described in 16.3.4.1 in 3GPP TS 38.213 as following [3]:*

|  |
| --- |
| ......16.2.4.1 Simultaneous NR and E-UTRA transmission/receptionIf a UE - would transmit a first channel/signal using E-UTRA radio access and second channels/signals using NR radio access, and- a transmission of the first channel/signal would overlap in time with a transmission of the second channels/signals, and- the priorities of the channels/signals are known to both E-UTRA radio access and NR radio access at the UE $T$ msec prior to the start of the earliest of the two transmissions, where $T\leq 4$ and is based on UE implementation, the UE transmits only the channels/signals of the radio access technology with the highest priority as determined by the SCI formats scheduling the transmissions or, in case of a S-SS/PSBCH block or a sidelink synchronization signal using E-UTRA radio access, as indicated by higher layers or, in case of PSFCH, equal to the priority of the corresponding PSSCH....... |

*Furthermore, if the priority values of LTE and NR sidelinks are the same, it is up to UE implementation to determine which RAT is prioritized. On the other hand, if the priority of at least one of LTE and NR sidelinks is not known to both RATs at a UE prior to time of transmission, it is also up to UE implementation to determine which RAT has higher priority.*

In [5], the draft answer was provided as following:

*No. In RAN1#98 meeting, the following agreements are made:*

Agreements:

* RAN1 understand that NR V2X priority field and PPPP are directly comparable i.e. the same numerical value has the same meaning in both the RATs.

In [6], the draft answer was provided as following:

*No, it is possible that transmission/reception of a channel/signal in LTE SL has higher priority than that in NR SL.*

In [7], the draft answer was provided as following:

*Yes (See RAN1 reply to Q2)*

In [8], the draft answer was provided as following:

*As captured in the above agreements, there is no fixed priority between LTE SL and NR SL. In RAN1 the priority is evaluated per packet. Packets are treated with regards to their priority, independently of their RAT. As captured in the above agreements, in the case where the priorities of LTE SL and NR SL transmissions are the same, then it is up to UE implementation as to which transmission is chosen/prioritize.*

In [9], the draft answer was provided as following:

*No. The priority level for NR PC5 has the same format, meaning, and value range as the Priority value of the ProSe Per-Packet Priority (PPPP) for LTE PC5. Details can be found in the specifications referred to for Question 1*

# References

[1] R1-2100009 LS on SL switching priority RAN4, Xiaomi

[2] R1-2100139 Draft reply LS on SL switching priority OPPO

[3] R1-2100316 Draft Reply LS on SL switching priority CATT, GOHIGH

[4] R1-2100935 [Draft] Reply LS on SL switching priority ZTE, Sanechips

[5] R1-2101090 [Draft] Reply LS on SL switching priority Xiaomi

[6] R1-2101148 Draft relay LS on SL switching priority vivo

[7] R1-2101169 Draft reply LS on SL switching priority Samsung

[8] R1-2101706 [Draft] LS on SL switching priority Ericsson

[9] R1-2101735 Discussion on RAN4 LS on SL switching priority Huawei, HiSilicon