**3GPP TSG RAN WG1 #102-e R1-200xxxx**

**August 17th – 28th, 2020**

**Agenda item:** 7.2.4.4

**Source:** Moderator (Qualcomm)

**Title:** FL Summary of In-device Coexistence Aspects in NR-V2X

**Document for:** Discussion and Decision

# Introduction

This document provides a list of issues pertaining to the coexistence aspects (AI 7.2.4.4) of NR V2X. The list is based on views expressed by companies in their respective contributions.

# List of Issues for In-device Coexistence

Different proposals made in contributions are provided in Table 2. Most of the proposals are either agreed in some form. Some of the proposals introduce new functionality that has not been agreed or discussed earlier.

In the feature lead’s view, two issues are more urgent than the others:

1. Timeline for LTE sidelink and NR sidelink prioritization [3][7][8][9]
2. Capture the agreement on prioritization of multiple overlapping transmissions between NR sidelink and LTE sidelink [1][4].

Issue #1 is an open issue in specifications, the UE feature discussion concluded that there will not be a UE capability to signal the prioritization processing time and that it would be captured in specifications.

Issue #2 is about capturing an existing agreement and has already been discussed in RAN1 #100bis-e and RAN1 #101-e.

Given that Issue #1 has not been discussed, the proposal is to prioritize this discussion in the email thread allocated to this agenda item.

**FL Proposal:** Have one email discussion to discuss the processing time for prioritization of LTE sidelink and NR sidelink (Issue #1 in this summary).

**Table 1 Comments on FL proposal**

|  |  |
| --- | --- |
| Company | Comments |
| vivo | We support FL’s proposal, i.e., to discuss Issue #1 in this AI. |
| OPPO | OK with FL’s proposal. |
| LG Electronics | We agree with FL’s suggestion (i.e., having only one email discussion thread to discuss the processing time for prioritization of LTE SL and NR SL). |
| Ericsson | Agree with FL’s proposal. |
| ZTE, Sanechips | OK with FL’s proposal to discuss issue #1. Meanwhile the issue #2 is still a pending issue in our understanding.  |
| Futurewei | Ok to discuss issue 1. For issue 2, since it needs a TP to capture a previous agreement, we suggest to address it as well when the TP for issue 1 is drafted |
| Huawei, HiSilicon | For issue #1, the current specification does not prescribe a time, thus it is left to UE and network implementation as currently written. It may not be necessary to discuss altering the status quo.Issue #2 is still open from the previous meeting, and needs implementing in the specification. |
| ASUSTeK | We support FL’s proposal. |
| Qualcomm | Agree with the proposal. |

Table 2: Topics discussed in company contributions

|  |
| --- |
| 1. Timeline for LTE sidelink and NR sidelink prioritization [3][7][8][9]
2. Capture the agreement on prioritization of multiple overlapping transmissions between NR sidelink and LTE sidelink [1][4].
	1. The discussion in [1] further focuses on the case of mixed SCS and on the case of multiple PSFCHs.
3. Incorporate *sl-MaxTransPower* directly into *P*PSSCH(i) calculation for static power allocation when FDMing NR sidelink and LTE sidelink [5].
4. Clarify that inter-band FDM-based solutions with static power allocation can be used when frequency separation is large enough [10]
5. Editorial:
	1. Correct reference for priority field [2].
6. As UE assistant information, UE reports information on its configured resource pool of LTE sidelink and/or NR sidelink to the eNB and gNB [6].
 |

# References

1. R1-2005319, “Remaining issues of in-device coexistence,” ZTE, Sanechips.
2. R1-2005343, “Remaining issues on In-device coexistence between NR and LTE sidelinks,” vivo.
3. R1-2005744, “Discussion on essential corrections in in-device coexistence,” LG Electronics.
4. R1-2005800, “Remaining details of in-device coexistence between LTE and NR sidelinks,” Huawei, HiSilicon.
5. R1-2006005, “FDM-based semi-static power split for in-device coexistence,” OPPO.
6. R1-2006103, “On In-device Coexistence between LTE and NR Sidelink,” Samsung.
7. R1-2006438, “Correction for in-device coexistence in SL,” Ericsson.
8. R1-2006771, “In-device Coexistence between LTE and NR sidelink,” Qualcomm Incorporated.
9. R1-2006869, “Discussion on processing time restriction for in-device coexistence,” ASUSTeK.
10. R1-2006910, “Remaining details of In-device coexistence between LTE and NR sidelinks,” Nokia, Nokia Shanghai Bell.

# Appendix: Agreements made in previous RAN1 meetings

## RAN1 #95

Agreements:

* Consider solutions for sidelink coexistence for the following:
	+ Potential LTE V2X Tx and NR V2X Tx
	+ Potential LTE V2X Tx and NR V2X Rx
	+ Potential LTE V2X Rx and NR V2X Tx
* FFS the case of potential LTE V2X Rx and NR V2X Rx, e.g., whether or not it can be handled implementation

Agreements:

RAN1 will identify both TDM and FDM solutions for coexistence. The specific support for each solution is FFS.

For FDM solutions:

* For both dynamic and semi-static power allocation solutions, RAN1 assumes synchronization between NR and LTE V2X sidelinks, for a NR V2X UE when NR and LTE V2X sidelinks are intra-band
* The case of inter-band is FFS

Note: If the identified solutions can be applied to systems that are not synchronized, then RAN1 may revisit this assumption.

## RAN1 AH1901

Agreements**:**

* For TDM solutions for in-device coexistence between LTE and NR V2X:
	+ Time Alignment
		- Subframe boundary alignment is required between LTE and NR V2X sidelinks
		- Both LTE and NR V2X sidelinks are aware of the time resource index (e.g., DFN for LTE) in both carriers

Agreements**:**

* For long term time scale TDM solutions for in-device coexistence between LTE and NR V2X:
	+ For a UE with coexistence impact, non-overlapping (in time domain) resource pools are (pre-)configured for NR V2X and LTE V2X sidelinks
		- No information is exchanged between LTE and NR sidelinks within the UE
* Long term time scale TDM solution is feasible from RAN1 point of view
	+ Note: although feasible, it is expected that such a solution may have impact on latency, reliability and data rate requirements for some applications
	+ No additional modifications to LTE specifications are needed

Agreements**:**

Assuming SPS scheduling (mode -3 or mode-4) for LTE V2X, for short time scale TDM solutions for in-device coexistence for V2X,

* For each occurrence of Tx/Tx overlap, one RAT is prioritized over another
	+ This requires some information exchange between LTE and NR sidelinks within the UE
	+ FFS: whether the information exchange between LTE and NR sidelinks can support this requirement
	+ FFS: if there is impact to RAN1 LTE specification with this agreement
	+ FFS: whether this solution can be up to UE implementation
* For each occurrence of Tx/Rx overlap, one RAT is prioritized over another
	+ This requires some information exchange between LTE and NR sidelinks within the UE
	+ FFS: if there is impact to RAN1 LTE specification with this agreement
	+ FFS: whether this solution can be up to UE implementation
	+ FFS: If determination of priority for Rx operation is feasible and whether the information exchange between LTE and NR sidelinks can support this requirement

Agreements**:**

* Inter-band FDM Solutions for coexistence
	+ For static power assignment of Pc,max for each carrier
		- Synchronization is not assumed for inter-band coexistence of NR sidelink and LTE sidelink.
		- This FDM solution is feasible for resolution of Tx/Tx coexistence conflicts
		- If the band separation is large enough (based on RAN4 indication), then this FDM solution for coexistence is feasible for Tx/Rx coexistence
		- If the band separation is NOT large enough, then this FDM solution is not feasible for resolution of Tx/Rx coexistence conflicts
	+ For dynamic power sharing between carriers,
		- FFS details of FDM solutions and whether they are feasible

## RAN1 #96

Agreements:

* From RAN1 point of view, short term TDM solutions for NR and LTE V2X in-device coexistence is considered to be feasible for a UE when the load for the UE from LTE side and from NR side is at or below an acceptable level
* For each occurrence of Tx/Tx overlap and of Tx/Rx overlap, one RAT is prioritized over another
	+ High-level principles of prioritization (e.g., BSM is deemed to have a higher priority, etc.) of LTE/NR can be discussed during the WI phase, while it is expected that detailed solutions may be left for implementation

GM has concerns over the “e.g.” in the agreements above.

Agreements**:**

* From RAN1 point of view, for both intra-band and inter-band Tx/Tx FDM solutions for in-device coexistence are considered to be feasible, at least if the following conditions are met:
	+ For the intra-band case for dynamic power sharing, NR and LTE transmissions are fully overlapped in the time domain, i.e., NR transmissions have to span the entire LTE TTI such that the total power across the transmissions is constant.
* For intra-band and inter-band FDM dynamic power sharing solutions, the following additional conditions apply:
	+ Subframe boundary alignment is required between LTE and NR V2X sidelinks
	+ Both LTE and NR V2X sidelinks are aware of the time resource index (e.g., DFN for LTE) in both carriers
* For purposes of dynamic power sharing between LTE and NR Tx,
	+ High-level principles of prioritization (e.g., BSM is deemed to have a higher priority, etc.) of LTE/NR can be discussed during the WI phase, while it is expected that detailed solutions may be left for implementation

Agreements:

* Rx/Rx coexistence are feasible for intra- & inter-band from RAN1 point of view
	+ High-level principles of Rx/Rx coexistence of LTE/NR can be discussed during the WI phase, while it is expected that detailed solutions may be left for implementation

Agreements:

* Based on the study from physical layer specification perspective, in-device coexistence of LTE and NR sidelink is feasible for intra- & inter-band under the respective conditions & solutions for TX/TX, TX/RX, & RX/RX
	+ - In the TR, also provides a reference to the respective sections

## RAN1 #96bis:

**Conclusion:**

* RAN1 does not see any specification impact for support of Long Term Time-Scale TDM for coexistence of NR and LTE sidelinks

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

RAN1 #97:

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.

RAN1 #98:

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), then

1. 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.

RAN1#98Bis:

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.
	+ UE reports its capability to the network of whether it supports short-term time scale TDM solutions.
	+ Resource allocation related information is not reported to other RAT.

RAN1#99:

Agreements:

* 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.

Agreements:

* In-device coexistence conflicts for network-controlled modes are addressed in the same way as for UE-autonomous modes
	+ No addition spec is expected