3GPP TSG-RAN WG2 #110-e TDoc R2-200xxxx

**Electronic, June 1st – June 12th, 2020**

Agenda Item: 6.4.2.2

Source: ZTE Corporation, Sanechips

Title: Summary of NR V2X UE cell (re-)selection related contribution

Document for: Discussion, Decision

# Introduction

In this contribution, we will give a summarize of all contributions related to NR V2X cell selection/ reselection, which is based on the following contributions.

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| TDoc No. | Title | Source |
| R2-2002829 | Discussion on inter-RAT Cell Selection/Reselection | CATT |
| R2-2003097 | Remaining issues of cell (re)selection for NR V2X | Lenovo, Motorola Mobility |
| R2-2003515 | Remaining issues on cell reselection for sidelink in TS 38.304 | Huawei, HiSilicon |
| R2-2003721 | Finalising cell reselection for V2X | Samsung |

In details, all proposals raised in those contributions are quite essential at this stage. Thus, all issues listed out in the following are marked with essential.

# Discussion

## [Essential] Rel-16 V2X UE performing cell (re-)selection in RRC connected state

According to the description in [1], it clarifies that in LTE sidelink and V2X, UE is allowed to perform cell selection/reselection under RRC connected mode. The reason is that the SL/V2X UE may also work as a normal Uu UE, then it may access into RRC connected mode due to Uu services, but the eNB which it accesses into may not support SL/V2X SL features. As the consequence, the UE may still need to choose another cell for SL configurations if it has the SL traffic. Thus, in their opinion, the same principle should be applied to NR V2X as well. Thus,

**Question 1: Whether the procedure of cell selection and reselection should apply to RRC\_CONNECTED UE as well ?**

**- Alt 1: Yes**

**- Alt 2: No**

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| **Company** | **Option** | **Comments (if any)** |
| Ericsson | Yes | Ok to follow LTE principle. |
| vivo | Yes for cell selection, FFS for cell reselection  | The section of ‘11.4 Cell selection and reselection for sidelink’, saying that ‘the requirements defined in this clause for sidelink operation apply for UEs in RRC\_IDLE and in RRC\_CONNECTED’ was captured and agreed in the CR in RAN2 #88, but after tracking some of the discussions then we have some kind of feeling that the reason could just be that the UE shall perform cell selection during RRC re-establishment when the UE is in CONNECTED, rather than from the service point of view. For cell reselection, it seems that the scenario for RRC\_CONNECTED UE to perform cell reselection based on sidelink service was not really discussed then, and in fact this may have impact on the whole RRM design (e.g. the UE may reselect to another cell without NW handover command and awareness), so we need to be careful about this. |
| CATT | Yes | Same as LTE  |
| Huawei | Yes | Follow LTE SL (TS 36.304, subclause 11.4) |
| ZTE | Yes | We should follow LTE SL |
| OPPO | Yes with comments | We are fine to follow LTE. But it is not clear whether UE is allowed to read system information of neighboring cell when UE is RRC\_CONNECTED when T310 is not running in current spec so some clarification is needed in 38.331. In addition when UE realize that a neighboring cell met reselection condition, it should be up to UE’s implementation to decide whether to stay in current cell to continue with current service, or reselect to the neighboring cell to start V2X service. In LTE system such kind of UE’s behavior is captured in CT1 spec. Hence a LS is needed to inform CT1 to capture similar UE’s behavior.Here is LTE part:*2) else if in EMM-CONNECTED mode, either:**i) perform a detach procedure as specified in 3GPP TS 24.301 [11] and then perform PLMN selection triggered by V2X communication over PC5 as specified in 3GPP TS 23.122 [9]; or**ii) not initiate V2X communication over PC5.* *Whether the UE performs i) or ii) above is left up to UE implementation; or* |
| Nokia | Yes | Follow LTE V2X principle for cell (re)selection |
| Intel | Yes | We are also fine to follow LTE SL behavior |
| Lenovo | Yes with comments | We are OK to follow LTE principle to support cell (re)selection under RRC\_CONNECTED mode.However, it is not clear what is the UE behavior during cell (re)selection on Uu interface, which needs to be clarified. |
| LG | Yes | Same as LTE V2X cell (re)selection principle |
| Samsung | Yes | Same as in LTE |
| BlackBerry | Yes | Same as LTE. |
| Interdigital | Yes | We should follow LTE. |
| Convida Wireless | Yes | We agree that we should follow the same principle as for LTE |

Conclusion:

Count: Alt 1: 14 companies / Alt 2: 0 companies

Totally there are 14 companies participating to feedback this question, and all companies agree that for RRC connected UE, it shall also perform cell selection for V2X service. In details, majority companies think RAN2 should directly follow LTE principle and use the similar specification description. Some companies(Vivo) think for cell reselection case, it will have impact on the RRM design. E.g. the UE may reselect to another cell without NW handover command and awareness, thus ,RAN2 should carefully consider the issue. Some other companies(OPPO and Lenovo) suggest that UE behaviour in Uu should be further clarified. As OPPO suggested, an LS should be sent out to check whether it can depend on UE implementation when UE realize that neighboring cell meets cell reselection criteria due to V2X service.

Considering the limited time left, it is suggested to follow majority companies’ view to agree that RRC\_Connected UE can also perform cell reselection due to its sidelink service, which directly follows LTE principle. However, it is also recommended that an LS can be sent to CT1 to further check UE’s behaviour

**Proposal 1: To follow LTE principle, for NR V2X, RRC\_Connected UE can also perform cell reselection due to its sidelink service.**

**Recommendation 1: RAN2 is suggested to send LS towards CT1 to further check whether UE behaviour among the two options can be its implementation:**

**Alt 1: Perform a detach procedure and then perform PLMN selection triggered by V2X communication over PC5.**

**Alt 2: Not initiate V2X communication over PC5.**

## [Essential] On-demand SI providing anchor carrier configuration

In LTE, SIBs will only be configured to the camping UE via broadcast communication. Thus, the UE can recognize whether the cell can provide sidelink configuration or only anchor carrier configuration via reading the related SIB message. However, when it comes to NR V2X, the SIB is allowed to be configured to the UE not only via broadcast, but also can be through on-demand SI. If the V2X SIB is configured to the UE through on-demand SI, the UE cannot recognize whether there is detailed V2X configuration or only anchor carrier configuration until it performing random access and acquire the on-demand SI, where it is somehow a waste of time. Therefore, to avoid this issue, the following alternatives are proposed, as concluded in [2],[3] and [4]:

Alt 1: If a cell providing only anchor carrier configuration, the cell should always broadcast the V2X SIB.

Alt 2: If the NR V2X SI is provided on-demand, then the UE does not prioritize this cell.

Alt 3: If a carrier doesn’t broadcast the V2X SIB but provide it by on-demand, then this frequency should be indicated by other frequency as anchor frequency in the V2X SIB.

Alt 4: Introduce an IE in SIB 1,3/4 to indicate whether the cell will only providing anchor carrier configuration.

**Question 2: Targeting on the issue that cell broadcasting only anchor carrier configuration via on demand SI, which one of the following solutions shall be adopted ?**

**- Alt 1: If a cell providing only anchor carrier configuration, it should always broadcast the V2X SIB.**

**- Alt 2: If the NR V2X SI is provided on-demand, then the UE does not prioritize this cell.**

**- Alt 3:If a carrier doesn’t broadcast the V2X SIB but provide it by on-demand, then this frequency should be indicated by other frequency as anchor frequency in the V2X SIB.**

**- Alt 4:Introduce an IE in SIB 1,3/4 to indicate whether the cell will only providing anchor carrier configuration.**

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| **Company** | **Option** | **Comments (if any)** |
| Ericsson | Alt 3 and upon implementation | In our view, this issue can be handled by NW implementation, i.e. this frequency might be indicated by other frequency as anchor frequency in V2X SIB. We don’t see specification impact.  |
| vivo | Alt 1 | This is already discussed in previous meeting’s offline discussion(R2-2001974), and we think alt-1 is the simplest way to solve this problem by network implementation. |
| CATT | Alt 4, in SIB 1 | **Introduce an IE in SIB 1 to indicate whether the cell will only providing anchor carrier configuration.**For Alt1 and Alt2, since the V2X SI is broadcasted or on demand is up to gNB implementation. Alt1 explicitly restricts gNB can’t provide only anchor carrier configuration by on demand. For Alt2, the UE doesn’t distinguish the V2X configuration in the SIB12 is anchor carrier configuration or not. The V2X capable UE may camp on the cell without V2X configuration when Alt2 is agreed. To avoid this issue, gNB should either provide SIB12 by broadcast or indicates the cell information in which provides V2X configuration in every cell. It will not provision in specification. For Alt3, it can be only used for cell reselection. However, for cell selection, the UE may camp on the cell only provides anchor carrier configuration first, and then reselect to the cell provides SL configuration. To avoid UE (re)selects to the cell only provides anchor carrier configuration, an IE in SIB 1 should be introduced to indicate whether the cell will only providing anchor carrier configuration..  |
| Huawei | Alt 4. | In Alt 4, [SIB 1,2/4] may be an editorial mistake, it should be [SIB 1,3/4]?Alt 1 has restriction on network implementation, which is not a good solution from the network vendors’ perspective. A key reason why there is no agreement on this issue in the RAN2#109 meeting is that some companies object the restriction on network implementation.Alt 2 means that even for the cells providing V2X SL configurations, if the V2X SI is provided on-demand, then the UE does not prioritize these cells, which is not reasonable according to the related agreements. To be specific, when the UE cannot find any cell always broadcasting V2X SL configurations while some neighboring cells provide V2X SL configuration on-demand, it is possible for the UE to reselect a cell providing only anchor carrier configuration (i.e. without V2X SL configuration).Alt 3 is to restrict the network to put all the neighbouring frequencies that providing V2X SL configurations into “AnchorCarrierFreqList”, so that all the neighboring frequencies which provide V2X SIB but are not within “AnchorCarrierFreqList” can be considered only providing anchor carrier configuration. However, as in Alt1, the restrictions on network implementation is not a good solution. Moreover, in Alt 3 “a carrier that doesn’t broadcast the V2X SIB but provide it by on-demand” may only provide anchor carrier configuration, which is not align with the definition of as follows.***sl-NR-AnchorCarrierFreqList***This field indicates the NR anchor carrier frequency list, which can provide the NR sidelink communication configurations. |
| ZTE | Alt 3  | Alt 3 is a network implementation method which can solve thisissue without too much specification effort, but as Huawei mentioned, alt 3 may need to modify the definition of sl-NR-AnchorCarrierFreqList, |
| OPPO | ALT3 | Alt1 and alt3 are feasible network’s implementation to resolve this issue hence no new UE’s behavior should be introduced e.g. alt2 and alt4 are not necessary. Alt1 however enforce network always broadcast SIB12 without detail V2X configuration which is not essential for V2X operation.Just to clarify “a carrier that doesn’t broadcast the V2X SIB but provide it by on-demand” in ALT3 does provide the NR or LTE sidelink communication configuration. In case the carrier provides only anchor carrier, then other carrier should not broadcast it as anchor carrier i.e. the definition of anchor carrier is not changed.In summary here is network’s implementation:If there are more than one frequency layers (e.g. frequency A and B) and a V2X SIB providing NR or LTE sidelink communication configuration, but network doesn’t provide it on-demand e.g. on frequency A, then networks should broadcast frequency A as anchor carrier in V2X SIB of carrier BIf network can always follow this behavior, then if only anchor carrier is broadcast in V2X SIB of frequency A, then UE can find nothing but its scheduling information in SIB1. UE will realize most likely there is only anchor carrier information because otherwise it will be broadcast as anchor carrier in V2X SIB of carrier B.Note, If there is only one frequency carrier, then this issue doesn’t exist because priority is not applied for intra-frequency cell reselection. |
| Nokia | Alt 3 | Alt3 provides a solution with minimal/zero specification and is handled by NW implementation, i.e. this frequency might be indicated by other frequency as anchor frequency in V2X SIB (to be discussed in next R2#110 meeting how to modify sl-NR-AnchorCarrierFreqList,) |
| Intel | Alt3 | We agree with OPPO’s assessment that NW implementation to handle this issue is feasible and perhaps the simplest way forward (especially compared to Alt 1 and Alt4) |
| Lenovo | Alt3 | By Alt3, frequencies that can provide NR sidelink configuration but not broadcast such configuration can be known by UE via anchor carrier frequency list in serving frequency V2X SIB. Such mechanism is already supported could be done by NW implementation, and is the simplest way to solve the problem |
| LG | Alt 1 or Alt 2 | We think Alt-1 or Alt-2 is the simplest way to solve this problem |
| Samsung | Alt3 | Our understanding is that a sensible NW will include the anchor carrier frequency list, which *provides* sidelink communication configurations in sl-NR-AnchorCarrierFreqList. So, typically this issue can be handled by NW implementation i.e. this frequency providing sidelink communication configurations can be indicated by other frequency as anchor frequency in the V2X SIB. |
| BlackBerry | Alt3 | Lower impacts to standards. |
| Interdigital | Alt1 or Alt3 | We think NW implementation could solve this issue, and either alternative 1 or 3 would be acceptable. |
| Qualcomm | Alt 1  |  |
| Convida Wireless | Alt3 | Although Alt1 is probably the simplest solution, it does force the gNB to always broadcast the V2X SIB. As a result, we agree that Alt3 is probably a better alternative.Also, Alt3 does not change the Cell (re)selection rules at UE. |

Conclusion:

Count: Alt 1: 4 / Alt 2: 1 / Alt 3: 10 / Alt 4: 2

There are totally 15 companies participating to feedback this question, and the majority view is tend to accept Alt 3. As mentioned in the comment, companies agree alt 3 is basically a network implementation solution, which will not cause specification impact to TS 38.304. However, if alt 3 is adopted, then the definition of sl-NR-AnchorCarrierFreqList shall be modified.

**Proposal 2: If a carrier doesn’t broadcast the V2X SIB but provide it by on-demand, then this frequency should be indicated by other frequency as anchor frequency in the V2X SIB. There will be no specification impact in TS 38.304, whether the definition of sl-NR-AnchorCarrierFreqList shall be modified in TS 38.331 should be further discussed.**

## [Essential] How to use pre-configuration[4][5]

Currently, there are three types of sidelink carrier:

-Type 1:Frequency which can provide both NR sidelink communication configuration and LTE sidelink communication configuration.

-Type 2:Frequency which can provide either NR sidelink communication configuration and LTE sidelink communication configuration.

-Type 3: Frequency which cannot provide any sidelink communication configuration.

If there are only type 2 frequencies. Specifically, if some type 2 frequencies can provide only NR SL configuration, the other type 2 frequencies can provide only LTE SL configuration. On the other hand, the UE can support both NR and LTE SL traffics. When the UE camping on any type 2 frequencies, it can only acquire SL configuration for one SL RAT, but actually the UE may be in coverage for both of the two SL RATs since UE will determine its coverage status of each SL RAT independently as per current specification. Then for the other SL RAT of which UE cannot acquire SL configuration from the camping cell, whther pre-configuration is allowed to be used ?

**Question 3: For the case that if UE supports both NR and LTE SL, but UE’s camped cell can only provide one SL RAT configuration, whether pre-configured SL resource can be used on the other RAT if the UE is also in-coverage of that RAT ?**

**- Alt 1: Yes**

**- Alt 2: No**

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| **Company** | **Option** | **Comments (if any)** |
| Ericsson | No | When it is LTE V2X operating in unlicensed spectrum, it is fine. However, if a NR V2X UE using licensed spectrum within a cell according to pre-configuration and not known by the cell, it might cause problems in terms of resource allocation for other traffics within the cell. Better to avoid it overall.  |
| vivo | Yes | This is also discussed before and we think pre-configuration can work in this case. No big issue seems to be identified here. The cell is supposed to be able to know the resources configured in pre-configuration. |
| CATT | No | It may introduce interference between the UEs using pre-configuration and other UEs using network configuration, especially the interference to the dedicated grant configured by gNB. |
| Huawei | No need to discuss | No need to discuss this issue. Whether the UE uses preconfiguration on a SL RAT should depend on the V2X sidelink communication transmission procedure in TS 36.331 and NR sidelink communication transmission procedure in TS 38.331, respectively. If the UE on an SL RAT meets the condition for using preconfiguration, the UE uses it; otherwise, it does not. What’s the extra problem?The key point here is that the transmission/reception procedure for NR SL and that for V2X SL are independent, so how the resource (pre)configuration for one SL RAT is used shouldn’t be coupled with the other SL RAT. |
| ZTE | No need to discuss | Share the same view with Huawei, not only the determination of UE’s coverage status for each RAT is independent, but also the transmission/reception procedure for each RAT is also independent.  |
| OPPO | No | Since the precondition is that UE is in coverage of the concerned RAT, in this case UE should not use pre-configuration of that RAT  |
| Nokia | No | As discussed inter-RAT resource allocation requires coordination by the network in order to avoid problems. |
| Intel | No | We agree with Ericsson’s comment that if the cell is in coverage of the other RAT, it does not make much sense for it to be able to use pre-configured resource for that RAT. |
| Lenovo | No need to discuss | Agree with Huawei and ZTE |
| LG | No need to discuss | We think that the operation of NR SL and V2X SL is independent. So, if a BS(base station) supports only one RAT, the other RAT which is not supported by the BS can operate such as out-of-coverage. There is no need to think about resource coupling between two different RATs. |
| Samsung | No | We should not deviate from the general principle i.e. it is not allowed to use pre-configuration when the UE is in coverage. |
| BlackBerry | No | V2X SL and NR SL are independent. |
| Interdigital | No | We should not change the principle that a UE is allowed to use pre-configuration only when it is out of coverage. |
| Qualcomm | Yes | Per TS 23.287, frequencies are either “operator managed” or “non-operator-managed.” For “non-operator managed” frequencies, a UE will always use pre-configuration |
| Convida Wireless | No | Using the pre-configured SL resource while in-coverage of a cell seems to violate the rules for use of pre-configuration resources. There may be an impact on the other UEs using the cell  |

Conclusion:

Count: Alt 1: 2 / Alt 2: 8 / No need to discuss: 5 (BlackBerry’s feedback should be no need to discuss according to their comments for question 3 and 4.)

There are totally 15 companies participating to feedback this question. Majority companies cannot accept to allow V2X UE use pre-configuration for the other SL RAT in the case that UE supports both NR and LTE SL RAT while its camped cell can only provide one SL RAT configuration, since it will cause interference between UE using pre-configuration and other UEs using network configuration.

**Proposal 3:** **For a concerned frequency, If UE supports both NR and LTE SL, but UE’s camped cell can only provide one SL RAT configuration in the concerned frequency, then pre-configured SL resource on that frequency cannot be used on the other RAT if the UE is also in-coverage of that RAT.**

Moreover, if pre-configuration is not allowed to use in the above mentioned case, then several alternatives to help UE acquire V2X configuration are provided in [4],[5].

* Option 1: UE performs cell reselection to select the carrier which provides the SL configuration of the other RAT.
* Option 2: UE requests the SL configuration of the other RAT from the camped cell.
* Option 3: UE a quires the SL configuration of the other RAT by reading the broadcast V2X SIB on the concerned carrier.

Then RAN2 should filter out one workable solution to help UE acquire V2X related configuration.

**Question 4: If pre-configuration is not allowed for the UE to use which is in coverage, then which one of the following solution shall be adopted ?**

**- Alt 1: UE performs cell reselection to select the carrier which provides the SL configuration of the other RAT.**

**- Alt 2: UE requests the SL configuration of the other RAT from the camped cell.**

**- Alt 3: UE acquires the SL configuration of the other RAT by reading the broadcast V2X SIB on the concerned carrier.**

**- Alt 4: Others (Please specify)**

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| **Company** | **Option** | **Comments (if any)** |
| Ericsson | Option 1 | we don’t need to optimize the scenario.  |
| vivo | Alt 3 with comments | As comments in Question 3, we think the pre-configuration can work in this case. But if majority think there is a big issue to use pre-configuration and alternatives are needed, then we prefer to go for alt-3, which seems aligned with LTE solution to some extent, because in LTE the UE seems also capable to read the broadcast V2X SIB on the concerned carrier which is not serving frequency for transmission and reception. |
| CATT | Alt 1 for on-demand SIAlt 3 for broadcast SI | If the V2X SIB is by on-demand, UE only can perform cell reselection to select the carrier to acquire the SL configuration of the other RAT.If the V2X SIB is by broadcast, UE can acquire the SL configuration of the other RAT by reading the broadcast V2X SIB‎, which follows the LTE rule. |
| Huawei | No need to discuss | Same comments as to Q3. |
| ZTE | No need to discuss | Same comments as Q3. |
| OPPO | Alt3 | We intend to agree with vivo that such kind of UE’s behavior is just to follow LTE principle. |
| Nokia | Alt 3 preferable, Alt 1 optional |  |
| Intel | Alt3 | Agree with vivo |
| Lenovo | No need to discuss | Same comments as Q3. |
| LG | No need to discuss | Same comments as to Q3. |
| Samsung | Alt3 | Agree with vivo i.e. alt-3 seems the simplest way to perform both LTE and NR sidelink communications simultaneously. |
| BlackBerry | No need to discuss. | Same answers as for Q3. |
| Interdigital | Alt3 | There is no specification impact needed to handle explicitly handle this case, as the UE can read the SIB on the concerned frequency for any SL communications on that frequency. |
| Qualcomm | Alt 4 | Pre-configuration should always be allowed |
| Convida Wireless | Alt 3 |  |

Conclusion:

Count: Alt 1: 3 / Alt 2: 0 / Alt 3: 8 / No need to discuss: 5 / using pre-configuration: 1

There are 15 companies participating to feedback this question, majority companies think that in the case UE supports both NR and LTE SL RAT, but UE’s camped cell can only provide one SL RAT configuration, then if the UE is also in coverage for the other RAT, then the UE may acquire the other SL RAT configuration by reading the broadcast V2X SIB on the concerned carrier, where it follows LTE principle and will not cause any specification impact.

**Proposal 4: In the case UE supports both NR and LTE SL RAT, but UE’s camped cell can only provide one SL RAT configuration, then if the UE is also in coverage for the other RAT, then the UE may acquire the other SL RAT configuration by reading the broadcast V2X SIB on the concerned carrier. There will be no specification impact.**

# Conclusion

In this contribution, we have summarized all principle opinions from NR V2X cell selection/reselection contributions, a brunch of proposals have been provided in the following:

**Proposal 1: To follow LTE principle, for NR V2X, RRC\_Connected UE can also perform cell reselection due to its sidelink service.**

**Recommendation 1: RAN2 is suggested to send LS towards CT1 to further check whether UE behaviour among the two options can be its implementation:**

**Alt 1: Perform a detach procedure and then perform PLMN selection triggered by V2X communication over PC5.**

**Alt 2: Not initiate V2X communication over PC5.**

**Proposal 2: If a carrier doesn’t broadcast the V2X SIB but provide it by on-demand, then this frequency should be indicated by other frequency as anchor frequency in the V2X SIB. There will be no specification impact in TS 38.304, whether the definition of sl-NR-AnchorCarrierFreqList shall be modified in TS 38.331 should be further discussed.**

**Proposal 3:** **For a concerned frequency, If UE supports both NR and LTE SL, but UE’s camped cell can only provide one SL RAT configuration in the concerned frequency, then pre-configured SL resource on that frequency cannot be used on the other RAT if the UE is also in-coverage of that RAT.**

**Proposal 4: In the case UE supports both NR and LTE SL RAT, but UE’s camped cell can only provide one SL RAT configuration, then if the UE is also in coverage for the other RAT, then the UE may acquire the other SL RAT configuration by reading the broadcast V2X SIB on the concerned carrier. There will be no specification impact.**

# References

1. R2-2003515 Remaining issues on cell reselection for sidelink in TS 38.304 Huawei, HiSilicon
2. R2-2001974 Report of offline discussion 709 ZTE Corporation, Sanechips
3. R2-2003097 Remaining issues of cell (re)selection for NR V2X Lenovo, Motorola Mobility
4. R2-2002829 Discussion on inter-RAT Cell Selection/Reselection CATT
5. R2-2003721 Finalising cell reselection for V2X Samsung