**3GPP TSG-RAN WG4 Meeting # 98-bis-e R4-21xxxxx**

**Electronic Meeting, 12th - 20th April, 2021**

**Agenda item:** 8.10.5

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [98-bis-e][135] NRSL\_enh\_Part\_2

**Document for:** Information

# Introduction

In RAN4#98e meeting, partially used SL operation with Uu in licensed band was discussed with a lot of issues unsettled. This email discussion summary will continue to focus on TDM, FDM and synchronous operation between SL and Uu.

The agenda items involved are as follows:

*8.10.5 Partially used SL operation with NR Uu operating bands [NRSL\_enh-Core]*

*8.10.5.1 FDM operation [NRSL\_enh-Core]*

*8.10.5.2 TDM operation [NRSL\_enh-Core]*

*8.10.5.3 Synchronous operation between NR Uu and NR SL in a TDD band [NRSL\_enh-Core]*

*8.10.5.4 Others*

The candidate targets of this email discussion for 1st round and 2nd round:

* 1st round
  + Companies to provide comments on each sub-topic and try to converge.
  + Companies to check TPs and provide comments
  + Assign the corresponding WF after the 1st round discussion if needed.
* 2nd round
  + Capture the agreements and open issues if any in WF and further discuss the WF.
  + Recommend the final status of the WFs and TPs.

# Topic #1: Operating scenarios for partially used SL operation

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104530 | vivo | Title: Further discussion on operation mode and core requirements for licensed bands partially used for SL  **Observation 1: The operation modes for TDM and FDM for intra-band con-current operation are overlapping. Observation 2: Option 2 for TDM operation mode is equivalent to Option 1 for FDM operation mode. Observation 3: Option 1 for TDM operation mode can be included in Option 2 for FDM operation mode. Proposal 1: RAN4 needs to narrow down the operation modes for intra-band con-current operation. Proposal 2: Consider the following two cases for intra-band con-current operation: • Option A: SL and Uu are in the same carrier with different BWPs • Option B: SL and Uu are in different carriers Proposal 3: The BWP switching requirements should be defined for the case Uu and SL are in the same carrier for intra-band con-current operation. Proposal 4: No need to introduce the frequency separation for the case Uu and SL are in different channels for intra-band con-current operation.** |
| R4-2104778 | CATT | Title: Discussion on FDM operation between SL and Uu  **Frequency Separation Proposal 1: If the adjacent channel of SL and Uu (without frequency separation) is allowed, additional TDM, i.e. only UL slot used for SL Tx and Rx, can be considered to eliminate interference. Observation 1: To study the frequency separation in non-adjacent channel, the frequency separation between existing UL band and DL band of FDD bands can be considered as a starting point. Based on the existing FDD bands distribution, the frequency separation of the highest FDD band n7 is 50MHz while the frequency separation of the lowest FDD band n12 is 13MHz. However, band n79 has higher frequency location compared to the existing FDD bands, which should be considered to study the frequency separation of SL and Uu. RF Architecture Proposal 2: For FDM operation with different carriers, it is preferred to adopt separate RF chain considering the large frequency range of band n79. For FDM operation with the same carrier, single RF chain can be considered.** |
| R4-2104970 | LG Electronics France | Title: RF requirements for partial used licensed band bewteen NR Uu and NR SL operation  **Observation 1: The restricted operations (e.g common power control or only same waveforms) between NR V2X and NR Uu were observed when RAN4 consider single RF architecture in a licensed band. Observation2: Even though RAN4 consider TA with transient period with 10us, RAN4 expect there would be no self-interference problem in its own device based on previous RRM agreement.  Observation3: For the 60 kHz SCS V2X operation, self-interference from NR Uu will impact to NR V2X reception in more than one symbol.  Proposal 1: The separate RF architecture should be considered as baseline to derive the RF requirements for partial usage between NR V2X and NR Uu in licensed band. Proposal 2: For the SL transmission time alignment, RAN4 can keep the current RRM agreements as specified in section 12.2.3 in TS38.133. Proposal 3: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band regardless of adjacent/ non-adjacent carrier. Proposal 4: RAN4 would allow the intra-band con-current SL operation with adjacent carrier for both TDM/FDM operation in TDD band without in-device coexistence study.  Proposal 5: For the FDD/TDD intra-band con-current operation with non-adjacent carrier, RAN4 need further discussion on the detail coexistence scenarios based on operator deployment scenarios and request  Proposal 6: Firstly, Based on Table 3.1, RAN4 further study the detailed RF requirements for intra-band con-current V2X operation in TDD band.** |
| R4-2106293 | Xiaomi | Title: on FDM operation for partially used SL operation  **Observation: Two interference scenarios are observed for FDM operation and different assessment method need to be considered.** |
| R4-2106554 | OPPO | Title: Title: R17 V2X FDM operation  **2.1 FDM scenario Observation 1: Rel-16 V2X only support the case that license band (n38) is exclusively applied to V2X in certain region. Observation 2: Both scenario 1 and 2 can be considered as the enhancement from Rel-16. Observation 3: It is unclear whether the FDM operation only consider the scenario of UU and SL in same band supported by same UE or can be supported by different UEs. Observation 4: Scenario 2 (SL and UU in different bands) is more easy in UE implementation and performance is better than Scenario 1 due to no interference inside UE.  Proposal 1: It is proposed to clarify whether scenario 2 (SL and UU in different bands) is considered in Rel-17. 2.2 UE architecture Proposal 2: It is proposed to use single RF chain architecture for scenario 2 (SL and UU in different bands).  Observation 5: For the Scenario 1 (NR uu and SL supported by UE in same band) separate RF chain architecture has better performance than single RF chain architecture from interference perspective. Observation 6: Requirements can be based on either single RF chain architecture, or separate RF chain architecture, or both.  Proposal 3: It is proposed to choose which of following approach is adopted for scenario 1 (NR uu and SL supported by UE in same band) in requirement definition. • Option 1: Only define requirements for separate RF chain architecture • Option 2: Only define requirements for the worst case, i.e. single RF architecture  • Option 3: Define requirements for both and rely on UE capability to indicate which requirements it follows 2.3 Frequency separation Observation 7: No frequency separation is needed for scenario 2 (SL and UU are in different bands), the general requirements like OOBE and spurious emission can be used.  Proposal 4: It is proposed to not define frequency separation for scenario 2 (SL and UU are in different bands).  Observation 8: Several issues might be caused by supporting NR uu and SL within same band, like IMD emissions, power limitation, OOBE/SE, and Tx to Rx interference. Observation 9: With larger frequency separation the sensitivity degradation or power back off in meeting emission requirements could be smaller. Observation 10: Current RAN4 requirements can cover the issues caused by supporting NR uu and SL within same band. Observation 11: How to apply the frequency separation in requirement definition is unclear. Proposal 5: It is proposed to not introduce the frequency separation for scenario 1(NR uu and SL supported by UE within same band) unless the necessity and how to apply the frequency separation in requirement definition is clarified.** |
| R4-2107241 | Ericsson | Title: FDM operation for partially used SL operation in licensed band  **Observation#1: There is no con-current reception of SL in one carrier and Uu transmission in another carrier in licensed band for LTE ProSe and LTE V2X. Observation#2: There is no con-current reception of SL in one carrier and SL transmission in another carrier in B47 band for LTE V2X. Observation#3: There is no con-current reception of SL in one carrier and Uu transmission in another carrier in a band for NR V2X. Proposal-1: RAN4 discuss whether to introduce the full duplex of SL operation and NR Uu operation within the licensed band. Proposal-2: Allow the Uplink time alignment for NR SL for FDM operation within a licensed band. Proposal-3: the MPR of con-current operation of the NR SL and NR Uu could refer to the framework of MPR of con-current EN-DC (two RAT operating in the same band ) specified in TS 38.101-3.** |
| R4-2104777 | CATT | Title: Discussion on TDM operation between SL and Uu  **UE RF architecture for TDM Proposal 1: To consider both single RF chain and separate RF chain for TDM operation with different carriers. Time mask for SL and Uu switching Observation 1: One important issue needing to be clarified is whether the same carrier here means the same carrier frequency and same channel bandwidth. If different channel bandwidths with the same carrier frequency between SL and Uu are allowed, the time occupied by different channel bandwidths configuration during the switching process should be taken into account. Proposal 2: To consider the time mask in Figure 1 and Figure 2 for SL and Uu switching with the same carrier. Proposal 3: To locate the switching period based on the prioritization for SL and Uu, i.e. the switching period is located on the RAT that has a lower priority. Proposal 4: To consider the time mask in Figure 3 and Figure 4 for SL and Uu switching with different carriers without dual PA capability.** |
| R4-2106298 | Xiaomi | Title: on TDM operation for partially used SL operation  **Observation 1: The switching time between NR sidelink and NR Uu consist of the transient period and the switching period based on UE capability. Observation 2: TTA should also be considered for switching since it implies the advance of NR Uu comparing to NR sidelink. Observation 3: Two interference scenarios are observed for FDM operation and different assessment method need to be considered. Proposal 1: To agree the figure 2 on the content of switching time as 2 transient period + switching period + Timing advance. Proposal 2: Define similar time mask as Uplink TX switching with capability signaling of SidelinkSwitchingPeriod.  Proposal 3: To take timing advance into consideration of the timing mask.** |

## Open issues summary

Based on above contributions, the following sub-topics and issues regarding operating scenarios for partially used SL operation will be discussed in this clause:

* Sub-topic 1-1: Clarification on operating scenarios
* Issue 1-1-1: Whether to narrow down operating scenarios
* Issue 1-1-2: Other operating scenario
* Issue 1-1-3: Full duplex or half duplex
* Sub-topic 1-2: TDM operation between SL and Uu
* Issue 1-2-1: TDM operating scenarios
* Sub-topic 1-3: Time mask for SL and Uu switching
* Issue 1-3-1: Switching period position
* Issue 1-3-2: Switching period length
* Issue 1-3-3: Time mask
* Sub-topic 1-4: FDM operation with different carriers
* Issue 1-4-1: Operating scenarios with adjacent carriers
* Issue 1-4-2: Frequency separation for non-adjacent carriers
* Sub-topic 1-5: FDM operation within same carrier (different BWPs)
* Issue 1-5-1: BWP switching
* Sub-topic 1-6: UE RF architecture
* Issue 1-6-1: UE RF architecture

### Sub-topic 1-1: Clarification on operating scenarios

**Issue 1-1-1: Whether to narrow down operating scenarios**

* Proposals
  + Option 1: RAN4 needs to narrow down the operation modes for intra-band con-current operation.
  + Option 1a: Consider the following two cases for intra-band con-current operation:

Case 1: SL and Uu are in the same carrier with different BWPs

Case 2: SL and Uu are in different carriers

* Recommended WF
  + Need more discussion.

**Issue 1-1-2: Other operating scenario**

* Proposals
  + Option 1: To clarify whether scenario 2 (SL and Uu in different bands) is considered in Rel-17 (R4-2106554)

Note: Scenario 2 - n79 Uu and SL supported by different UE

* Recommended WF
  + Need more discussion.

**Issue 1-1-3: Full duplex or half duplex**

* Proposals
  + Option 1: RAN4 discuss whether to introduce the full duplex of SL operation and NR Uu operation within the licensed band.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-2: TDM operation between SL and Uu

**Issue 1-2-1: TDM operating scenarios**

* Proposals
  + Option 1: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band regardless of adjacent/ non-adjacent carrier.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-3: Time mask for SL and Uu switching

**Issue 1-3-1: Switching period position for TDM operation**

* Proposals
  + Option 1: To locate the switching period based on the prioritization for SL and Uu, i.e. the switching period is located on the RAT that has a lower priority.

**Issue 1-3-2: Switching period length**

* Proposals
  + Option 1: To agree the figure 2 on the content of switching time as 2 transient period + switching period + Timing advance (R4-2106298).
* Recommended WF
  + Need more discussion.

**Issue 1-3-3: Time mask**

* Proposals
  + Option 1: Consider the time mask for SL and Uu switching in paper R4-2104777.
  + Option 2: Define similar time mask as Uplink TX switching with capability signaling of SidelinkSwitchingPeriod.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-4: FDM operation with different carriers

**Issue 1-4-1: Operating scenarios with adjacent carriers**

* Proposals
  + Option 1: RAN4 would allow the intra-band con-current SL operation with adjacent carrier for both TDM/FDM operation in TDD band without in-device coexistence study.
* Recommended WF
  + Need more discussion.

**Issue 1-4-2: Frequency separation for non-adjacent carriers**

* Proposals
  + Option 1: For the FDD/TDD intra-band con-current operation with non-adjacent carrier, RAN4 need further discussion on the detail coexistence scenarios based on operator deployment scenarios and request.
  + Option 2: No need to introduce the frequency separation for the case Uu and SL are in different channels for intra-band con-current operation.
  + Option 3: To study the frequency separation in non-adjacent channel, the frequency separation between existing UL and DL of FDD bands can be considered as a starting point.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-5: FDM operation within same carrier (different BWPs)

**Issue 1-5-1: BWP switching**

* Proposals
  + Option 1: The BWP switching requirements should be defined for the case Uu and SL are in the same carrier for intra-band con-current operation.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-6: UE RF architecture

**Issue 1-6-1: UE RF architecture**

* Proposals
  + Option 1: The separate RF architecture should be considered as baseline to derive the RF requirements for partial usage between NR V2X and NR Uu in licensed band.
  + Option 2: Choose which of following approach is adopted for scenario 1 (NR Uu and SL supported by UE in same band) in requirement definition.

Alt 1: Only define requirements for separate RF chain architecture

Alt 2: Only define requirements for the worst case, i.e. single RF architecture

Alt 3: Define requirements for both and rely on UE capability to indicate which requirements it follows

* + Option 3: Decide UE RF architecture based on specific operating scenario.
* Recommended WF
  + Need more discussion.

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1-1: Whether to narrow down operating scenarios**

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| **Company** | **Comments** |
| LGE | We prefer to keep the last RAN4 agreements. The detail intra-band V2X con-current operation band configuration is up to operator request. |
| Xiaomi | Firstly, the intra-band con-current operation seems to be the intra-band LTE and NR SL operation but we believe currently within this topic it is for licensed band partially used for SL.  Secondly, according to physical layer design, SL has only one BWP but with different resource pool hence we don’t see the situation as one carrier containing both NR BWP and SL BWP cases. For the narrow down selections, we believe the FDM operation scenarios have been defined in our paper as different NR and Sidelink carriers and simultaneous UL+SL TX and UL+ SLRX(two scenarios to be considered). |
| vivo | Option 1a is our proposal. We did not narrow down the operation modes. We just merged the operation modes because we think they are overlapping. Could companies please check whether splitting intra-band con-current operation as TDM/FDM appropriate? |
| CATT | It is expected to prioritize some of operating scenarios based on feasibility analysis and workload.  For instance, TDM operation can be prioritized like band n47. For FDM, different carriers for SL and Uu should be higher priority. |
| OPPO | Option 1a. It is understood that the operating scenario is based on operator request, however, it may be better to narrow down the scope and be more focus. |
| Huawei | We think both cases should be considered. But some priority can be considered for TDM and FDM scenarios. In our view, TDM requirements would be easier to be completed in Rel-17 time frame. |
| Ericsson | Option 1a. The same and adjacent carrier operation between sidelink and Uu interface for intra-band con-current operation in a license carrier is in the WID:  Support of new sidelink frequency bands for single-carrier operations [RAN4]   * Support of new sidelink frequency bands should ensure coexistence between sidelink and Uu interface in the same and adjacent channels in licensed spectrum. |
| Qualcomm | We think that TDM scenarios should be prioritized as they will be easier to implement. Whether this is done with the same or different carriers is left up to implementation. The issue of same or different BWPs can be decided after the operation scenarios are selected. |

**Issue 1-1-2: Other operating scenario**

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| **Company** | **Comments** |
| LGE | The inter-band con-current operation is already allowed based on operator request. The current discussion point is how to define the intra-band V2X con-current operation in licensed band. So, we prefer to discuss the detail RF requirements for intra-band V2X con-current operation as partial usage between V2X and NR Uu in a licensed band. |
| Xiaomi | Scenario 2 is not considered for Rel-17. Furthermore, we believe this can be similar to nominal co-exist of different bands for NR. |
| Xiaomi |  |
| vivo | It is a little confusing for the terms for scenario 2 ‘SL and Uu in different bands’ and ‘n79 Uu and SL supported by different UE’ are contradicting with each other. The former term means inter-band con-current, however we are discussing intra-band con-current here. |
| CATT | Based on our understanding, scenario 2 is not in the scope in Rel-17. |
| OPPO | Scenario 2 is as below figure, in which the SL is at n79 and with the associated NR in n1. This can make the SL UE more easier implementation since no interference is inside UE. This is an extension of Rel-16 where the license band is required to be exclusively deployed for SL in certain region. And in the below scenario 2, the n79 is existing in this region, but not associated with SL n79. Then the question is whether it is supported or not?    LGE: To OPPO, scenario 1 is our target in [135] email thread. For scenarios 2, it is possible scenarios when V2X UE support inter-band V2X con-current operation in V2X\_n1A-n79A, in here, we can study the self-interference issues and inter-device interference problem. But we think that n1 is not impact by dual transmission by V2X\_n1A-n79A. For the inter-device coexistence, it is not critical issues compare to NR Uu and NR V2X in n79. Also it was verified in coexistence evaluation in TDD band. |
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| Huawei | Con-current band combination can be considered separately. |
| Ericsson | It is our understanding the inter-band con-current operation (x Band in NR Uu + y Band in SL) should be based on operation request and not in Rel-17 scope. |
| Qualcomm | Though it is not explicitly stated we feel that the Uu link of UE1 interfering with the SL link of UE2 which is operating in the same band is not within the scope of this rel-17 WID covering NR SL enhancements. |

**Issue 1-1-3: Full duplex or half duplex**

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| **Company** | **Comments** |
| LGE | The terminology “full duplexer “ is not correct to all simultaneous Tx/Rx between NR V2X and NR Uu operation. The baseline is Half-duplexer for V2X or SL operation. In FDD band such as n79 (4.4~5.0GHz), operator requested to study and define the partial used operation between NR V2X and NR Uu in wide operating frequency range in n79. So, in case the Full duplexing operation is possible when RAN4 define the separating freq. gap between NR V2X carrier and NR Uu carrier. Therefore, specially RAN4 can allow simultaneous NR Uu transmission and NR V2X reception. |
| Xiaomi | Full duplex is preferred, however, this will also depend on the frequency separation study outcome to see whether full duplex is feasible with limited frequency separation. |
| vivo | In email thread [134], it is suggested to align ‘the licensed bands partially used for SL’ as intra-band con-current operation. In the definition of con-current option, the simultaneous transmission and reception of sidelink and Uu interfaces while operation is agnostic of the service used on each interface. In our understanding, the con-current operation already implies full duplex. |
| CATT | We are open to discuss full duplex based on specific operating scenario. |
| Huawei | What’s the exact meaning of “full duplexer” specific to SL should be clarified firstly. |
| Ericsson | The concurrent operation of SL and Uu only happen at uplink time slot for a TDD licensed carrier. During the uplink time slot, Uu and SL can simultaneous transmit (SL TX / Uu TX) or (SL RX/Uu TX), so it is like “FDD” SL RX and Uu TX happens simultaneusly. In Rel-16 NR V2X, SL RX/Uu Tx only happen for inter-band con-current case. For intra-band con-current operation of multi-carrier SL operation (e.g two SL carrier in B47 or n47), there is no simultaneous SL RX/SL TX, when SL is transmitting at one carrier, by default there is no reception on the other SL RX.  To allow the “FDD” like operation between SL RX and Uu TX in a licensed band, the “duplex distance” need to be introduced and divide the licensed band into SL RX frequency part and Uu TX frequency part, such division reduce a flexibility how the SL carreri and Uu carrer is configured in a licensed band. There are also implementation constrains to ensure a good isolation.  We donot see benefit of the allowing this operation but we also open to the discussion from implementation aspects. |
| Qualcomm | Do not think that the terminology for half duplex is clear. If half duplex means only SL or Uu either transmitting or receiving at a given time then this is a preferred option as it will not have coexistence interference issues and will be easier to implement. Else if it means the Uu and SL transmit simultaneously and/or receive simultaneously this is also possible however synchronization issues may cause interference. We think that full duplex with simultaneous transmit and receive will be the most difficult to implement and may require a frequency gap |

**Issue 1-2-1: TDM operating scenarios**

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| **Company** | **Comments** |
| LGE | Support option 1 |
| Xiaomi | This allowance should be based on specific guard period or time mask considering TA and switching. |
| vivo | We should clarify Issue 1-1-1 Whether to narrow down operating scenarios first. |
| CATT | The case in option 1 is much more feasible and can be considered. |
| OPPO | Option 1. |
| Huawei | For TDM operation, this scenario is viable. |
| Ericsson | Option 1. |
| Qualcomm | Option1 as in TDM operation only Uu or SL is present at any one time. |

**Issue 1-3-1: Switching period position for TDM operation**

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| **Company** | **Comments** |
| LGE | It can follow the decision of RAN4 NR V2X maintenance. In Rel-17, RAN4 only need to define ON/OFF time mask for TDM operation between NR V2X and NR Uu. |
| Xiaomi | With the existence of current TA and the DL alignment of SL, the overlap of SL and UL only occurs on the SL switching to UL. Also considering the already defined guard period, we prefer to locate the switching to SL and fully use the guard period for switching. |
| vivo | For now, we are not sure about the operation modes. We need clarification on the time mask defined for which operation modes. |
| CATT | Support option 1 that can be aligned with Rel-16 band n47. TA and timing misalignment issues can be considered to determine the switching period length. We also share the similar view as Xiaomi that guard period of SL should be used as fully as possible. |
| Huawei | Similar to that of switching between NR SL and LTE SL, the conclusion can be reused for the TDM operation. |
| Ericsson | We think it is too early to discuss this as the discussion also relate to the sycnhrnizition issue. |
| Qualcomm | We think that this issue should first be resolved for intra-RAT n47/B47 switching in Rel-16 maintenance before being addressed in Uu/SL coexistence in the same band |

**Issue 1-3-2: Switching period length**

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| **Company** | **Comments** |
| LGE | Need more discussion whether to add TA for switching period length |
| Xiaomi | The mask is provided by Xiaomi and would like to see companies’ view on it. |
| vivo | For now, we are not sure about the operation modes. We need clarification on the time mask defined for which operation modes. |
| CATT | Whether to add TA in switching period length can be discussed together with transmission timing issue. We are open to further discuss it. |
| Huawei | More discussion on TA for the switching period. |
| Ericsson | We think it is too early to discuss this as the discussion also relate to the sycnhrnizition issue. |
| Qualcomm | Switching period length should be similar to n47/B47 switching agreement captured in 38.133 section 12.9.1 in Rel-16 |

**Issue 1-3-3: Time mask**

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| **Company** | **Comments** |
| LGE | Need more discussion for time mask. |
| Xiaomi | The option 2 is provided by Xiaomi and would like to see companies’ view on it. |
| vivo | For now, we are not sure about the operation modes. We need clarification on the time mask defined for which operation modes. |
| CATT | Support option 1. The detailed time mask can be further discussed particularly for switching period length. However, some general principle can be decided as way forward, e.g. switching period position, how to use guard period. |
| Huawei | Can be further discussed once the remaining issue for Rel-16 is stable. |
| Ericsson | Need more discussion: need to consider the DL timing alignment principle or UL timing alignment principle as there is TA advance in place, the Tming mask need postphoned till the sync mechanism is clear. |
| Qualcomm | Postpone discussion on time mask issue until the operation mode and coexistence scenario are clear as per agreed WF R4-2103244. Also, this issue should be first resolved in NR V2X Rel-16 maintenance |

**Issue 1-4-1: Operating scenarios with adjacent carriers**

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| **Company** | **Comments** |
| LGE | Support option 1. In adjacent carrier between NR V2X and NR Uu, RAN4 only synchronous operation. So there is no IDC problem. |
| Xiaomi | We don’t agree with the statement. As from our paper R4-2106293, the in-device co-existence study is needed when UL TX and SL RX of the same UE simultaneously.  LGE: to Xiaomi and all, RAN4 only allowed synchronous operation for adjacent carrier case. So, In our paper, UL Tx will be impact to SL RX when RAN4 keep the current Time slot alignment with DL slot. But for 15kHz & 30kHz SCS, the TA is smaller than 1symbol. It was punctured for NR V2X operation. (R4-2104970). So it is not impact to SL reception.  Hence, RAN4 only need to study for IDC problem for for non-adjacent carrier scenarios. Since in here, RAN4 can allow non-synchronous operation between NR Uu and NR V2X. |
| vivo | We should clarify Issue 1-1-1 Whether to narrow down operating scenarios first. |
| CATT | In case of only FDM with adjacent carrier, in-device coexistence study is required. If TDM is used, it is expected no in-device coexistence study is needed. |
| OPPO | The SL transmits and receives on the TDD UL time slots, with adjacent carriers in the same band, isn’t the SL Rx will be impacted by NR Tx?  LGE: Need to check the (R4-2104970 & R4-2106293) |
| Huawei | Prefer to have more discussion. Priority for TDM/FDM scenarios can be considered firstly. |
| Ericsson | When SL RX and Uu TX simultaneously operation is allowed, there will be in-device coexisting issue. Together with Xiaomi comments, seems two scenarios are identified.  LGE: see the above LGE feedback in Xiaomi comment |
| Qualcomm | FFS. R4-2104970 presents 4 cases for FDM operation in TDD mode. Interference in case 1 depends on DL timing being used for NR SLthe use of which is currently being debated. Also interference in case 4 depends on the TA being less than the guard period. We believe that this issues requires more study. |

**Issue 1-4-2: Frequency separation for non-adjacent carriers**

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| **Company** | **Comments** |
| LGE | Support option 1. In non-adjacent carrier between NR V2X and NR Uu, RAN4 need more detail deployment operating scenarios. Based on the operator request RAN4 can study how much freq, gap is needed to eliminate self-interference problem each other. |
| Xiaomi | We see option 1 and option 3 can both be agreed and to further study the co-existence scenario and frequency separation. |
| vivo | We support option 2, i.e., no frequency separation definition is needed. Uu and SL can be configured as adjacent or non-adjacent, and frequency separation can be left to configuration.  LGE: this is already make consensus in Rel-16 for FDM operation in n79in WF. RAN4 defer the freq. separation study in Rel-17. |
| CATT | Support option 1 and option 3. Option 3 can be considered as a starting point. |
| OPPO | Option 2. It is unclear of the necessity and how to apply the frequency separation in requirement definition.  LGE: this is already make consensus in Rel-16 for FDM operation in n79in WF. RAN4 defer the freq. separation study in Rel-17. |
| Huawei | NC scenario in general can be considered, but inputs from operators would be helpful to carry out specific analysis. |
| Ericsson | This is SL RX and Uu TX simultaneously operation and it is IDC issue, the impact on the SL and Uu carrier configuration also needs to be understood. |
| Qualcomm | Option 1: For the FDD/TDD intra-band con-current operation with non-adjacent carrier, RAN4 need further discussion on the detail coexistence scenarios based on operator deployment scenarios and request. |

**Issue 1-5-1: BWP switching**

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| **Company** | **Comments** |
| LGE | No, In RF session for NR Uu, RAN4 do not define BWP switching requirements. So, the same principle can be considered. |
| Xiaomi | As we discussed in issue 1-1-1, we don’t see the case that one carrier with SL BWP and NR BWP. |
| vivo | We should clarify Issue 1-1-1 first. If Uu BWP and SL BWP are configured in the same carrier, the BWP switching requirements are needed in TDM manner. |
| CATT | No need to define BWP switching requirements. |
| OPPO | Similar as LGE. Not sure how this BWP switching is specified in RF, maybe RRM? |
| Huawei | Is it for TDM operation scenario? No need to consider it for FDM scenario. |
| Ericsson | BWP switching is a concept of two different UE of different BWP configuration belong ing the same cell. For Uu and SL , are we talking about two RAT? |
| Qualcomm | Before discussing BWP the candidate operating scenarios should be narrowed down first. |

**Issue 1-6-1: UE RF architecture**

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| **Company** | **Comments** |
| LGE | Prefer option 3. The single RF architecture can be considered for TDM operation. But we believe separate RF architecture is baseline for FDM operation. |
| Xiaomi | We prefer option 3. We prefer that the single RF architecture is assumed for TDM while different RF architecture is assumed for FDM. |
| vivo | Option 1. Separate RF architectures are assumed for SL and Uu. |
| CATT | Support option 3. Single RF chain can be used for TDM and different RF chains are preferred for FDM. |
| OPPO | Option 2 Alt-3 is preferred. This kind of UE architecture chosen also exists in other topics like UL CA, etc. And the down selection of architectures or define requirements for different architecture both are considered there. In general, our understanding is RAN4 requirements should cover different reasonable implementation architectures. But from progress point of view focus on certain architecture would be necessary to speed up the progress. Therefore, it is ok to focus on separate RF chain at the beginning and consider others afterwards. |
| Huawei | Option 2 Alt-3 and Option 3 can be further considered.  For FDM, separate RF architecture should be considered. Requirements for different architectures could be different. Baseline architecture need to be decided. To narrow down the study scope, priority also needs to be considered. |
| Ericsson | Option 3 for now as many issues are open. Option 3 and option2-Alt-3 seem to be connected. |
| Qualcomm | Option 2: Choose which of following approach is adopted for scenario 1 (NR Uu and SL supported by UE in same band) in requirement definition. (R4-2106554)   * + - Alt 3: Define requirements for both and rely on UE capability to indicate which requirements it follows |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* | |
| **Sub-topic 1-1: Clarification on operating scenarios** | **Issue 1-1-1: Whether to narrow down operating scenarios**  Tentative agreements: NONE.  Candidate options:   * + Option 1: RAN4 needs to narrow down the operation modes for intra-band con-current operation.   + Option 1a: Consider the following two cases for intra-band con-current operation:   Case 1: SL and Uu are in the same carrier with different BWPs  Case 2: SL and Uu are in different carriers  Recommendations for 2nd round: Prioritization on operating scenarios including TDM and FDM will be discussed in the 2nd round.  **Issue 1-1-2: Other operating scenario**  Tentative agreements: Scenario 2 in R4-2106554 is not in Rel-17 scope. Inter-band con-current operation can be treated in Rel-17 basket WI of NR\_LTE\_V2X\_PC5\_combos.  Candidate options: NONE.  Recommendations for 2nd round: No discussion needed in 2nd round.  **Issue 1-1-3: Full duplex or half duplex**  Tentative agreements: NONE.  Candidate options: NONE  Recommendations for 2nd round: Clarify the meaning of full duplex and half duplex for SL and Uu within the same licensed band together with operating scenarios. | |
| **Sub-topic 1-2: TDM operation between SL and Uu** | **Issue 1-2-1: TDM operating scenarios**  Tentative agreements: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band regardless of adjacent/ non-adjacent carrier (Option 1 as the majority view in 1st round).  Candidate options: NONE.  Recommendations for 2nd round: Focus on prioritization on operating scenarios including TDM and FDM. | |
| **Sub-topic 1-3: Time mask for SL and Uu switching** | **Issue 1-3-1: Switching period position for TDM operation**  Tentative agreements: NONE  Candidate options: NONE.  Recommendations for 2nd round: Postpone until sync mechanism between SL and Uu is clear.  **Issue 1-3-2: Switching period length**  Tentative agreements: NONE  Candidate options: NONE  Recommendations for 2nd round: Postpone until sync mechanism between SL and Uu is clear.  **Issue 1-3-3: Time mask**  Tentative agreements: NONE.  Candidate options: NONE.  Recommendations for 2nd round: Postpone until sync mechanism between SL and Uu is clear. | |
| **Sub-topic 1-4: FDM operation with different carriers** | **Issue 1-4-1: Operating scenarios with adjacent carriers**  Tentative agreements: NONE.  Candidate options: NONE.  Recommendations for 2nd round: Prioritization on operating scenarios including TDM and FDM will be discussed in the 2nd round.  **Issue 1-4-2: Frequency separation for non-adjacent carriers**  Tentative agreements: NONE  Candidate options:   * + Option 1: For the FDD/TDD intra-band con-current operation with non-adjacent carrier, RAN4 need further discussion on the detail coexistence scenarios based on operator deployment scenarios and request.   + Option 2: No need to introduce the frequency separation for the case Uu and SL are in different channels for intra-band con-current operation.   + Option 3: To study the frequency separation in non-adjacent channel, the frequency separation between existing UL and DL of FDD bands can be considered as a starting point.   Recommendations for 2nd round: Prior to decide whether to need frequency separation, focus on prioritization on operating scenarios including TDM and FDM. | |
| **Sub-topic 1-5: FDM operation within same carrier (different BWPs)** | **Issue 1-5-1: BWP switching**  Tentative agreements: No need to define the BWP switching requirements  Candidate options: NONE  Recommendations for 2nd round: No discussion needed in 2nd round. | |
| **Sub-topic 1-6: UE RF architecture** | **Issue 1-6-1: UE RF architecture**  Tentative agreements: NONE  Candidate options:   * + Option 1: The separate RF architecture should be considered as baseline to derive the RF requirements for partial usage between NR V2X and NR Uu in licensed band.   + Option 2: Choose which of following approach is adopted for scenario 1 (NR Uu and SL supported by UE in same band) in requirement definition.   Alt 1: Only define requirements for separate RF chain architecture  Alt 2: Only define requirements for the worst case, i.e. single RF architecture  Alt 3: Define requirements for both and rely on UE capability to indicate which requirements it follows   * + Option 3: Decide UE RF architecture based on specific operating scenario.   Recommendations for 2nd round: Determine basic RF architecture for different operating scenarios. | |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on operating scenarios for SL and Uu operated in the same licensed band | CATT |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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## Discussion on 2nd round (if applicable)

## Companies views’ collection for 2nd round

### Open issues

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**Issue 1-1-1: Whether to narrow down operating scenarios**

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| **Company** | **Comments** |
| LGE | TDM is 1st priority and FDM with adjacent carrier is 2nd priority.  For the adjacent carrier operation, RAN4 already agree not to consider simultaneous Rx/Tx. It means that only synchronous operation between NR Uu and NR SL is allowed.  The 3rd priority is FDM with non-adjacent carrier. |
| CATT | Generally agree with LGE’s proposal. Regarding FDM with adjacent carrier and with non-adjacent carrier, which of them could be higher priority can be based on operator’s request.  Prioritization on operating scenarios is proposed below:  1st priority: TDM  2nd priority: FDM with adjacent carrier / FDM with non-adjacent carrier  3rd proiority: FDM with non-adjacent carrier / FDM with adjacent carrier |
| Xiaomi | To LGE, when you mention that “RAN4 already agree not to consider simultaneous Rx/Tx” we think this imply that all the SL TX and RX will happen on UL slots. However, for UL slots with simultaneous SL RX, we don’t have agreement that whether this is applicable.  For the priority issue, we have a clarification question as this might be considered together with issue 1-1-3 of duplex mode. For FDM with non-adjacent channel, we think Full-duplex should be considered, but for FDM with adjacent channel, are we considering half-duplex or full-duplex? |

**Issue 1-1-3: Full duplex or half duplex**

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| **Company** | **Comments** |
| LGE | As I mentioned before, full duplexer terminology is not good explaination for partial used in licensed band.  RAN4 can use the simultaneous Rx/Tx operation in adjacent /non- adjacent carrier operation in n79 licensed band since operator request the V2X con-current operation in here.  The baseline is Half-duplexer for V2X or SL operation. in n79 as wideband, the simultaneous Rx/Tx operation is possible by IDC study. Therefore, specially RAN4 can allow simultaneous NR Uu transmission and NR V2X reception with separate freq. gap as 3rd priority based on issue 1-1-2. |
| CATT | It seems to have different understandings on duplex mode among companies. Currently, our preference is half duplex. |
| Xiaomi | TDM can be baseline then this must be half-duplex.  For FDM, we have clarification question as stated in issue 1-1-1. |

**Issue 1-4-2: Frequency separation for non-adjacent carriers**

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| --- | --- |
| **Company** | **Comments** |
| LGE | RAN4 can treat as 3rd priority |
| CATT | Prioritization on operating scenarios is proposed below:  1st priority: TDM  2nd priority: FDM with adjacent carrier / FDM with non-adjacent carrier  3rd proiority: FDM with non-adjacent carrier / FDM with adjacent carrier |
| Xiaomi | Same clarification question as Issue 1-1-1. |

**Issue 1-6-1: UE RF architecture**

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| **Company** | **Comments** |
| LGE | Agreeable moderator suggestion in WF |
| CATT | RAN4 decide basic RF architecture for different operating scenarios after prioritization on operating scenarios is agreed. Currently, it is proposed to define the following RF architecture:  1st priority: TDM (Single RF chain as baseline)  2nd priority: FDM with adjacent carrier / FDM with non-adjacent carrier (Separate RF chain as baseline)  3rd proiority: FDM with non-adjacent carrier / FDM with adjacent carrier (Separate RF chain as baseline) |
| Xiaomi | Also the RF architecture actually depend on the duplex mode since for full-duplex that separate RF chain is baseline. So for TDM single RF chain is provided as baseline. For FDM with non-adjacent carrier which is assumed as full-duplex then separate RF chain should be considered for baseline. For FDM with adjacent, the duplex mode needs clarification. |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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# Topic #2: Synchronous operation between SL and Uu

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104970 | LG Electronics France | Title: RF requirements for partial used licensed band bewteen NR Uu and NR SL operation  **Observation2: Even though RAN4 consider TA with transient period with 10us, RAN4 expect there would be no self-interference problem in its own device based on previous RRM agreement.  Observation3: For the 60 kHz SCS V2X operation, self-interference from NR Uu will impact to NR V2X reception in more than one symbol.**  **Proposal 2: For the SL transmission time alignment, RAN4 can keep the current RRM agreements as specified in section 12.2.3 in TS38.133.** |
| R4-2104779 | CATT | Title: Discussion on synchronous operation between SL and Uu  **Proposal 1: To avoid potential timing misalignment between SL and Uu, network should be used as synchronization reference source of SL at least in case SL and Uu are operated in the same licensed band. However, this restriction possibly has conflict with RAN1 design and thus an LS is required to be sent to RAN1 for the sake of alignment among WGs.**  **Proposal 2: It is proposed to keep SL timing aligned with UL timing of Uu. An LS is expected to be sent to RAN1 to avoid potential misalignment among WGs.** |
| R4-2104919 | Qualcomm Incorporated | Title: Synchronization and timing reference for NR SL and general issues on SL enhancements  **Observation 1: The standard does not state that the network should be always configured as synchronization reference source for in-coverage scenario.**  **Observation 2: The standard does not state that the network should always be the highest priority to be used when it is configured as one synch source for SL UE.**  **Observation 3: The standard already provides the network with mechanism to properly configure synchronization reference.**  **Observation 4: Current RAN1 agreement states that DL timing should be used for NR sidelink when gNB/eNB is used as a synchronization reference**  **Observation 5: The selection of which timing reference to use for the SL when gNB/eNB is used as a synchronization reference falls within the purview of RAN1** |
| R4-2106299 | Xiaomi | Title: synchronous operation between NR Uu and NR SL in an operating band  **Observation 1: SL timing aligning UL timing can reduce switching time and have better performance for the SL slot which configures the NR SL and NR Uu switching.**  **Observation 2: SL timing to be aligned with DL timing is to consider the case that SL UE is in-active mode in the network.**  **Proposal 1: To keep original timing advance as captured currently in TS 38.133.**  **Observation 3: If the NR SL and NR Uu switching mask has been defined properly, the guard period can be extended to cover the whole switching time.**  **Observation 4: From RAN1 agreement, two sets of synchronization rules are set and which set to be selected is by gNB configuration or pre-configuration.** |
| R4-2106555 | OPPO | Title: R17 V2X synchronization  **Observation 1: Align SL with uu UL can mitigate interference, however, it has large impact on RAN1 design, should not be decided by RAN4 only.**  **Proposal 1: It is proposed to send LS to RAN1 asking their view on the possibility of align SL with uu UL, and not make the decision in RAN4.**  **Observation 2: For the in-coverage scenario, NW can configure GNSS based synchronization or gNB/eNB based synchronization as higher priority.** |
| R4-2107243 | Ericsson | Title: SL UE synchronization issue for licensed operation  **Observation#1: To avoid the interference to the network UL receiving, the SL guard period should be greater than (2\*Tp+ Transient time)**  **Observation#2: If Uu transmission should happen after SL transmission at time slot immediately after SL transmission, to avoid the disturbance to its own SL transmission, the SL guard period should be greater than (3\*Tp+ TA\_Offset+Transient time)**  **Observation#3: The time mask for the SL and Uu TDM operation needs to be discussed together with the synchronization discussion.**  **Observation#4: More symbols needs to be punctured for 8km cell radius for SL transmission: 4 symbol for SCS=60kHz, 2 symbols for SCS=30kHz.**  **Observation#5: More symbols needs to be punctured for 8km cell radius for SL transmission when Uu : 6 symbol for SCS=60kHz, 3 symbols for SCS=30kHz and 2 symbols for SCS = 15kHz.**  **Observation#6: SL transmission time alignment with Uu uplink timing will not need puncture more symbols.**  **Observation#7: The DL timing alignment will introduce the phase discontinuity for FDM operation between SL and Uu transmission and degrade the uplink performance impact on network side.**  **Proposal-1: There is system benefit on SL if the SL transmission could be time aligned with the Uu uplink timing.**  **Proposal-2: Because the uplink timing alignment is against the RAN1 agreement and thus possible LS should be sent to RAN1 when RAN4 reach consensus.** |
| R4-2107302 | Huawei, HiSilicon | Title: On synchronous operation between Uu and SL  **Proposal 1: It is proposed to revisit the Rel-16 RAN4 decision on SL timing alignment issue.**  **Proposal 2: For the sync reference source, send an LS to RAN1 to align the understanding between RAN4 and RAN1.** |
| [R4-2104780](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104780.zip) | CATT | Title: LS on synchronous operation between Uu and SL in licensed band  RAN4 respectfully request RAN1 to clarify the following questions regarding partially used SL with Uu in TDD band n79:  **Question 1: If RAN4 specify SL transmission timing to be aligned with Uu UL timing, does it have any impact or conflict from RAN1 perspective?**  **Question 2: If RAN4 specify only network as synchronization reference source of SL in case of partially used SL with Uu in TDD band n79, does it have any impact or conflict from RAN1 perspective?** |

## Open issues summary

Based on above contributions, the following sub-topics and issues regarding synchronous operation between SL and Uu will be discussed in this clause:

* Sub-topic 2-1: SL transmission timing
* Issue 2-1-1: Pros and cons of SL transmission timing aligned with UL timing
* Issue 2-1-2: SL transmission timing
* Sub-topic 2-2: Sychronization reference source
* Issue 2-2-1: SL synchronization reference source

### Sub-topic 2-1: SL transmission timing

**Issue 2-1-1: Pros and cons of SL transmission timing aligned with UL timing**

* Proposals
  + Option 1: There is system benefit on SL if the SL transmission could be time aligned with the Uu uplink timing.
* Recommended WF
  + Need more discussion.

**Issue 2-1-2: SL transmission timing**

* Proposals
  + Option 1: RAN4 decide SL transmission timing to be aligned with UL timing of Uu.
  + Option 2: RAN4 follow existing SL transmission timing aligned with DL timing of Uu.
  + Option 3: Leave this issue to RAN1 for decision and send LS to RAN1 to clarify the situation in RAN4
  + Option 4: Send LS to RAN1 if RAN4 have any agreement/divergence on this issue.
* Recommended WF
  + Need more discussion.

### Sub-topic 2-2: Synchronization reference source

**Issue 2-2-1: SL synchronization reference source**

* Proposals
  + Option 1: RAN4 decide to configure network based synchronization as higher priority in case SL and Uu operate in the same licensed band.
  + Option 2: RAN4 follow the existing RAN1 design on sync reference source.
  + Option 3: Leave this issue to RAN1 for decision and send LS to RAN1 to clarify the situation in RAN4
  + Option 4: Send LS to RAN1 if RAN4 have any agreement/divergence on this issue.
* Recommended WF
  + Need more discussion.

## Companies views’ collection for 1st round

### Open issues

**Issue 2-1-1: Pros and cons of SL transmission timing aligned with UL timing**

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| **Company** | **Comments** |
| LGE | We think there is not specific concerning points when RAN4 keep the current RRM agreements. The simple way is to follow RRM agreements. |
| Xiaomi | As mentioned by our paper and also QC’s paper, RAN1 has considered the RRC\_IDLE mode UE which has no TA information and hence the UL timing alignment is not feasible for these kind of UEs. |
| vivo | We think RAN1 already defines SL timing aligned with DL timing. We can check this issue with RAN1. |
| CATT | We believe there is system benefit if SL transmission could be time aligned with UL timing. However, based on the current situation in RAN4, RAN1’s involvement is required to address this issue. |
| OPPO | Benefit is from interference point of view, but there is other group impact, we don’t think it can be easily decided in RAN4. |
| Huawei | We see there could be some benefit to align SL transmission timing with UL. Can be further checked with RAN1. |
| Ericsson | Option 1. As RAN4 needs to answer the same channel coexisting for SL and Uu operation in a licensed band, I think it is RAN4 task bring any identified issue to other group as issue itself cannot be solved by RAN4. |
| Qualcomm | The reason DL timing was selected is because UL timing is not available to all UE’s. When a UE is in RRC\_IDLE it is not connected to the network and does not have timing advance information. Therefore, an RRC\_IDLE UE does not have access to UL timing information. The same is true for a UE working autonomously in NR V2X mode 2. |

**Issue 2-1-2: SL transmission timing**

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| **Company** | **Comments** |
| LGE | Prefer option 2. |
| Xiaomi | We prefer Option 4. We think before sending the LS to RAN1, we should have consensus that the UL alignment method has large enough benefit to ask RAN1 to consider the change of SL timing advance. |
| vivo | OK with O4. |
| CATT | Support option 4. |
| OPPO | Option 2, and if companies insist on align with UL, then we see option 3 can be adopted. |
| Huawei | Prefer option 4. |
| Ericsson | Option 3 or 4. Why RAN4 keep silent when coexisting issue is identified? |
| Qualcomm | Option 2: RAN4 follow existing SL transmission timing aligned with DL timing of Uu. |

**Issue 2-2-1: SL synchronization reference source**

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| **Company** | **Comments** |
| LGE | We think that gNB based sync. Source and GNSS can be considered by NW signalling in coverage NW. |
| Xiaomi | Firstly, we need to decide if it is real a problem if the sync reference source is not NW for the sidelink. Currently, it has been agreed that the SL timing is aligned with DL timing (by setting the TA and TA offset of SL equal to 0.) With this, the SL timing has already been aligned with the network. The sync reference source for SL is to guarantee the synchronization of the two SL UEs and we don’t see the problem of these two SL UEs choosing their own sync reference source by SL synchronization procedure as defined already by RAN1. |
| vivo | OK with O4. It is better to consider NW as the reference source. However, the priority of choosing the synchronization source has been defined in RAN1. We need to check with RAN1 with this issue. |
| CATT | Support option 4. Send the LS to include transmission timing and sync reference source.  Discussion on SL sync reference source is mainly to reduce the mutual interference with Uu. |
| OPPO | Option 2. RAN4 follow the existing RAN1 design on sync reference source. |
| Huawei | Option 2.  To our knowledge, RAN1 already has the agreement of the synchronization source. Companies can check with RAN1 offline firstly. If no consensus reached, we can then consider to send an LS to RAN1 for clarification. |
| Ericsson | Option 2. If RAN4 cannot agree than option 4 is also ok. |
| Qualcomm | Option 2: RAN4 follow the existing RAN1 design on sync reference source. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| [R4-2104780](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104780.zip)  (LS on synchronous operation between Uu and SL in licensed band) | Vivo: If RAN4 cannot conclude on timing and sync reference source in this meeting, we support to send this LS to RAN1 for the progress. |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
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|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 2-1: SL transmission timing** | **Issue 2-1-1: Pros and cons of SL transmission timing aligned with UL timing**  Tentative agreements:   * + Option 1: There is system benefit on SL if the SL transmission could be time aligned with the Uu uplink timing. (Consensus among RAN4)   Candidate options: NONE.  Recommendations for 2nd round: Further discussion needed together with Issuse 2-1-2.  **Issue 2-1-2: SL transmission timing**  Tentative agreements:   * + Option 4: Send LS to RAN1 if RAN4 have any agreement/divergence on this issue. (Majority view in 1st round)   Candidate options: NONE.  Recommendations for 2nd round: Focus on the content of LS. |
| **Sub-topic 2-2: Synchronization reference source** | **Issue 2-2-1: SL synchronization reference source**  Tentative agreements: NONE  Candidate options:   * + Option 1: RAN4 decide to configure network based synchronization as higher priority in case SL and Uu operate in the same licensed band.   + Option 2: RAN4 follow the existing RAN1 design on sync reference source.   + Option 3: Leave this issue to RAN1 for decision and send LS to RAN1 to clarify the situation in RAN4   + Option 4: Send LS to RAN1 if RAN4 have any agreement/divergence on this issue.   Recommendations for 2nd round: Companies to check whether option 2 (majority view in 1st round) can be acceptable. Also, it is expected this issue can be captured in the LS together with Issue 2-1-2 if no consensus achieved in RAN4. |
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*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on synchronization issue for SL and Uu operated in the same licensed band | Huawei, HiSilicon |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| [R4-2104780](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104780.zip)  (LS on synchronous operation between Uu and SL in licensed band) | To be revised. |

## Discussion on 2nd round (if applicable)

## Companies views’ collection for 2nd round

### Open issues

**Issue 2-1-2: SL transmission timing**

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| --- | --- |
| **Company** | **Comments** |
| LGE | We already share our view in e-mail as follow.  In 1st round 3companies commented to keep the previous RRM agreements for Timing alignment for SL and Uu in licensed band. But CATT mentioned the existing timing alignment raise interference problem in SL Rx.  It is not true in our understanding due to Guard period in last symbol. Also RAN1 do not allow simultaneous Tx/Rx operation. The SL operation only allowed in UL configuration slot in TDD band. And also allow SL operation in UL band in FDD band.  Also the following was considered during Rel-16 RRM discussion as QC mentioned.  “The SL UE is in RRC\_IDLE it is not connected to the network and does not have timing advance information. Therefore, an RRC\_IDLE UE does not have access to UL timing information.”  In my understading, the changing from DL based time to UL based time can raise problem not to guarantee for Rel-17 V2X UE to communicate with legacy Rel-16 V2X UE when the UEs are operated in same licensed band.  It does not support backward compatibility. It seems be critical to legacy V2X UE compare to you mentioned above issues. |
| CATT | We also share our view here as presented in reflector:  For 15/30kHz SCS, guard period could mitigate interference by containing time misalignment part but for 60kHz SCS it is difficult.  We share the same understanding why in Rel-16 to define SL timing aligned with DL timing in RAN1. The similar sentence as below can be captured in the LS as common understanding to indicate this factor is realized in RAN4.  “The SL UE is in RRC\_IDLE it is not connected to the network and does not have timing advance information. Therefore, an RRC\_IDLE UE does not have access to UL timing information.”  Probably this issue will have an impact on legacy Rel-16 V2X UE within the same licensed band. However, RAN4 has identified coexistence problem between Uu and SL arising from TA difference and is obligated to let RAN1 know the current situation in RAN4 even if no conclusion made. We can focus on the content of the LS to fully reflect some common understanding in RAN4. |
| Xiaomi | We have also shared our view on our paper. The interference issue as mentioned by CATT can also be discussed in three scenarios:  1, TDM, then larger time mask can help to solve the problem which is more efficient and with less impact on legacy spec and other groups.  2, FDM, for non-adjacent carrier. Large enough frequency separation can help to solve this problem and we believe this is the important issue that frequency separation need to solve.  3, FDM, for adjacent carrier. This seems to be a problem but with some scheduling restriction can also solve the problem.  Based on the above, we think besides the UL timing alignment, many other methods can help to solve the interference issue. Before deciding to ask RAN1 to change their design and causing many problems for backward compatibility, we think it is really important that we have fully analyzed the pros and cons. |

**Issue 2-2-1: SL synchronization reference source**

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| --- | --- |
| **Company** | **Comments** |
| LGE | We think that gNB based sync. Source and GNSS can be considered by NW signalling in coverage NW. this is maybe existing RAN1 agreement. |
| CATT | SL sync reference source can be captured in the LS together with SL timing. RAN4 should further discuss these based on RAN1’s feedback. |
| Xiaomi | As stated in first round discussion, we don’t see why the synchronization of gNB is a must for the intra-band con-current operation as the SL reference source only aligns the synchronization of the SL UEs which should have no impact of the Uu interface. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Revision of [R4-2104780](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104780.zip)  (LS on synchronous operation between Uu and SL in licensed band) | LGE: need more discussion the pros & cons. To change the timing alignment. |
| CATT: Companies are encouraged to check if QC’s revision is acceptable and to provide comments on the content if any. |
| Xiaomi: Agree with LGE and also stated in our previous comments, we need to be really careful checking all the pros and cons before sending the LS. |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Other RF requirements & general issue

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2104972 | LG Electronics France | TP on MPR/coexistence simulation assumptions for leftover issues  In this paper, we propose to capture MPR/A-MPR simulation assumptions for left over issues such as PC2 V2X operation in ITS spectrum and intra-ban con-current operation in licensed band.  (Intra-band con-current operation will be treated in this summary) |
| R4-2106301 | LG Electronics Polska | MPR for NR V2X intra-band con-current operation with Uu  **Proposal 1: Define MPR for NR V2X intra-band con-current operation of SL PC5 and Uu taking configured Modulation Order and RB allocations into account. Proposal 2: Do not consider the ratio of total RB allocations over 1MHz (‘B’) for MPR for NR V2X intra-band con-current operation of SL and Uu Link. Proposal 3: Specify MPR in Table 2.1 and 2.2 for NR V2X intra-band con-current operation for maximum total output power of 26dBm. Proposal 4: Specify MPR in Table 2.3 and 2.4 for NR V2X intra-band con-current operation for maximum total output power of 23dBm.** |
| R4-2104919 | Qualcomm Incorporated | Title: Synchronization and timing reference for NR SL and general issues on SL enhancements  **Proposal: Companies should decide whether n79 partial used SL operation with NR n79 Uu and other Uu operating bands and high power UE (PC2) for SL enhancements work items apply only to V2X or to both V2X and non-V2X SL enhancements.** |
| R4-2107241 | Ericsson | Title: FDM operation for partially used SL operation in licensed band  **Proposal-3: the MPR of con-current operation of the NR SL and NR Uu could refer to the framework of MPR of con-current EN-DC (two RAT operating in the same band ) specified in TS 38.101-3.** |

## Open issues summary

Based on above contributions, the following sub-topics and issues on MPR for intra-band con-current operation will be discussed in this clause:

* Sub-topic 3-1: MPR for intra-band con-current operation
* Issue 3-1-1: Whether to consider modulation order and RB allocation
* Issue 3-1-2: Whether to consider the ratio of total RB allocation over 1MHz
* Issue 3-1-3: MPR requirements for PC2
* Issue 3-1-4: MPR requirements for PC3
* Sub-topic 3-2: Partial used SL with Uu is for NR V2X or SL enhancement
* Issue 3-2-1: Partial used SL with Uu is for NR V2X or SL enhancement

### Sub-topic 3-1: MPR for intra-band con-current operation

**Issue 3-1-1: Whether to consider modulation order and RB allocation**

* Proposals
  + Option 1: Define MPR for NR V2X intra-band con-current operation of SL PC5 and Uu taking configured Modulation Order and RB allocations into account.
* Recommended WF
  + Need more discussion.

**Issue 3-1-2: Whether to consider the ratio of total RB allocation over 1MHz**

* Proposals
  + Option 1: Do not consider the ratio of total RB allocations over 1MHz (‘B’) for MPR for NR V2X intra-band con-current operation of SL and Uu Link.
* Recommended WF
  + Need more discussion.

**Issue 3-1-3: MPR requirements for PC2**

* Proposals
  + Option 1: Specify MPR in Table 2.1 and 2.2 for NR V2X intra-band con-current operation for maximum total output power of 26dBm (R4-2106301).
  + Option 2: The MPR of con-current operation of the NR SL and NR Uu could refer to the framework of MPR of con-current EN-DC (two RAT operating in the same band) specified in TS 38.101-3.
* Recommended WF
  + Need more discussion.

**Issue 3-1-4: MPR requirements for PC3**

* Proposals
  + Option 1: Specify MPR in Table 2.3 and 2.4 for NR V2X intra-band con-current operation for maximum total output power of 23dBm (R4-2106301).
  + Option 2: The MPR of con-current operation of the NR SL and NR Uu could refer to the framework of MPR of con-current EN-DC (two RAT operating in the same band) specified in TS 38.101-3.
* Recommended WF
  + Need more discussion.

### Sub-topic 3-2: Partial used SL with Uu is for NR V2X or SL enhancement

**Issue 3-2-1: Partial used SL with Uu is for NR V2X or SL enhancement**

* Proposals
  + Option 1: Companies should decide whether n79 partial used SL operation with NR n79 Uu and other Uu operating bands and high power UE (PC2) for SL enhancements work items apply only to V2X or to both V2X and non-V2X SL enhancements.
* Recommended WF
  + Need more discussion.

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1-1: Whether to consider modulation order and RB allocation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Support Option1. Based on the simulation results (R4-2106301), MO and RB allocation should be considered for MPR for NR V2X intra-band con-current operation. Interested companies can provided their simulation results for progress. |
| Huawei | More inputs are needed for the intra-band con-current scenario. |
| Qualcomm | FFS. We should have results from multiple sources to determine whether Modulation order and RB allocation should be considered |

**Issue 3-1-2: Whether to consider the ratio of total RB allocation over 1MHz**

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| --- | --- |
| **Company** | **Comments** |
| LGE | Support Option1. Based on the simulation results (R4-2106301), parameter ‘B’ which was used for Rel-16 EN-DC MPR is not key parameter for MPR for NR V2X intra-band con-current operation because 1 RB was considered as minimum number of PRB in Rel-16 EN-DC however minimum sub channel of 10RB is the minimum number of PRB for NR V2X. Therefore, Rel-16 EN-DC MPR cannot be referred. Interested companies can provided their view based on simulation results for progress. |
| Huawei | More inputs are needed for the intra-band con-current scenario. |
| Qualcomm | FFS. We should have results from multiple sources to determine whether the parameter ‘B’ needs to be considered or not. |

**Issue 3-1-3: MPR requirements for PC2**

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| --- | --- |
| **Company** | **Comments** |
| LGE | Support Option 1. The reason is same as Issue 3-1-2. Also RAN4 define other MPR requirements for S-SSB transmission and multiple PSFCH transmission for PC2 intra-band con-current operation. |
| Huawei | More inputs are needed for the intra-band con-current scenario. |
| Qualcomm | FFS. MPR simulations for PFSCH and SSSB waveforms have to be done. Also, we should have simulation results from multiple sources for comparison |

**Issue 3-1-4: MPR requirements for PC3**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Support Option 1. The reason is same as Issue 3-1-2. Also RAN4 define other MPR requirements for S-SSB transmission and multiple PSFCH transmission for PC3 intra-band con-current operation. |
| Huawei | More inputs are needed for the intra-band con-current scenario. |
| Qualcomm | FFS. MPR simulations for PFSCH and SSSB waveforms have to be done. Also, we should have simulation results from multiple sources for comparison |

**Issue 3-2-1: Partial used SL with Uu is for NR V2X or SL enhancement**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LGE | Yes, RAN4 need to decide whether support PC2 intra-band con-current V2X UE in Rel-17. |
| Xiaomi | The licensed band partially used for SL is coming from operator’s request, hence this can be clarified by operators. |
| vivo | We are not sure why option 1 is brought up. What are non-V2X SL enhancements implying? |
| CATT | Based on our understanding, these leftover issues could be supported from Rel-16. For band n79, we also would like to hear the operator’s view. |
| Huawei | Clarification from operators are helpful. If no specific request, we can focus on NR V2X in Rel-17. |
| Qualcomm | From our reading of the WID we think that these work items apply only to V2X SL enhancements. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2104972  (TP on MPR/coexistence simulation assumptions for leftover issues) | LGE: support to capture the agreed simulation assumptions for MPR/coexistence evaluation. |
| Huawei: some typo in the assumptions, PUSCH rather than PDSCH for simultaneous transmission. |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic 3-1: MPR for intra-band con-current operation** | **Issue 3-1-1: Whether to consider modulation order and RB allocation**  Tentative agreements: NONE.  Candidate options:   * + Option 1: Define MPR for NR V2X intra-band con-current operation of SL PC5 and Uu taking configured Modulation Order and RB allocations into account.   Recommendations for 2nd round: Need more inputs from companies for alignment. Postpone this issue to the next meeting.  **Issue 3-1-2: Whether to consider the ratio of total RB allocation over 1MHz**  Tentative agreements: NONE.  Candidate options:   * + Option 1: Do not consider the ratio of total RB allocations over 1MHz (‘B’) for MPR for NR V2X intra-band con-current operation of SL and Uu Link.   Recommendations for 2nd round: Need more inputs from companies for alignment. Postpone this issue to the next meeting.  **Issue 3-1-3: MPR requirements for PC2**  Tentative agreements: NONE.  Candidate options:   * + Option 1: Specify MPR in Table 2.1 and 2.2 for NR V2X intra-band con-current operation for maximum total output power of 26dBm (R4-2106301).   Recommendations for 2nd round: Need more inputs from companies for alignment. Postpone this issue to the next meeting.  **Issue 3-1-4: MPR requirements for PC3**  Tentative agreements: NONE.  Candidate options:   * + Option 1: Specify MPR in Table 2.3 and 2.4 for NR V2X intra-band con-current operation for maximum total output power of 23dBm (R4-2106301).   Recommendations for 2nd round: Need more inputs from companies for alignment. Postpone this issue to the next meeting. |
| **Sub-topic 3-2: Partial used SL with Uu is for NR V2X or SL enhancement** | **Issue 3-2-1: Partial used SL with Uu is for NR V2X or SL enhancement**  Tentative agreements: NONE  Candidate options: NONE  Recommendations for 2nd round: The voice from operator is expected. Postponed this issue to the next meeting. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2104972 | To be revised. |

## Discussion on 2nd round (if applicable)

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Revision of R4-2104972  (TP on MPR/coexistence simulation assumptions for leftover issues) | LGE: agreeable |
|  |
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## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
| WF on operating scenarios for SL and Uu operated in the same licensed band | CATT |  |
| WF on synchronization issue for SL and Uu operated in the same licensed band | Huawei, HiSilicon |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| [R4-2104780](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98bis_e/Docs/R4-2104780.zip) | LS on synchronous operation between Uu and SL in licensed band | CATT | Revised |  |
| R4-2104972 | TP on MPR/coexistence simulation assumptions for leftover issues | LG Electronics France | Revised |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents