**3GPP TSG-RAN WG4 Meeting # 98-e R4-2102991**

**Electronic Meeting, Jan. 25- Feb. 5, 2021**

**Agenda item:** 11.10.4

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [98e][143] NRSL\_enh\_Part\_2

**Document for:** Information

# Introduction

In RAN4#97e meeting, partially used SL operation with Uu in licensed band is included in the scope of NR SL enhancement in Rel-17. This email discussion summary will focus on operating scenarios and synchronous operation for partially used SL operation with Uu.

The agenda items involved are as follows:

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

*11.10.4.1 Operating scenarios for partially used SL operation [NRSL\_enh-Core]*

*11.10.4.2 Synchronous operation between NR Uu and NR SL in an operating band [NRSL\_enh-Core]*

*11.10.4.3 Others [NRSL\_enh-Core]*

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.
	+ 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 WF if any.

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2102346 | Ericsson | Title: SL UE Timing mask for Partially used SL operation with NR Uu operating bandsObservation#1: There should not be any switch time between Uu to SL switch to keep the DL time alignment principle.Proposal: Consider the above the TDM timing mask for partially used SL operation with NR Uu operating bands in licensed band operation. |
| [R4-2100415](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014425.zip) | CATT | Title: Discussion on operating scenarios for partial used SL operationObservation 1: For Case 2, NR SL UE should transmit SL on UL slot while NR SL UE only receives DL on DL slot. The timing alignment issue needs be studied including synchronization reference source, timing advancing and switching time mask between Uu and SL.Observation 2: For Case 3, the RF requirements and RF architecture of intra-band CA in band n79 could be considered as a starting point for intra-band V2X con-current operation in band n79.Proposal: It is proposed to prioritize Case 2 and Case 3 and deprioritize Case 1 and Case 4. |
| R4-2100784 | vivo | Title: General issues about licensed bands partially used for SLProposal 1: It is proposed to agree on the following UE operations for licensed bands partially used for SL in Rel-17:a) NR UE operates in the licensed band through Uu interface only;b) NR V2X UE operates in the licensed band through PC5 interface only;c) NR V2X UE operates in the licensed band through Uu and PC5 synchronously.Proposal 2: Agree on the working assumptions of RF architectures for UEs supporting the scenario licensed bands partially used for SL.Proposal 3: RAN4 needs to define the core requirements for single carrier operation and intra-band con-current operation for the scenario licensed bands partially used for SL.Proposal 4: For the synchronous operation between Uu and SL in the same licensed TDD bands, NR SL should use network as the synchronization reference source. |
| [R4-2101875](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | Xiaomi | Title: On operating scenarios for partially used SL operationObservation 1: For UL and SL are FDMed operation, the licensed band partially used for sidelink is similar to the scenario of 2UL intra-band CA scenario in case the synchronization of SL and UL is aligned.Observation 2: Frequency separation needs to be investigated in case simultaneous UL and SL RX for FDMed UL and SL operation.Observation 3: Shared or separate antenna architecture needs also to be taken into consideration when defining requirements.Observation 4: For UL and SL are TDMed operation, switching period mask from UL to SL and SL to UL needs to be defined. |
| [R4-2102343](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | Ericsson | Title: Operating scenarios for partially used SL operationProposal: RAN4 discuss the above scenario to be considered for SL operation partially in a licensed band. |
| [R4-2100283](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100283.zip) | LG Electronics France | Title: Consideration on partial usage operation with PC5 and Uu in a licensed bandObservation 1: Only a separate RF architecture between Uu RF path and PC5 RF path is possible to support different transmission time.Observation2: Even though there is a Tx time difference between PC5 and Uu, RAN4 expect there would be no self-interference problem in its own device.Proposal 1: RAN4 allow TDM operation between PC5 and Uu operation in a licensed TDD band.Proposal 2: RAN4 can specify the con-current V2X operation in TDD intra-band without in-device coexistence study. For the FDD intra-band con-current operation, RAN4 need further discussion on the detail coexistence scenarios.Proposal 3: Based on Table 3.1, RAN4 further study the detail MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation.  |
| [R4-2101877](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101877.zip) | Xiaomi | Title: Synchronous operation between NR Uu and NR SL in an operating bandObservation 1: Current timing setting as 0 timing advance has not considered the synchronous operation between NR Uu and NR SL.Observation 2: When SL timing is aligned to UL timing, the synchronous NR Uu and NR SL operation is similar to 2UL carrier aggregation from UE perspective.Proposal 1: For specific synchronous operation of NR Uu and NR SL, the timing advance of SL to DL is aligned with the timing advance of UL to DL.Observation 3: Separate antenna architecture is assumed for UL and SL simultaneous transmission scenario. |

## 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: TDM operation between SL and Uu
* Issue 1-1-1: Whether to introduce TDM operation between SL and Uu
* Issue 1-1-2: Time mask for SL and Uu switching
* Sub-topic 1-2: FDM operation between SL and Uu
* Issue 1-2-1: Whether to introduce FDM operation between SL and Uu
* Issue 1-2-2: Frequency separation
* Sub-topic 1-3: UE RF architecture for partially used SL with Uu
* Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79
* Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79
* Issue 1-3-3: Shared antenna architecture or separate antenna architecture
* Sub-topic 1-4: Other related issues
* Issue 1-4-1: Intra-band V2X con-current operation
* Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation

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

**Issue 1-1-1: Whether to introduce TDM operation between SL and Uu**

* Proposals
	+ Option 1: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band.
	+ Other options are not precluded.
* Recommended WF
	+ Need more discussion.

**Issue 1-1-2: Time mask for SL and Uu switching**

* Proposals
	+ Option 1: Consider the TDM timing mask for partially used SL operation with NR Uu in paper R4-2102346.
	+ Other options are not precluded.
* Recommended WF
	+ More potential issues that have impact on time mask for SL and Uu switching should be explored.

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

**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**

* Proposals
	+ Option 1: RAN4 should allow FDM operation for partially used SL with Uu in licensed band
	+ Other options are not precluded.
* Recommended WF
	+ Need more discussion.

**Issue 1-2-2: Frequency separation**

* Proposals
	+ Option 1: RAN4 study frequency separation in case of FDM operation between SL and Uu
	+ Other options are not precluded.
* Recommended WF
	+ The further details on how frequency separation can be derived, e.g. simulation assumptions, should be discussed.

### Sub-topic 1-3: UE RF architecture for partially used SL with Uu

**Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**

* Proposals
	+ Option 1: YES
	+ Option 2: NO
* Recommended WF
	+ Need more discussion.

**Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**

* Proposals
	+ Option 1: YES
	+ Option 2: NO
* Recommended WF
	+ Need more discussion.

**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**

* Proposals
	+ Option 1: Shared antenna architecture
	+ Option 2: Separate antenna architecture
* Recommended WF
	+ Need more discussion.

### Sub-topic 1-4: Other related issues

**Issue 1-4-1: Intra-band V2X con-current operation**

* Proposals
	+ Option 1: RAN4 can specify the con-current V2X operation in TDD intra-band without in-device coexistence study. For the FDD intra-band con-current operation, RAN4 need further discussion on the detail coexistence scenarios.
	+ Other options are not precluded.
* Recommended WF
	+ Need more discussion.

**Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation**

* Proposals
	+ Option 1: RAN4 further study the detailed MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation.
	+ Other options are not precluded.
* Recommended WF
	+ Need more discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Vivo** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** What does the wording ‘spectrally partially used for SL and Uu’ mean in option 1? In our interpretation, only TDM operation in different carriers are considered for SL and Uu, but not in the same carrier. Why preclude the scenario in the same carrier? We need clarification of that.**Issue 1-1-2: Time mask for SL and Uu switching**It is early to discuss time mask before we agree on the UE operations for licensed bands partially used SL. **Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**For Option 1, on what condition, FDM between SL and Uu is allowed? Do we need to add a condition that SL can only be transmitted in the UL of the Uu?**Issue 1-2-2: Frequency separation**Why do we need to study frequency separation?**Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79****Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**For Issue 1-3-1/2, we think the RF architecture and requirements are related to specific UE operations. These issues can be discussed after we agree on the UE operations.**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**What does this antenna architecture mean? Antenna plus RF chain?In our understanding, antennas can be shared and RF chains should be separated for Uu and SL.**Issue 1-4-1: Intra-band V2X con-current operation**For Option 1, what’s the technical reason for not considering in-device co-existence study in TDD band? For FDD, we may not need to do the coexistence study.**Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation**We agree with Option 1. Besides MPR/A-MPR for PC3, we may also need to consider PC2 for the simulation assumptions since we are discussing introducing HPUE for SL. |
| **LGE** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** **LGE:** prefer Option 1: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band.**Issue 1-1-2: Time mask for SL and Uu switching****LGE:** It is depend on RAN4 agreements the position of switching period between LTE SL and NR SL at n47**.** For the consistency, RAN4 can wait to define the TDM time mask in licensed band.**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu****LGE:** prefer Option 1in TDD licensed band: RAN4 should allow FDM operation for partially used SL with Uu in TDD licensed band. In FDD band, the the UL transmission is not restricted, so the V2X SL reception in UL frequency can be impacted in FDD band. So RAN4 need to study the frequency gap in FDD licensed band.**Issue 1-2-2: Frequency separation****LGE:** For the FDM operation in TDD band, based on the LGE analysis paper (R4-2100283), RAN4 can allow FDM operation in TDD licensed band with restriction of SL Tx/Rx only allowed in UL configuration when NR Uu has not transmitted signalling.**Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79****LGE:** prefer option2: No.For the RF architecture of V2X intra-band con-current operation shall consider separate RF architecture. In 2UL intra-band CA, there are two different RF architectures. One is single RF architecture for 2UL intra-band contiguous CA and the other is separate 2PA RF architecture for 2UL intra-band non- contiguous CA. So it is not applicable to the V2X intra-band con-current operation.**Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79****LGE:** prefer option2: No.For the MPR/A-MPR, RAN4 need to analyse the specific A-MPR requirements according to each channel such as PSCCH/PSSCH, S-SSB and PSFCH transmission. Also if RAN4 consider different RF architecture, RAN4 need to study the detail RF core requirements as mentioned in LGE paper (R4-2100283)**Issue 1-3-3: Shared antenna architecture or separate antenna architecture****LGE:** prefer option2: separate RF architecture**Issue 1-4-1: Intra-band V2X con-current operation****LGE:** prefer option1: RAN4 can specify the con-current V2X operation in TDD intra-band without in-device coexistence study. For the FDD intra-band con-current operation, RAN4 need further discussion on the detail coexistence scenarios.**Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** **LGE:** prefer option1: RAN4 further study the detailed MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation. |
| **Xiaomi** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** Similar question as Vivo that what is “spectrally partially used” mean? For TDM operation, we believe both same carrier and different carrier are feasible.**Issue 1-1-2: Time mask for SL and Uu switching**Need more analysis on the time mask before making decision.**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**Option 1. As discussed in our paper, the FDM operation is feasible considering specific Timing Alignment requirement as the NTA\_SL = NTA.**Issue 1-2-2: Frequency separation**Option 1. The frequency separation needs to be considered for the scenario that simultaneous UL and SL RX as enough FS is needed to guarantee the throughput of SL RX.**Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. In our paper, the observation is for the scenario however we also pointed out that the intra-band CA requirements are based on ONE PA architecture while the partial SL should be based on TWO PA architecture. **Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. The intension of mentioning the 2UL intra-band CA is for consideration of co-existence scenario but for RF requirements, we need further study.**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**Option2: separate RF architecture**Issue 1-4-1: Intra-band V2X con-current operation**For TDD band, as based on the “puncture the last symbol” for SL decision, it seems current interference because of TA causing some UL/DL and SL overlap can be ignored. It seems this issue should be discussed together with Ericsson’s discussion of timing issue in R4-2102345.For FDD bands, there is no co-existence study made in any band so we agree with the simulation necessisty.**Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** Option1: RAN4 further study the detailed MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation. |
| **Ericsson** | **Issue 1-1-1: option 1.****Issue 1-1-2: option 1****Issue 1-2-1:Option 1. It is good to discuss whether this FDM operation apply also between NR SL and NR Uu coexisting for same carrier operation.****Issue 1-2-2: does this relate to the coexisting simulation assumption discussion? If so, maybe we cannot decide now and will depend on coexisting simulation conclusion.****Issue 1-3-1: if the V2X intra-band con-current operation is for 2 V2X carrier, single PA is fine. If the V2X intra-band con-current operation is for 1 V2X carrier plus 1 NR Uu carrier, both single PA and dual PA should be ok, this may relate to the V2X capability if there are different implementations.****Issue 1-3-2: option 2.** **Issue 1-3-3: this is up to UE vendor, need to agree the RF architecture to settle some RF requirement for con-current operation though.****Issue 1-4-1: option 1****Issue 1-4-2: option 1.** |
| **Huawei, HiSilicon** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** TDM as an optional operation could be considered, but firstly we should be clear what the possible applicable scenarios are for specific bands, e.g. static resource allocation, timing alignment. **Issue 1-1-2: Time mask for SL and Uu switching**The discussion of time mask requirement can be postponed after the scenarios and operation mode is clear.**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**FDM is one of the possible operation mode, but the term of “partially used” is ambiguous, which should be clarified in the group. Coverage of SL due to power control may be seriously impacted by FDM operation, which should be carefully considered. **Issue 1-2-2: Frequency separation**Together with issue 1-2-1, some clarification is needed. Does it mean we just need to consider the non-contiguous carriers for Uu and SL just like NC CA? **Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. The RF architecture for V2X could be different from that of Uu intra-band CA, further study is needed. **Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. The RF requirements for 2UL intra-band CA cannot be simply applied to V2X, further study is needed.**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**Option2: separate RF architectureAt least for FDM, separate RF architecture. **Issue 1-4-1: Intra-band V2X con-current operation**It would be better to study based on request for specific band. We may focus on TDD band, e.g. n79 firstly. **Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** Option1: simulation assumptions should be further studied together with specific scenario of the intra-band con-current operation, e.g. operating band, CBW, etc. |
| **CATT** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** We also have question on “spectrally partially used SL for TDM operation” and share the similar view with Xiaomi. TDM operation for both the single carrier and different carriers is consider feasible. No self-interference is observed in TDM mode.**Issue 1-1-2: Time mask for SL and Uu switching**It is premature to define time mask for SL and Uu for the time being before the coexistence mechanism is clear. Also, if TDM with one single carrier for SL and Uu is decided, it is expected no switching period specified for SL and Uu switching due to no frequency shift. In Rel-16 V2X, the switching period specified for LTE SL and NR SL is caused by frequency switching between LTE SL and NR SL. In the case of TDM with one single carrier, it seems only one transient period 10us for SL and Uu switching is needed, aligned with the case of intra-RAT NR Uu slot n switching to slot n+1.**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**Option 1. We prefer to not define the single/shared carrier for FDM mode between SL and Uu. The different carrier case should be prioritized with consideration of frequency separation between SL and Uu.**Issue 1-2-2: Frequency separation**Option 1. To Ericsson, in our understanding, frequency separation is not associated with coexisting simulation assumption. The frequency separation here should be applied between SL and Uu regarding in-device UE coexistence. I assume the coexistence simulation you referred to is dedicated to UE v.s. UE. To Huawei, non-contiguous carrier for SL and Uu is one of the feasible solutions like NC CA. The worst case, i.e. simultaneous UL TX and SL RX, should be taken into consideration to specify frequency separation. RAN4 should further discuss the methodology and simulation assumption to specify frequency separation. It seems the assumption of filter performance needs to be first defined, e.g. reuse the filter performance specified for Uu and SL. **Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. RAN4 should define the specific RF architecture for intra-band con-current operation.**Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 2. RAN4 should define the core RF requirements based on the specified RF architecture for intra-band V2X con-current operation.**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**Option 2.**Issue 1-4-1: Intra-band V2X con-current operation**Option 1 is OK with us.**Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** Option1. Based on the methodology of intra-band CA irrespective of contiguous or non-contiguous, the MPR/A-MPR requirements should be specified to satisfy the SEM requirements. |
| **Qualcomm** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu**Option 2: Needs more discussion. Issues such as the synch signal (UL vs DL timing signal) between SL and Uu has to be resolved. What reference signal is to be used for synchronization has to be agreed. Is TDM on the same frequency for separate frequencies. If on separate frequencies the PLL tune time has to be considered.**Issue 1-1-2: Time mask for SL and Uu switching**Option 2: Option1 needs further study. The synchronization signal (UL vs DL timing signal) between for SL and Uu have to be agreed. There may also be more timing related issues that have not been fully investigated. Therefore, we feel that this issue needs more discussion.**Issue 1-2-1: Whether to introduce FDM operation between SL and Uu**Option 2: Needs more discussion. Issues such as frequency separation between Uu and SL and the related issue of interference between them has to be investigated. The issue of what TX architectures can support FDM operation has also to be discussed. The power of the Uu TX and SL TX may have to be reduced to prevent cross-coupling. Special MPRs may have to be defined for this mode of operation. For FDM RX the powers of the 2 signals have to be similar otherwise the larger signal acts as a jammer for the smaller one. Issues related uneven RX powers, because they come from different sources, would have to be resolved**.****Issue 1-2-2: Frequency separation**Option 1: RAN4 study frequency separation in case of FDM operation between SL and Uu. **Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 3: Needs more discussion. Though the 2UL intra-band CA may have similarities to the Uu/SL there are differences such as the fact that they are not transmitting to the same gNB/eNB that may lead to differences in the RF architecture and timing that has to be investigated further. Also, the Uu and SL may not be transmitting and receiving at the same time which may cause cross coupling between the TX and RX.**Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79**Option 3: Needs to be studied further for the same reasons as stated in Issue 1-3-1**Issue 1-3-3: Shared antenna architecture or separate antenna architecture**Option3: This is an implementation detail which should be left to UE vendors. There should be no restriction on which antenna architecture is used. Both shared antenna and separate antenna architectures should be considered in RAN4 specification development.**Issue 1-4-1: Intra-band V2X con-current operation**Option 2: Needs more discussion. The TDD operation needs to specify a synchronization signal that will ensure that Uu and SL will not interfere with one another. The selection of the sych reference signal has not been agreed yet. **Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** Option 1: RAN4 further study the detailed MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation. |

### 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** |
|  |  |
|  |
|  |

## 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 1-1: TDM operation between SL and Uu** | **Issue 1-1-1: Whether to introduce TDM operation between SL and Uu** *Tentative agreements:* **None***Candidate options:** + **Option 1: RAN4 allow TDM operation between spectrally partially used PC5 SL and Uu UL/DL operation in a licensed TDD band.**
	+ **Option 2: RAN4 allow TDM operation without FDM for SL and Uu in a licensed TDD band.**

*Recommendations for 2nd round:***Focus on TDD licensed band, i.e. n79. RAN4 further discuss TDM operation as to whether additional FDM is needed.****Issue 1-1-2: Time mask for SL and Uu switching***Tentative agreements:* **None***Candidate options:** + **Option 1: Consider the TDM timing mask for partially used SL operation with NR Uu in paper R4-2102346.**
	+ **Option 2: Postpone until the operation mode and coexistence scenario are clear.**

*Recommendations for 2nd round:***RAN4 check whether option 2 can be agreeable.** |
| **Sub-topic 1-2: FDM operation between SL and Uu** | **Issue 1-2-1: Whether to introduce FDM operation between SL and Uu***Tentative agreements:* **None***Candidate options:** + **Option 1: RAN4 should allow FDM operation for partially used SL with Uu in licensed band.**
		- **Option 1a: RAN should allow FDM operation with one single or shared carrier for SL and Uu in licensed band**
		- **Option 1b: RAN should allow FDM operation with different carriers for SL and Uu in licensed band.**

*Recommendations for 2nd round:***Focus on TDD licensed band, i.e. n79. RAN4 further discuss whether to introduce FDM operation with single/shared carrier or different carriers for SL and Uu in licensed band. The impact of different power control mechanisms between SL and Uu can be considered.****Issue 1-2-2: Frequency separation***Tentative agreements:* **None***Candidate options:** + **Option 1: RAN4 study frequency separation in case of FDM operation between SL and Uu**
		- **Option 1a: RAN4 study frequency separation in FDM operation between SL and Uu to allow simultaneous UL Tx and SL Rx.**

*Recommendations for 2nd round:***RAN4 should make a common understanding on whether frequency separation in FDM operation between SL and Uu is similar to intra-band non-contiguous CA. Companies are encouraged to provide views on how to study frequency separation, e.g. simulation assumption, etc.** |
| **Sub-topic 1-3: UE RF architecture for partially used SL with Uu** | **Issue 1-3-1: Whether the RF architecture of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79***Tentative agreements:* **Option 2: No. The RF architecture of 2UL intra-band CA could not simply apply to V2X intra-band con-current operation in band n79***Candidate options:* **None***Recommendations for 2nd round:***The initial consideration on RF architecture for TDM operation and FDM operation can be discussed in the 2nd round based on the corresponding WF if possible.****Issue 1-3-2: Whether the core RF requirements of 2UL intra-band CA could apply to V2X intra-band con-current operation in band n79***Tentative agreements:* **Option 2: NO. The core RF requirements of 2UL intra-band CA could not simply apply to V2X intra-band con-current operation in band n79.***Candidate options:* **None***Recommendations for 2nd round:***The initial consideration on core RF architecture for TDM operation and FDM operation can be discussed in the 2nd round based on the corresponding WF if possible.****Issue 1-3-3: Shared antenna architecture or separate antenna architecture***Tentative agreements:* ***None.*** *Candidate options:** + **Option 2: Separate antenna architecture.**
	+ **Option 3: Decision of shared or separate antenna architecture should be left to UE vendors.**

*Recommendations for 2nd round:***Make final decision between option 1 and option 2 in the 2nd round.** |
| **Sub-topic 1-4: Other related issues** | **Issue 1-4-1: Intra-band V2X con-current operation***Tentative agreements:* **None***Candidate options:* * + **Option 1: RAN4 can specify the con-current V2X operation in TDD intra-band without in-device coexistence study. For the FDD intra-band con-current operation, RAN4 need further discussion on the detail coexistence scenarios.**

*Recommendations for 2nd round:***This issue can be discussed together with Sub-topic 1-2: FDM operation between SL and Uu based on the corresponding WF for FDM operation.****Issue 1-4-2: MPR/A-MPR for intra-band V2X con-current operation** *Tentative agreements:** + **Option 1: RAN4 further study the detailed MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation.**

*Candidate options:* **None.***Recommendations for 2nd round:***The initial consideration on MPR/A-MPR simulation assumption and specification aspects for intra-band V2X con-current operation can be discussed in the 2nd round based on the corresponding WF if possible.** |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| **#1** | **WF on TDM operation for SL and Uu in licensed band** | **CATT** |
| **#2** | **WF on FDM operation for SL and Uu in licensed band** | **Xiaomi**  |
| **#3** | **WF on MPR/A-MPR simulation assumption for intra-band V2X con-current operation** | **LGE** |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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”* |
|  |  |

## Discussion on 2nd round (if applicable)

## Companies views’ collection for 2st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  |  |
|  |  |
|  |  |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
|  |  |
|  |
|  |

## 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 #2: Synchronous operation between Uu and SL

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2100416](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100416.zip) | CATT | Title: Discussion on synchronous operation between NR Uu and NR SLProposal 1: When SL and Uu are operated in the same licensed band, network should be used as synchronization reference source for SL.Proposal 2: SL timing should be aligned with UL timing of Uu instead of Uu when SL and Uu are operated in the same licensed band. |
| R4-2100784 | vivo | Title: General issues about licensed bands partially used for SLProposal 1: It is proposed to agree on the following UE operations for licensed bands partially used for SL in Rel-17:a) NR UE operates in the licensed band through Uu interface only;b) NR V2X UE operates in the licensed band through PC5 interface only;c) NR V2X UE operates in the licensed band through Uu and PC5 synchronously.Proposal 2: Agree on the working assumptions of RF architectures for UEs supporting the scenario licensed bands partially used for SL.Proposal 3: RAN4 needs to define the core requirements for single carrier operation and intra-band con-current operation for the scenario licensed bands partially used for SL.Proposal 4: For the synchronous operation between Uu and SL in the same licensed TDD bands, NR SL should use network as the synchronization reference source. |
| [R4-2102345](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102345.zip) | Ericsson | Title: SL UE synchronization issue for licensed operationObservation#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+ 2\*Transient time)Observation#3: The time mask for the SL and Uu TDM operation needs to be discussed together with the synchronization discussion.Proposal-1: RAN4 discuss the benefit of the introducing the Uplink timing alignment for both TDM and FDM mode. Possible LS could be sent to RAN1 if agreement deviate from the RAN1 agreement in Rel-16. |
| [R4-2100283](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2100283.zip) | LG Electronics France | Title: Consideration on partial usage operation with PC5 and Uu in a licensed bandObservation 1: Only a separate RF architecture between Uu RF path and PC5 RF path is possible to support different transmission time.Observation2: Even though there is a Tx time difference between PC5 and Uu, RAN4 expect there would be no self-interference problem in its own device.Proposal 1: RAN4 allow TDM operation between PC5 and Uu operation in a licensed TDD band.Proposal 2: RAN4 can specify the con-current V2X operation in TDD intra-band without in-device coexistence study. For the FDD intra-band con-current operation, RAN4 need further discussion on the detail coexistence scenarios.Proposal 3: Based on Table 3.1, RAN4 further study the detail MPR/A-MPR simulation assumptions and specification for intra-band con-current V2X operation.  |
| [R4-2101877](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101877.zip) | Xiaomi | Title: Synchronous operation between NR Uu and NR SL in an operating bandObservation 1: Current timing setting as 0 timing advance has not considered the synchronous operation between NR Uu and NR SL.Observation 2: When SL timing is aligned to UL timing, the synchronous NR Uu and NR SL operation is similar to 2UL carrier aggregation from UE perspective.Proposal 1: For specific synchronous operation of NR Uu and NR SL, the timing advance of SL to DL is aligned with the timing advance of UL to DL.Observation 3: Separate antenna architecture is assumed for UL and SL simultaneous transmission scenario. |

## Open issues summary

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

* Sub-topic 2-1: Transmission timing between SL and Uu
* Issue 2-1-1: Transmission timing between SL and Uu
* Issue 2-1-2: SL guard period
* Sub-topic 2-2: Synchronization reference source
* Issue 2-2-1: Synchronization reference source for SL

### Sub-topic 2-1: Transmission timing between SL and Uu

**Issue 2-1-1: Transmission timing between SL and Uu**

* Proposals
	+ Option 1: SL transmission timing should be aligned with UL timing of Uu.
	+ Option 2: SL transmission timing should be aligned with DL timing of Uu.
	+ Option 3: RAN4 discuss the benefit of the introducing the Uplink timing alignment for both TDM and FDM mode. Possible LS could be sent to RAN1 if agreement deviate from the RAN1 agreement in Rel-16.
* Recommended WF
	+ Need more discussion.

**Issue 2-1-2: SL guard period**

* Proposals
	+ Option 1: To avoid the interference to the network UL receiving, the SL guard period should be greater than (2\*Tp+ Transient time). 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+ 2\*Transient time).
	+ Option 2: Even though there is a Tx time difference between PC5 and Uu, RAN4 expect there would be no self-interference problem in its own device.
	+ Other options are not precluded.
* Recommended WF
	+ Need more discussion.

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

**Issue 2-2-1: Synchronization reference source for SL**

* Proposals
	+ Option 1: Use network as synchronization reference source.
	+ Option 2: Check RAN1 decision and follow RAN1 agreements.
* Recommended WF
	+ Need more discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Issue 2-1-1: Transmission timing between SL and UuRAN1’s agreement is consistent with Option 1. Option 3, maybe a typo, in Rel-17?Issue 2-1-2: SL guard periodIs this issue discussed in option1 within the scope of RAN4?Issue 2-2-1: Synchronization reference source for SLOK with option1. Check with RAN1 is also OK. |
| Xiaomi | Issue 2-1-1: Transmission timing between SL and UuWe prefer option 3 as mentioned in our paper, the decision for 0 TA of DL hasn’t considered the partial SL condition and we have shown that for the alignment of UL there will be easy implementation and requirement definition.Issue 2-1-2: SL guard periodThis topic is similar to LG discussion as R4-2100283 and we think it is quite important as defining the self-interference scenario for partial SL used of licensed band. For LG proposal, it is from NW TA requirement perspective without considering the transient period while for Ericsson proposal, it is from deployment scenario perspective but it doesn’t fully consider the timing advance requirement especially the NTA \_offset. We believe the guard period as one symbol should consider both the timing advance and the transient period as 2Tp + transient time + TAoffset = 2 + 10 + 20 =32us as considering 2us for 500m ISD. In this case it is quite near to the 35.7us of 30kHz SCS. Also for Ericsson’s paper as indicated the observation 2 from figure 2 which is missing so if Ericsson can help to provide the figure 2 for further clarification. Before that we cannot ensure that the guard period is enough for current SL and DL timing alignment without causing self-interference.Issue 2-2-1: Synchronization reference source for SL We believe the partial SL usage of licensed band can be a specific capability of UE and with this case we can set specific synchronization reference source for this capability, e.g. use the NW as reference source. |
| Ericsson | **Issue 2-1-1: option 3. The RAN1 agreement is for Rel-16. If nothing is to be changed, it will apply to Rel-17 also.** The cell size for the public safety will be 8km due to the PC1 UE support for B14/n14. This corresponding to Tp of 2.67us. Considering the N\_TAoffset of 22us mentioned in paper (R4-2100283), to avoid the interference to network (this is the similar for self-inteference), the guard period should be 3\*2.67 + 22 us + 2\*Transient period= 8+22+20 =50 us. The punctured last symbol is 71.4us for SCS 15kHz and 35.7us for SCS 30kHz. So puncture the last symbol for SCS 30kHz is not good enough. Puncture more symbol seems a penalty for the SL UE near the gNB/eNB. To Xiaomi. The Figure 2 is for timing mask which is paper R4-2102346. Clearly it shows the guard period stretches into next Uu uplink receiving.**Issue 2-1-2: Option 1 with some modification.** **There are two cases needs consider the guard period. 1st case is the avoidance of the self -inteference and 2nd is to avoid the network interference. The formular is the same for the 2 cases. Though option 1 needs some modification. The N\_TA\_offset needs to be considered also so the gurad period should be** (3\*Tp+ 2\*Transient time + N\_TA\_offset). The N\_TA\_offset needs to be consider because the gNB will advance UE receiving timing with this amount to RX to TX transient. **Issue 2-2-1: Seems option 1 can control the potential interference to network as the UL and SL has pre-known timing relation.** |
| Huawei, HiSilicon | Issue 2-1-1: Transmission timing between SL and UuOption 3. The feasible operation should be further studied for synchronization scenario. Transmission timing is one of the aspect. We support to have further study of the related issues. Issue 2-1-2: SL guard periodWe think that Guard period is an important issue to be studied, issues identified in option 1 can be considered as starting point. Issue 2-2-1: Synchronization reference source for SLBesides network, GNSS shall also be considered as synchronization reference source, which depends on the operation scenario. |
| CATT | **Issue 2-1-1: Transmission timing between SL and Uu**Option 3 is OK with us. **Issue 2-1-2: SL guard period**SL guard period should be discussed along with transmission timing between SL and Uu. If SL transmission timing is aligned with UL timing of Uu, no need to consider whether SL guard period can contain the interference period.**Issue 2-2-1: Synchronization reference source for SL** Support option 1. Using network as sync reference source can avoid self-interference caused by different sync reference source between SL and Uu. After aligning the sync source reference, the remaining issue of timing alignment is TA. We agree to configure network as sync reference source when V2X UE supports partial SL usage in licensed band as a specific capability. |
| Qualcomm | **Issue 2-1-1: Transmission timing between SL and Uu**Option 4: Needs more discussion. The benefits of using either UL timing or DL timing has not been fully studied. Also, RAN1 has specified DL time as the sych source if gNB/eNB is going to be used as the reference source. The impact on the system of changing this to UL timing has not been studied yet. It would be good to send a LS to RAN1 to seek their opinion**Issue 2-1-2: SL guard period**Guard period is an important topic and needs to be discussed further. **Issue 2-2-1: Synchronization reference source for SL**Option 3: Check with RAN1 as to what synchronization source would be best to use.  |

### 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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 2-1: Transmission timing between SL and Uu** | **Issue 2-1-1: Transmission timing between SL and Uu***Tentative agreements:* **None***Candidate options:** + **Option 1: SL transmission timing should be aligned with UL timing of Uu.**
	+ **Option 2: SL transmission timing should be aligned with DL timing of Uu.**
	+ **Option 3: RAN4 further discuss the pros and cons of introducing UL timing alignment for both TDM and FDM mode, taking RAN1 Reply LS in near further into consideration.**

*Recommendations for 2nd round:***RAN4 send an LS to RAN1 to check transmission timing and synchronization reference source issues. RAN4 further discuss transmission timing between SL and Uu by taking TA difference into account in the 2nd round.****Issue 2-1-2: SL guard period***Tentative agreements:* **None***Candidate options:** + **Option 1: To avoid the interference to the network UL receiving, the SL guard period should be greater than (2\*Tp+ Transient time). 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+ 2\*Transient time + N\_TA\_offset).**
	+ **Option 2: Even though there is a Tx time difference between PC5 and Uu, RAN4 expect there would be no self-interference problem in its own device.**
	+ **Option 3: Postpone until transmission timing between SL and Uu is decided.**

*Recommendations for 2nd round:* **Option 3 can be considered.** |
| **Sub-topic 2-2: Synchronization reference source** | **Issue 2-2-1: Synchronization reference source for SL** *Tentative agreements:* **None***Candidate options:** + **Option 1: Use network as synchronization reference source.**
	+ **Option 2: Check RAN1 decision and follow RAN1 agreements.**
	+ **Option 3: RAN4 further discuss the pros and cons of introducing network based sync source for SL, taking into RAN1 reply LS in near future into consideration.**

*Recommendations for 2nd round:***RAN4 send an LS to RAN1 to check transmission timing and synchronization reference source issues. RAN4 further discuss synchronization reference source issue in the 2nd round.** |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| **#1** | **WF on synchronous operation between Uu and SL in licensed band** | **Ericsson** |
| **#2** | **LS on synchronous operation between Uu and SL in licensed band** | **CATT** |

### 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”* |

## Discussion on 2nd round (if applicable)

## 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”* |