**3GPP TSG RAN WG1 Meeting #110bis-e R1-** **2210296**

**e-Meeting, October 10th – 19th, 2022**

**Source: Moderator (Fraunhofer HHI)**

**Title: FL Summary#1 for AI 9.4.2 - Co-Channel Coexistence for LTE and NR Sidelink**

**Agenda item: 9.4.2**

**Document for: Discussion**

# Introduction

The work item for NR sidelink evolution was approved in RAN#94e and revised in RAN#97e, and the following objectives were identified in relation to the co-channel coexistence between LTE and NR sidelink:

4. Study and specify, if necessary, mechanism(s) for co-channel coexistence for LTE sidelink and NR sidelink including performance, necessity, feasibility, and potential specification impact if any [RAN1, RAN2, RAN4]

* Reuse the in-device coexistence framework defined in Rel-16 as much as possible
* Note, RAN1 continues the work on dynamic resource pool sharing based on existing agreements and WID with high priority for Type A devices and operating combination A

This document provides a summary of the submitted contributions, email discussion topics and outcomes during RAN1#110bis-e meeting for AI 9.4.2.

[110bis-e-R18-SL-03] Email discussion on co-channel coexistence for LTE-NR SL by October 19 – Sarun (Fraunhofer)

* Check points: October 14, October 19

# Collection of Agreements/Conclusions in RAN1#110bis-e

Section to be filled at the end of the meeting, compiling all agreements/conclusions/working assumptions.

## Agreements from GTW – Tuesday 11th October

**Agreement**

For dynamic resource pool sharing, the candidate information shared by the LTE SL module to the NR SL module may include one or more of the following parameters, to be down-selected:

* Time and frequency locations of reserved resources by other LTE UEs, determined based on decoded SCIs
* SL RSRP measurement results
* Resource reservation periods based on decoded SCI and for own LTE SL transmissions
* Priority based on decoded SCI and for own LTE SL transmissions
* Time and frequency location of resources used for own LTE SL transmissions
* Candidate resource set SA or SB
* SL RSSI measurements
* LTE logical subframe related information
* Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE

**Agreement**

For dynamic resource pool sharing, the NR SL module uses the information shared by the LTE SL module to the NR SL module to determine the set of resources for its own transmission.

* FFS: which layer carries out the resource determination: PHY layer or MAC layer.

# Resource Pool Partitioning and Sharing

Over the course of the discussions for the scope of the WID during the workshop and subsequent plenary meetings, the solutions considered for co-channel coexistence were semi-static and dynamic co-channel coexistence. Both these solutions were agreed to be studied in RAN1#109e, and while semi-static solutions that use separate resource pools for LTE SL and NR SL in a TDM or FDM manner are possible within the current specifications, issues in using them for co-channel coexistence have been identified by companies. On the other hand, dynamic solutions are not currently specified and would require some restrictions to be considered for a timely completion of the WID.

The subsequent RAN1#110 meeting went further by concluding that TDM-based semi-static resource pool partitioning (SRPP) is a possible solution using existing Rel-16/17 specifications. For the study of dynamic resource pool sharing (DRPS), certain restrictions such as the use of 15 kHz SCS and possible solutions for overcoming the AGC issue due to overlapping PSFCH transmissions were agreed upon.

In the following plenary meeting RAN#97e, it was agreed that while TDM-based SRPP can be used, the work on DRPS should continue with high priority for Type A devices and operating combination A. Hence, as per the plenary advisory, this section covers the different aspects of DRPS that were brought forth in various company contributions. The latter part of the section covers the views from companies on SRPP, which is currently marked as “Inactive".

## [*ACTIVE*] Issue 1-1: DRPS – PSFCH Overlapping

### Summary of Company Views from TDocs

The following agreement was made in the previous meeting, which defined different alternatives as to how NR PSFCH can be configured in the shared NR SL resource pool.

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| **Agreement**  For co-channel coexistence in Rel-18, dynamic resource pool sharing is studied, with the following constraints:   * + For NR PSFCH (if configured), at least the following alternatives are studied:     - Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.       * FFS: Avoiding PSFCH transmissions can be performed by the UE transmitting PSFCH and/or the UE transmitting PSSCH.     - Alt 2: NR SL UEs use a periodically repeating set of PSFCH slots.       * FFS: periodicities of the set. |

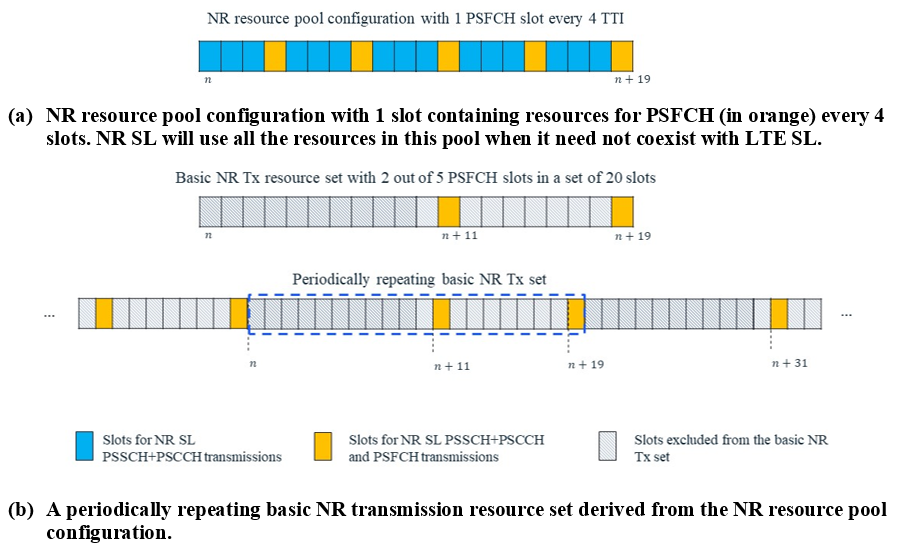
In Alt 1, the NR SL UE would avoid PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions. In the case of a TX UE performing this action, while selecting resources for a transmission with HARQ enabled, the TX UE would have to ensure that the time slot for PSCCH/PSSCH transmission as well as the time slot used for the feedback from the RX UE are available and not used by LTE SL UEs. In the case of an RX UE performing this action, the RX UE would simply not transmit on the PSFCH of a time slot if it overlaps with an LTE SL transmission, based on the LTE sensing information.

In Alt 2, the NR SL UE would transmit PSFCH only in time slots that are a subset of the full set of periodic PSFCH enabled time slots. This subset is referred to as a basic resource set, which is then repeated over time. This can be seen in Figure 1, from [28]. The advantage of using such a subset of PSFCH time slots is so that when the LTE SL UEs perform SL RSSI measurements, high RSSI would be detected on these subframes, and would thereby avoid them for their own transmissions.

On reviewing the contributions, 20 companies support Alt 1, with 5 companies expecting the UE transmitting PSFCH (RX UE) to avoid the overlapping resources, while 4 companies prefer the UE transmitting the PSCCH/PSSCH (TX UE) to avoid these resources. On the other hand, only 5 companies support Alt 2, while 11 companies have raised objections against Alt 2.

The main drawback that was identified in Alt 1 is that, while the NR SL UE can avoid resource collisions by avoiding resource overlaps based on received LTE sensing information, it is possible that the NR SL UE would miss out on LTE SL resource reservations that have taken place after the UE has transmitted the PSCCH/PSSCH and before the PSFCH transmission. Another issue is the hidden node problem, where the NR SL UE reserving resources for its PSCCH/PSSCH transmission is unaware of LTE SL UEs that are spatially distant from it, but close to the RX UE that is expected to transmit the feedback on the PSFCH time slot.

The issue with Alt 2 is that companies are not convinced that the SL RSSI measurements performed by the LTE SL UEs are adequate to identify whether an LTE SL resource overlaps with a PSFCH time slot. This is because the PSFCH occupies only 2 symbols, and if a higher SCS is used, these resources can still rank high enough for them to be included in the LTE SL candidate resource set. Another aspect that was identified was that in LTE SL UEs, the resource exclusion procedure based on received SCIs and SL RSRP measurements take place first, followed by a check on the candidate resource size. Only after this are the resources based on the RSSI rankings excluded, which might result in a skewed candidate resource set being generated.



*Figure 1: Depiction of Alt 2 where the NR SL UE uses a periodically repeating set of PSFCH time slots. [28]*

The following is a summary of the views from the different companies.

* Support Alt 1 – Avoid PSFCH transmission in overlapping resources - [2], [3], [4], [5], [6], [9], [12], [13], [14], [15], [16], [17], [20], [21], [24], [25], [26], [27], [29], [31]
  + UE transmitting PSFCH should avoid overlapping resources – [5], [19], [26], [29], [31]
    - Do not support – [27]
  + UE transmitting PSSCH should avoid overlapping resources – [19], [24], [26], [27]
  + NR SL UE selects only those time slots for PSSCH and PSFCH transmissions that do not overlap - [4]
  + Study methods to avoid PSFCH transmissions by postponing the PSFCH transmissions instead of dropping them - [31]
  + Do not support/sees issues - [7], [8], [30]
* Support Alt 2 – New set of PSFCH periodicities to avoid overlapping LTE resources – [6], [17], [18], [28], [30]
  + Retain existing PSFCH periodicities, restricting them to 2 or 4, with NR SL prioritizing transmissions on the time slots with PSFCH, ensuring that LTE subchannels overlap in frequency with PSFCH resources – [30]
  + Do not support/sees issues - [1], [2], [3], [5], [7], [8], [16], [25], [26], [27], [31]
* Other solutions, apart from Alt 1 and Alt 2:
  + Use 60 kHz SCS for NR SL resource pools - [1]
  + Use long PSFCH format, or a standalone feedback time slot - [1]
  + Transmit during AGC symbol in start of slot - [1]
  + PSFCH resources are configured in a TDM manner with LTE V2X resource pool - [7]
  + Use IUC to identify overlapping resources – [10]
  + PSFCH is not supported – [11]
  + Semi-static (pre-)configuration of NR PSFCH time slots that do not overlap with LTE resource pools – [14]
  + NR SL UE sends LTE SCI indicating resources reserved by LTE transmissions - [23]

Based on the identified issues and detailed descriptions by companies, the FL feels that Alt 1 is closer to being agreed by companies as compared to Alt 2. In order to sort out the issues identified in Alt 1, a few of the solutions have been captured in the proposal.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

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| **Company** | **Company proposal related to this issue** |
| Nokia | Observation 3: Solution Alt 1 for enabling PSFCH in dynamic co-channel coexistence, seems beneficial that both Tx and Rx UE will take actions to prevent transmitting PSFCH on top of an active LTE transmission. However, RAN1 will need to discuss conditions for avoiding PSFCH.  Observation 4: For Solution Alt 2 for enabling PSFCH in dynamic co-channel coexistence, it is unclear how an NR UE will prioritize to select resources in a slot which has PSFCH configured, without significantly increasing the risk of collisions and increasing the latency.  Observation 5: Current options (Alt 1 and Alt 2) on the table for PSFCH support for dynamic co-channel coexistence requires PSSCH resource selection restrictions.  Proposal 4: RAN1 to study the following alternatives for how to support PSFCH with dynamic resource pool sharing:  • Alt 1. Tx UE attempts to select a PSSCH resource such that no LTE reservation overlaps the slot with the associated PSFCH, while Rx UE detects whether an LTE transmission is occurring in the slot in which PSFCH is intended to be transmitted.  o FFS: Conditions for when to avoid transmission of PSFCH in a slot that is overlapping a reserved LTE resource  • Alt 3. Adopt a slot-format for slots where PSFCH is configured, such option c, where a common AGC symbol is introduce which is transmitted by all UEs intending to transmit during a slot (transmission of PSSCH/PSCCH and PSFCH)  Proposal 5: RAN1 to discuss how to handle a dropped PSFCH for groupcast option 1. |
| Huawei, HiSilicon | Observation 2: For dynamic resource sharing, resource collision issue and AGC issue may occur when LTE-V PSCCH/PSSCH and NR-V PSFCH are transmitted in the shared resource.  Observation 3: For Alt2, LTE-V cannot exclude the periodically repeating PSFCH based on the RSSI ranking procedure in Rel-14.  Proposal 5: Support Alt1 for NR-V and LTE-V co-channel co-existence via dynamic resource sharing,  • PSFCH occasions are (pre-)configured in the shared resource pool as in Rel-16 NR-V.  • For the UE transmitting a PSFCH, the PSFCH is transmitted only if the PSFCH resource is not overlapped with LTE-V’s reservation in time. |
| Spreadtrum | Proposal 5: Avoiding PSFCH transmission in the slots that overlap with the subframes used for LTE SL transmissions should be considered for supporting HARQ-ACK in dynamic resource sharing. |
| Vivo | Observation 5: PSFCH of NR devices may be disturbed by the LTE SL data transmission in the corresponding resource and vice versa.  Proposal 2：If dynamic resource sharing is supported, the sharing mechanism solution should be able to resolve the collision between PSFCH and LTE transmission.  Observation 6: Option 3 obtains around 4% PRR gain than Baseline, 1 ~ 2% gain than Option 1 and Option 2 in LTE RAT, while the PRR loss in NR RAT is not obvious.  • Option 1: NR UE does not transmit PSFCH when the PSFCH transmission in time slots would overlap with subframes used for LTE SL transmissions.  • Option 2: When perform resource allocation, NR UE would select the PSSCH resource that both the PSSCH resource and its corresponding PSFCH resource have not been reserved by LTE devices.  • Option 3: NR UE would try to select the PSSCH and PSFCH resources that have not been reserved by LTE devices. When this is not possible, it does not transmit PSFCH.  Proposal 3: If dynamic resource sharing is supported, the methods that NR UE selects the proper PSSCH resource where the corresponding PSFCH resource would collide with LTE SL transmission, and NR UE does not transmit PSFCH that would collide with LTE SL transmissions, can be considered to avoid the collision between PSFCH and LTE SL transmission. |
| ZTE, SANECHIPS | Proposal 3: Alt 1 is supported, i.e. when the slots configured for NR PSFCH resources overlap with the slots in LTE SL resource pool, no transmission or reception of NR PSFCH is performed on the NR PSFCH resources. |
| Panasonic | Proposal 13: If type C devices are not using PSFCH resource by proper resource pool configuration (or other means), it can be ok to have in the resource pool with dynamic resource sharing. We think both alternatives as in last meeting agreements could resolve the PSFCH issue. Either is ok to us. |
| OPPO | Proposal 7: PSFCH resources of NR SL should be configured in a TDM manner with the resource pool of LTE SL. |
| CATT, GOHIGH | Observation 1: Alt 1 needs to be evaluated for the HARQ performance of NR SL, especially for NACK only based groupcast, and the Alt 2 needs more investigations for NR PSFCH. |
| Intel | Proposal 6:  • For co-channel co-existence in Rel.18, if RAN1 conveys to support dynamic resource pool sharing and furthermore that NR PSFCH may need to be configured, PSFCH transmission avoidance in time slots that overlap with subframes used for LTE SL transmissions could be employed (Alt.1 is preferred). |
| Sony | Proposal 3: NR SL UE can avoid the PSFCH/PSCCH transmission in the same time slots with LTE SL transmission through intra/inter-UE coordination. |
| NEC | Proposal 2: For both solution B (FDM resource pools for the two RATs) and solution C (shared resource pool for the two RATs), the following basic settings should be used for NR sidelink:  − fixed to 15kHz (higher SCS is not supported);  − all symbols in a slot used as sidelink symbols;  − PSFCH is not supported; |
| Transsion | Proposal 3: If PSFCH is configured in NR sidelink resource pool, the PSFCH transmission in time slots that overlap with subframes used for LTE transmissions should be avoided. |
| CAICT | Observantion3: If the co-channel co-existence pool is configured with PSFCH resources, NR SL transmitter can avoid using PSFCH resources/slots in collision with LTE SL through channel sensing, which also would be ineffective due to hidden node issue.  Proposal5: Propose to support Alt1 where NR SL UEs avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.  Proposal6: FFS the hidden node issue in the PFSCH transmission avoidance from NR SL UEs to prevent interference to LTE SL UEs. |
| Xiaomi | Observation 1: semi-statically (pre)configure NR PSFCH on LTE reserved slots can avoid interference of NR PSFCH on LTE SL, however, it depends on LTE SL (pre)configurations.  Observation 2: Avoiding NR PSFCH transmission by utilizing sensing results shared by LTE SL model cannot fully avoid the potential interference from NR PSFCH on LTE SL.  Observation 3: Using a periodically repeating set of PSFCH slots for NR SL may not be effective when the resource is relatively congested, or when the distribution of NR devices is less dense.  Observation 4: LTE SL transmission may be impacted by NR PSFCH for a consecutive long duration if the period of LTE SL TX can divide the NR PSFCH periodicity.  Proposal 5: For dynamic resource sharing, if NR PSFCH is (pre)configured, NR SL shall avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions. |
| Lenovo | Proposal 4: Support PSFCH configuration for dynamic resource pool sharing.  Proposal 5: Support Alt.1 to address the AGC issue due to PSFCH, e.g., avoid PSSCH transmission if the associated PSFCH is overlapping with the LTE SL’s reservation in time domain. |
| CMCC | Proposal 2: For NR PSFCH (if configured), Alt 1 is considered as a starting point for co-channel coexistence scenario.   Alt 2 is not so clear and more clarifications are needed;   Both semi-static and dynamic ways can be considered for Alt 1;   RAN1 should further study the potential enhancements with Alt 1 as a starting point, with the consideration of keep the reliability improved by HARQ-ACK feedback. |
| ETRI | Proposal 5: It is proposed to support both following alternatives in order to overcome the AGC issue caused due to PSFCH transmission:   Alt 1: NR SL UEs avoid the transmission/reception of PSFCH in time slots that overlap with subframes used for LTE SL transmissions.   Alt 2: NR SL UEs use a basic set of periodically repeating PSFCH slots which enables LTE SL UE-s to avoid them using current R14 RSSI based resource avoidance.   FFS: How to configure/indication one of both |
| Fraunhofer | Proposal 2: For dynamic resource pool sharing, we propose to use a periodically repeating set of PSFCH slots (Alt 2) to avoid overlaps with LTE V2X transmissions. |
| LG | Proposal 1: In the case of dynamic resource pool sharing, the following rules are applied for PSFCH transmission:   On a PSFCH resource overlapping with LTE SL transmission, the corresponding PSFCH transmission is omitted.   A TB requesting SL HARQ-ACK feedback can be transmitted only on a PSSCH resource having a PSFCH resource that does not overlap with LTE SL transmission. |
| MediaTek | Proposal 3: Support Alt-1 for PSFCH channel:  • Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions. |
| Apple | Proposal 3: For dynamic resource pool sharing, support avoiding PSFCH transmission in time slots that overlap with subframes used for LTE sidelink transmissions.  • NR PSFCH resources are dropped if they have time overlap with LTE sidelink resource pool. |
| Mitsubishi | Proposal 4: For co-channel coexistence on overlapped resource pools, study the feasibility and benefits of at least the following solutions:  - Resource allocation modifications to NR Rel.17 procedure in order to take into account the LTE reservation in overlapping resources  - Solutions for enabling NR with PSFCH enabled to coexist with LTE  - Solutions for coexistence and cross-RAT interpretation of sidelink synchronization signals |
| Toyota | Observation 2: For the PSFCH AGC issue, among the solutions proposed or discussed at RAN1#110, some impose some restrictions on the NR SL or the PSFCH resource patterns, whereas others (B6: Use common AGC symbol and B4: NR SL UE sends LTE SCI to reserve the candidate slot containing a PSFCH occasion so that LTE SL UEs would exclude the reserved resources slot based on LTE SCI decoding) do not.  Observation 3: A common solution of NR SL UE sending LTE SCI (to reserve the candidate slot so that the LTE SL UE would exclude the reserved resources slot based on sensing) solves both issues of AGC issues caused by different SCSs and PSFCH.  Observation 4: To solve both AGC issue caused by different SCSs and PSFCH, combining the solutions of NR SL UE sending the LTE SCI, and the multi-slot aggregation where same or different TBs can be transmitted in each slot, seems to strike the best balance between flexibility, complexity, overhead and efficiency.  Proposal 2: To circumvent the AGC issues caused by the PSFCH being configured in NR SL resource pools, and also the AGC issue caused by different SCSs, NR SL UE sends LTE SCI to reserve the slots so that LTE SL UEs would exclude the reserved resources slot based on LTE SCI decoding.  Proposal 3: To circumvent the AGC issues caused by the PSFCH being configured in NR SL resource pools, and also the AGC issue caused by different SCSs, the solution of NR SL UE sending LTE SCI is combined with multi-slot aggregation where same or different TBs can be transmitted in each slot. |
| InterDigital | Proposal 5: Introduce mechanism in NR SL resource selection to exclude a resource for PSSCH/PSCCH transmission that will result in a PSFCH occasion overlapping with reserved LTE transmission or reception. |
| Samsung | Proposal 10: NR PSFCH is configured in slots that are not part of the LTE SL resource pool. This can be left to network implementation.  Proposal 11: If a slot with PSFCH occasions is shared with LTE SL, the UE transmits PSSCH/PSCCH and PSFCH in the same slot with the same power. |
| Sharp | Proposal 3: For study of the dynamic resource sharing with constraint of NR PSFCH (if configured), the following Alt.1 is studied.   Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.  • FFS: Avoiding PSFCH transmissions can be performed by the UE transmitting PSFCH and/or the UE transmitting PSSCH. |
| NTT DOCOMO | Observation 1: The way to avoid PSFCH transmissions performed by the UE transmitting PSSCH has an advantage in terms of complexity or resource efficiency over by UE transmitting PSFCH.  Proposal 3: In Alt 1 for handling NR PSFCH slots, support at least avoiding by UE transmitting PSSCH.   * Whether to support avoiding PSFCH transmission by UE transmitting PSFCH is further studied.   Observation 2: If LTE and NR resource pools are misaligned in frequency domain, LTE module/devices will not exclude NR-PSFCH slots properly.  Observation 3: In situation where LTE resource pool is congested, Alt 2 for handling NR PSFCH slots is possible not to work properly.  Proposal 4: On how to handle NR-PSFCH slot overlapped with LTE-SL transmission, deprioritize Alt 2 for handling NR PSFCH slots. |
| Qualcomm | Proposal 4: NR SL UE-s are (pre-)configured with a periodically repeating basic set of available resources for NR transmissions which are comprised of one or more PSFCH occasions. |
| Bosch | Proposal 9: For dynamic co-channel coexistence PSFCH handling:  - Confirm Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions  - Avoiding PSFCH transmissions can be performed by, at least, the UE transmitting PSFCH.  Proposal 10: Further study pros and cons of allowing FDM between LTE and NR in dynamic cochannel co-existence. |
| Ericsson | Observation 9 For LTE SL and NR SL co-channel coexistence, PSFCH periodicity should be 2 or 4.  Observation 10 Avoiding transmission of PSFCH in LTE SL subframe impacts the reliability and spectral efficiency of NR SL transmission.  Proposal 4 Dynamic co-channel coexistence is based on having NR SL UEs using a periodically repeating set of PSFCH slots.  Proposal 5 In designing dynamic co-channel coexistence solutions, RAN1 support Alt.2 assuming that the resource pool configuration defines PSFCH periodicity of 2 or 4 slots.  Observation 11 LTE Resource exclusion based on RSSI averages may successfully exclude resources in subframes overlapping with NR slots configured with PSFCH.  Observation 12 For correct coexistence between NR and LTE sidelinks, NR UEs should prioritize transmitting PSCCH+PSSCH using slots with PSFCH resources.  Proposal 6 For dynamic coexistence of NR and LTE SLs, Rel-18 NR UEs prioritize selecting and transmitting on resources with PSFCH resources whenever LTE transmissions are detected. FFS details, including how to prioritize and how to detect LTE transmissions.  Observation 13 To avoid proper operation of the sensing procedure and exclusion of all the LTE resources in subframes overlapping with NR slots with PSFCH resources it is important that RSSI measurements in all LTE sub-channels reflect the presence of PSFCH transmissions.  Proposal 7 RAN1 assumes that the NR resource pool configuration ensures that every LTE sub-overlaps in frequency with PSFCH resources. |
| WILUS | Proposal 1: The UE transmitting PSSCH should perform avoiding PSFCH transmissions by using the resource exclusion process or the re-evaluation process of NR SL Mode 2.  Proposal 2: The UE transmitting PSFCH should also perform avoiding PSFCH transmissions.   The UE transmitting PSSCH may not receive the LTE transmission due to UE topology.  Observation 1: Alt 1 with current NR SL specifications can cause several reliability issues.   In case of NACK-only feedback, a UE transmitting PSSCH can regard as ‘ACK’ if PSFCH transmission of NACK feedback is avoided.   In case of ACK/NACK feedback, a channel load may be increased as a UE transmitting PSSCH performs retransmissions for a non-feedbacked PSSCH transmission.  Proposal 3: RAN1 to study methods for avoiding PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.  Proposal 4: Postponing PSFCH transmission is preferable to dropping the transmission for the method for avoiding PSFCH transmission in case of co-channel coexistence.   It should be further investigated how to indicate postponed PSFCH transmission or how to multiplex with postponed PSFCH transmission and the other PSFCH transmission.  Proposal 5: RAN1 to study methods for postponing PSFCH transmission for co-channel coexistence of LTE sidelink and NR sidelink.   Time limit for transmission of postponed PSFCH transmission.   Handling mechanisms (e.g., multiplexing schemes) of simultaneous transmissions of postponed PSFCH and new PSFCH to a single UE.  Observation 2: In LTE SL Mode 4, the resource exclusion process based on RSRP measurements and LTE SCI reception is performed earlier than the resource exclusion process based on RSSI measurements.  Observation 3: From the observation 2, we can observe that LTE transmissions can occur in the NR PSFCH slots in case of high channel load.  Observation 4: From the observation 3, Alt 2 suffers similar issues as Alt 1, hence needs similar solutions as Alt 2.  Proposal 6: RAN1 to study Alt 1, i.e., avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-1:**

* **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).**
* **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**
  + **Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.**
  + **Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.**
  + **Option 3: Both Option 1 and Option 2.**
  + **FFS details.**
* **FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).**

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| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| OPPO | Comments | Alt 1 is a general direction that NR SL UE avoids PSFCH transmissions in time slots that overlap with the subframes used for the transmissions of LTE SL. In fact, it can be achieved by either a dynamic method or a semi-static way. Therefore, we propose to add the semi-static way as option 4 in above Proposal 1-1:   * **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**   + **Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.**   + **Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.**   + **Option 3: Both Option 1 and Option 2.**   + **Option 4: PSFCH resources are configured in a TDM manner with LTE V2X resource pool**   + **FFS details.**   According to TS36.213, the set of subframes that may belong to a PSSCH resource pool for sidelink transmission mode 3 or 4 is denoted by . Hence, the RSSI measurements in subframe or are performed within **the subframes that may belong to LTE SL resource pool** but the PSFCH resources are defined **within NR SL resource pool.** Although both RSSI measurement and PSFCH resources are repeated periodically, they work in different levels of logical slots/subframes. Therefore, we think the corresponding FFS of Alt 2 should be removed because it cannot work in our view. |
| Toyota | Comments | We could be ok with Alt1 option 1 if this is the majority views, however: Option 1 would impact the NR resource pattern, and option 2 would negatively impact the HARQ feedback.  Why listing Alt2, if we go for Alt. 1 ?  The solution of the NR UE sending the LTE SCI (on the SL transmission) would solve this issue, together with at least another issue (fairness between LTE and NR), so it would seem preferable. |
| Intel | Comment | We are OK with the updated version of the proposal provided by OPPO, and we also believe that combinations of semi-static and dynamic methods could be used. Also, as pointed out by Toyota, the FFS could be removed. |
| vivo | Yes | We support Option 3. In Option 1, PSCCH/PSSCH TX UE could avoid collision between LTE and PSFCH by resource exclusion. However, it may lead to frequent resource reselection, and thus increases the transmission delay as well as the congestion level of the resource pool. On the other hand, it is more accurate to assess whether a collision has occurred by the NR PSCCH/PSSCH RX UE because NR PSCCH/PSSCH TX UE module may be unaware of some resources being reserved by an LTE SL UE which is distant from the device, but it may suffer HARQ-ACK ambiguity if NACK only based HARQ-ACK scheme is used. Therefore, we believe that both options can be supported. |
| Apple | Comment | As FL mentioned that in Alt 2, it is not guaranteed that SL RSSI measurement-based ranking could help LTE SL module to identify the slots with PSFCH, since the NT slot with only PSFCH transmission (and without PSSCH transmission) does not always have higher SL RSSI measurement than the slot with PSSCH transmission. Hence, we do not think the last FFS is needed.  For Alt 1, it is possible that NR SL UE would miss out on LTE SL resource reservations, which will lead to PSFCH transmission and cause AGC issue on LTE SL resource reservations. Hence, the Option 4 mentioned by OPPO could be considered to ensure no overlap between PSFCH transmission and LTE PSSCH transmission. |
| Ericsson | No | We are not supportive of the current proposal containing Alt. 1.  In our view, the procedure indicated by Alt.1, i.e., that the NR SL UE does not perform PSFCH transmission in the intended pre-configured resources, is not a good design since it impacts the reliability and spectral efficiency of the NR SL transmissions.  As a compromise solution for the proposal, we propose that  “The (pre-)configuration defines resources for PSCCH/PSSCH transmission that the UE avoids selecting if the corresponding PSFCH occasion overlaps with the LTE SL transmission.”  Moreover, the procedure indicated by Alt. 2, provides appropriate coexistence between the NR and SL UEs, i.e., without detriment on one technology as proposed by Alt.1. In Alt.2, the LTE UEs can detect the slots which contain the PSFCH resources as pre-configured and avoid transmitting in that resources which only occur every 2 or 4 slots. |
| Nokia, NSB | Yes | Option 3 |
| InterDigital | Yes | We support Option 3 and share the view of that the FFS pertaining to Alt 2 is not needed and can be removed. |
| Samsung | Comments | Option 1 has the following drawbacks:   * It could lead to very few resources available for NR transmission (a lot of resource are wasted). * Even if a LTE was determined to be available at the time of transmission of PSSCH/PSCCH, it might become used by the time of PSFCH transmission.   On the other hand with option 2, if the PSFCH is not transmitted due to an LTE transmission in a subframe, the UE receiving the PSFCH assume a NACK even if the transmission has been received. (This is even more problematic with GC option 1, where a missing PSFCH is assumed to be a ACK).  We think that Option 2 is slightly better than option 1, but to minimize the probability of not transmitting PSFCH, the UE can attempt to send a “dummy” PSSCH/PSCCH in the first part of the subframe, with the same power as PSFCH. If this is not possible, drop PSFCH. Therefore, we suggest:  **Option 4: The PSCCH/PSSCH RX UE attempts to find available resources for PSSCH/PSCCH transmission in the same slot as PSFCH and transmits both with the same power (including the gap symbol in between). If no resources are available for PSSCH/PSCCH and PSFCH overlaps with the LTE SL transmission, PSFCH is dropped**  This would minimize the probability of dropping PSFCH.  We also think that in a PSFCH configured slot if UE transmits only PSSCH/PSCCH and not PSFCH, this could have an impact on AGC. That case should also be considered. |
| NEC | No | As “**dynamic resource pool sharing**” means that all the time/frequency domain resources comprised in a resource pool are shared for both LTE and NR sidelink, each slot with PSFCH is overlapped with potential LTE SL transmission in the resource pool. Based on that, option 1 may lead to no PSCCH/PSSCH resource could be selected by NR SL UE, and option 2 may lead to no SL feedback can be transmitted.  Therefore, we prefer to not support PSFCH in a dynamic shared resource pool for LTE and NR sidelink. |
| Lenovo | Comment | We support Option 1 of Alt.1, the option 2 of Alt.2 will cause the dropping of HARQ feedback even for NR transmission with high priority, and it cannot guarantee the reliability of NR SL transmission. |
| Panasonic | Yes | We support option 3 and also fine with the option 4 provided by OPPO. |
| Qualcomm | No | From our analysis, we observe that Alt. 2 reduces the probability that LTE UE-s will select resources that collide with the *periodically repeating NR PSFCH Tx resource set*. This is demonstrated by showing the distribution of the number of LTE transmissions per subframe when Alt. 2 is used at NR versus when it is not.    In the figure above, the arrows mark the location of the PSFCH slots used by NR. When Alt 2 is “off”, every 4th slot contains NR PSFCH resources while when Alt. 2 is “on”, slots 3, 11 and 19 are included in the *basic Tx resource set* and is avoided by the LTE UE-s through RSSI ranking. By using Alt 2, we observe that there are very few LTE Tx on NR PSFCH slots. Without Alt 2, there are many LTE Tx on NR PSFCH slots which increase the probability that at least one LTE reservation is present on a NR PSFCH slot. For this reason, we believe that Alt. 1, both options 1 and 2 or their combination, cannot work on its own. The following problems arise from using Alt. 1:   1. As the chance to receive an LTE reservation on a PSFCH slot is high when Alt 2 is not used, Option 1 of Alt. 1 will lead to over exclusion of resources at the NR SL UE. 2. Further, for Alt. 1 Option 2, as the possibility of NR devices to drop PSFCH feedback is very high, with a high probability feedback will be dropped. This will break the basic operating mechanism of NAK-only Groupcast Option 1 transmissions. Further, Alt. 1 Option 2 will also be detrimental for unicast and Groupcast Option 2 as missing ACK-s will lead to more re-transmissions, and more chance of NR collisions with LTE. This may be especially detrimental for GC Option 2 where even if one UE skips an ACK, a retransmission takes place over the shared pool.   On the other hand, in Alt.2 the collision between PSFCH is avoided before the packet transmission takes place. Thus, Alt. 2, which has been demonstrated in our contribution to work for a wide range of traffic load and system configurations should be considered for PSFCH transmissions in the shared NR SL – LTE SL resource pool. |
| ETRI | Yes |  |
| Transsion | Yes | We are OK with OPPO’s version.  We slightly prefer option 3 and option 4. |
| Spreadtrum | Yes | We are fine with this proposal and suggest to remove the last FFS. |
| CMCC | Yes with comments | We are also supportive of the option 4 added by OPPO, because NR SL UE anyway has the possibility to miss detect the reservation of LTE SL UE, option 4 can avoid this issue even less efficiency will be provided.  Further, we also think the FFS of Alt 2 should be removed. |
| Sony | Comments | We support option1 as this option can avoid the collision completely. And we can compromise on option 2. So, option 3 is the better option and Alt2 could be removed. |
| Xiaomi | Comments | We support the revised version from OPPO. Although we prefer to Alt 1 comparing with Alt 2, as FL has summarized, both alternatives have some problems which are difficult to solve. We are also fine to not support NR PSFCH for dynamic resource pool sharing. |
| ZTE | With comments | The three options of Alt 1 (i.e. Option 1 ,2 and 3) depend on the detection/sensing results of LTE SL transmission, based on which there is no 100% guarantee that NR SL PSFCH transmission and LTE SL transmission do not overlap in time domain. Therefore, we propose to replace “LTE SL transmission” in option 1 and 2 with “the slots in LTE SL resource pool”.  In addition, we also think the FFS of Alt 2 should be removed because it can not work well as described in our contribution. |
| Continental Automotive Technologies GmbH | Yes with comments | We support Alt. 1, with option 1. |
| NTT DOCOMO | Yes | We support Option 1 and Option 3.  Regarding Option 4 mentioned by oppo, we are ok to adopt Option4 as one of the solutions, but it is just constraint of resource pool configuration similar to semi-static cases, so we would prefer to consider the details of Option1-3. |
| Wilus | Yes with comments | We support Option 2 and Option 3. Also, FFS point for Alt 2 should be removed. |
| CATT/GOHIGH | No | Alt 1 is a principle. While the actual methods to achieve alt1 are more than option1 and option 2. For example, periodically configure PSFCH is an effective methods.  BTW, we do not think option 1 is feasible because there is no way to predict if the feedback is colliding with a future LTE UE’s resource occupation |
| Huawei, HiSilicon | Yes,  with comments | We support Alt1 and have several concerns on Alt2.  First of all, Alt2 in the proposal is not very clear, current PSFCH transmission is already periodical, what is new design here in the proposal? As our understanding, it may imply to introduce a set of larger PSFCH periodicities and more PSFCH occasions, but the intention is not clear, it will introduce large SL HARQ feedback delay in NR-V and decrease the system performance of NR SL.  As well explained by QC, Alt2 relies on LTE-V UE to exclude NR-V PSFCH slot based on RSSI ranking, however, it might be infeasible, since following:   * Resources with PSFCH may also be included in the SB after RSSI ranking and selected by LTE-V UE. This is because PSFCH only occupies 2 symbols and the RSSI measurement results of corresponding resource in the same subframe is not always high. So collision will happen between PSFCH and LTE-V transmission. This is also demonstrated by the figure in QC’s reply that there are still a lot LTE-V UEs keep using the resource with PSFCH So, the performance of LTE-V is decreased if Alt2 is implemented. * LTE-V UE cannot recognize the configuration of PSFCH periodicity, so it cannot perform exclusion periodically even it detects a resource with high RSSI. As shown in below, even if a resource, marked as R1, occupied by PSFCH with high RSSI is detected in a Rel-14 LTE-V device’s sensing window. The LTE-V device cannot derive the period of PSFCH (pre-)configured in NR-V’s resource pool. Thus, the periodically corresponding resource, marked as R2, in the selection is not identified as a reserved resource with high RSSI. Then, the LTE-V device will not exclude this resource using current Rel-14 RSSI based resource avoidance.     As the concern from companies that Alt1 will impact the performance of NR-V due to dropping of PSFCH, in Rel-16, similar dropping principle is introduced for PSFCH Tx/Rx collision and meet the UE capability. So we think the impact is similar here, which is acceptable.  Thus, we suggest the following proposal:  **Proposal 1-1:**   * **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).** * **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**   + **Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.**   + **Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.**   + **Option 3: Both Option 1 and Option 2.**   + **FFS details.** * **~~FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).~~** |
| MediaTek | Yes with comment | We prefer removing the last FFS on Alt.2 |
| Fraunhofer | No | We still feel that Alt 2 would be a better way to avoid PSFCH overlaps since it does not involve the TX UE from not selecting PSFCH resources, nor does it require the RX UE to not transmit the PSFCH.  We agree with Qualcomm’s and Ericsson’s analysis on Alt 2. |
| Bosch | Yes, with comments | We prefer Option 1 or Option 3. Option 2, if the TX is not aware about skipping PSFCH, it will always assume NACKs.  Our concern on ALT2, is that, even if PSFCH is periodic (which is already periodic), LTE is not aware about its periodicities and the PSFCH itself is short in time and very vulnerable to detect. |

### Summary of 1st Round of Discussions

Based on the responses from companies, 14 companies support the proposal, 5 do not, while 8 have comments. The following is a summary of their views:

* Support proposal
  + Yes – Vivo, Nokia, InterDigital, Panasonic, ETRI, Transsion, Spreadtrum, CMCC, Conti, DCM, Wilus, HW, MediaTek, Bosch (14)
  + No – Ericsson, NEC, Qualcomm, CATT, Fraunhofer (5)
  + Comments – OPPO, Toyota, Intel, Apple, Samsung, Lenovo, Xiaomi, ZTE (8)
* Support Option 1: TX UE avoids selecting PSFCH resource overlapping with LTE SL transmissions – Lenovo, Sony, Conti, DCM, Bosch (5)
* Support Option 2: RX UE does not transmit on PSFCH resource overlapping with LTE SL transmissions – Wilus (1)
* Support Option 3: Alt 1+Alt 2 – Vivo, Nokia, InterDigital, Panasonic, Transsion, Sony, DCM, Wilus, Bosch (9)
* Include Option 4: PSFCH resources are configured in a TDM manner with LTE V2X resource pool – OPPO, Intel, Apple, Transsion, CMCC, Xiaomi (6)
* Remove FFS on Alt 2 – OPPO, Toyota, Intel, Apple, InterDigital, Spreadtrum, CMCC, Sony, ZTE, Wilus, HW, MediaTek (12)
* Support Alt 2: NR SL UEs use a periodically repeating set of PSFCH slots – Ericsson, Qualcomm, Fraunhofer (3)
* Do not support PSFCH in DRPS – NEC, Xiaomi (2)
* Include Option 5: NR SL UE sends LTE SCI indicating resources reserved by LTE SL transmissions – Toyota (1)
* Include Option 6: RX UE attempts to find available resources for PSSCH/PSCCH transmission in the same slot as PSFCH and transmits both with the same power (including the gap symbol in between). If no resources are available for PSSCH/PSCCH and PSFCH overlaps with the LTE SL transmission, PSFCH is dropped – Samsung (1)
* Replace “LTE SL transmission” in Option 1 and 2 with “slots in LTE SL resource pool” – ZTE (1)
* The (pre-)configuration defines resources for PSCCH/PSSCH transmission that the UE avoids selecting if the corresponding PSFCH occasion overlaps with the LTE SL transmission – Ericsson (1)

Regarding the implementation of Alt 1, majority of the companies, 9 of them, support Option 3, which is for both the PSCCH/PSSCH TX to avoid selecting PSFCH resources, and PSCCH/PSSCH RX UE to not transmit on PSFCH resources, overlapping with LTE SL transmissions. Alternatively, 6 companies support the (pre-)configuration of PSFCH resources in a TDM manner with the LTE V2X resource pool, which is essentially a semi-static solution where resources are not shared between NR SL and LTE SL UEs. To clarify Ericsson’s comment, their intention is to have a pre-configured set of PSFCH resources (S1) where the NR SL does not transmit if these resources overlap with LTE SL transmissions, while another set of pre-configured PSFCH resources (S2) are used for NR SL transmissions. Option 1 and Option 2 had 5 and 1 company supporting them respectively.

Regarding Alt 2, only 3 companies are in favour of this approach, while 12 companies want to remove the FFS entirely. Given such support to remove the FFS, the FL sympathizes with the companies supporting it, but unless they can explain their position and clear the doubts of the companies opposing it, the FFS will have to be removed.

Based on this analysis, the FL has the following proposal to be discussed in the GTW.

### Proposal for GTW Session – Tuesday 11th October

**Proposal 1-1 (I):**

* **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).**
* **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**
  + **~~Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.~~**
  + **~~Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.~~**
  + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSFCH resources, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources, that overlap with LTE SL transmissions (Both Option 1 and Option 2).**
  + **Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.**
  + **FFS details.**
* **~~FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).~~**

### Company Views for 2nd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-1 (I):**

* **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).**
* **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**
  + **~~Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.~~**
  + **~~Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.~~**
  + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSFCH resources, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources, that overlap with LTE SL transmissions (Both Option 1 and Option 2).**
  + **Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.**
  + **FFS details.**
* **~~FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).~~**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| InterDigital | Yes | We prefer Option 3. |
| Apple | Yes | We prefer Option 4. |
| Qualcomm | No | For the FL’s proposed Option 4, this will require existing legacy Type C devices to be re-configured with an updated resource pool. As extensively discussed in the previous meeting this is usually infeasible in practice.  Further, for Alternative 1, which relies on NR excluding resources and/or dropping PSFCH transmissions, we show in our updated contribution (R1-2210397) that such techniques cannot, in general, work (shown in figure below). Fundamentally, both Alt 1 Option 1 and Alt 2 Option 2 suffer from the fact that it is very likely to find a PSFCH slot in a shared pool with at least one LTE V2X transmission. We are not sure how a combination of these two options can overcome such a shortcoming.    On the other hand, Alt. 2 makes sure that NR PSFCH slot is free from LTE transmissions with high probability. Under such condition Alt. 1 options 1 and 2 may be able to provide some further optimization.  Here we would also like to answer some of the question raised by our colleagues on Alt 2:   1. **Periodicity reservation of the PSFCH resources**: The basic resource set containing the PSFCH resource is generated such that the length of the basic set is same or a factor of the LTE reservation period (100 ms). For example, if the basic set is defined over 20 slots, indexed from 0 to 19, with slots 11 and 19 as the basic PSFCH slots, an LTE UE determining a high power in slot n+11 will also be able to exclude slot n + 111, and n+211, etc (with preservation period of 100 ms). Repeating this set of PSFCH slot in time has been shown to make sure that LTE UE-s with a very high probability exclude the NR PSFCH resources. 2. **Guaranteeing exclusion of PSFCH resources:** The analysis in our updated contribution clearly shows that Alt. 2 with a high probability, LTE SL UE-s avoid NR PSFCH slots. On the other hand, using Alt. 1 makes sure that NR UE-s either over-exclude resources or essentially drop all PSFCH transmissions from which the NR performance has no way to recover. |
| CMCC | Yes | If PSFCH resources are (pre-)configured in a TDM manner, option 4 is adopted; otherwise, option 3 should be adopted; both of them can be supported. |
| Lenovo | Yes with comment | We support Option 3 and propose following modification on Option 3:   * + **Option 3: The PSCCH/PSSCH TX UE avoids selecting ~~PSFCH~~ resources with associated PSFCH resources, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources, that overlap with LTE SL transmissions in time domain (Both Option 1 and Option 2).** |
| Wilus | Yes with comment | We prefer Option 3 and share the same view with Lenovo. |
| Panasonic | Yes | We share similar view as CMCC that both option 3 and option 4 could be supported. |
| Spreadtrum | Yes |  |
| OPPO | Yes | We prefer Option 4. |
| Sony | Yes | We prefer option3. |
| Transsion | Yes | We prefer Option 3. |
| vivo | Yes | We prefer Option 3. We want to clarify whether Option 3 means both Option 1 and Option 2 are supported but UE could enable both of them or just one of them.  While in Option 4, when the period of PSFCH is 1, it’s impossible to configure PSFCH in a TDM manner with LTE V2X resource pool, Hence, it’s not a unified solution to address this problem if Option 4 only works in some cases. |
| NEC | No | As mentioned by several companies, the issues introduced by using option 3 cannot be completely avoided. It leads to non-negligible impact on NR UE PSCCH/PSSCH resource selection and HARQ process.  For option 4, as NR SL slots with PSFCH are TDM with LTE resource pool, it means NR resource pool and LTE resource pool are partially overlapped. It may further introduce extra complexity for co-existence study, such as periodic resource reservation misalignment between NR and LTE sidelink, etc. Therefore, the partial overlapping resource pools should not be allowed for co-existence.  In a word, dynamic resource pool sharing should be discussed based on the resource pool is full overlapped for NR and LTE sidelink. |
| ETRI | Yes | We prefer option 3. |
| Samsung | No | Avoiding transmission of PSFCH in sub-frames with LTE SL transmissions can lead to a lot of resource wastage. For example, in a subframe with LTE transmission, if LTE only uses a single sub-channel, the entire sub-frame becomes unavailable for NR to use.  We think that NR should attempt to transmit a “placeholder” PSSCH/PSCCH in available resources in that sub-frame and continue with the PSFCH transmission. Only if the NR UE can’t find resources for PSSCH/PSCCH will it drop PSFCH.  We also think that in a PSFCH configured slot if UE transmits only PSSCH/PSCCH and not PSFCH, this could have an impact on AGC. That case should also be considered. |
| Fraunhofer | No, with comments | Option 1 has the drawback that in the case that an overlap has been detected, the transmission has to be postponed. This would adversely affect the latency and performance of NR SL UEs. Option 2 has the issue that in the case where the RX UE cannot send feedback on an overlapping PSFCH resource, the TX UE expecting the feedback would either assume a NACK (in unicast or GC option 2), causing the TX UE to repeat a transmission that would have been actually successfully decoded by the RX UE, or an ACK (in GC option 1), when in reality, the UE has not been able to receive the TB successfully.  In our opinion, both these options are sub-optimal, and clubbing them together might not resolve the effect on NR UE’s latency and performance. This has been highlighted in the simulation results that have been shared by Qualcomm above. Option 4 makes things worse by semi-statically configuring the PSFCH time slots, mandating an update in the LTE SL resource pools, which was found to be technically possible, but realistically improbable.  On the other hand, Alt 2 has been shown to maintain system performance, while the LTE SL UEs can avoid the resources with PSFCH by RSSI measurements. Details such as how to determine the subset of PSFCH slots to be used can be dynamically (pre-)configured based on the traffic scenario, making Alt 2 quite versatile and future-proof.  Hence, we still prefer to retain Alt 2. |
| NTT DOCOMO | Yes with comment | We prefer Option 3 with Lenovo’s modification. And we are open to adopting Option 4 as one of the solutions. |
| Nokia, NSB | Comments | For Alt1, we prefer Option 3. Option 4, while straightforward, seems at variance with one of the rationales for dynamic sharing (difficult/impossible in practice to update the preconfiguration of already deployed LTE vehicles).  Regarding Alt2, it seems premature to already rule it out. |
| Intel | Yes | We are OK with the proposal and prefer Option 3. |
| MediaTek | Yes | We support the proposal. |
| Ericsson | No | As mentioned in the previous round, we are not supportive of the current proposal containing Alt. 1, which induces several limitations to the existing 5G NR SL operation in terms of reliability and spectral efficiency.  On the other hand, with Alt. 2, by configuring the PSFCH transmissions with a certain periodicity of 2 or 4, the network can facilitate the coexistence between the NR and LTE SL UEs by configuring the NR resource pool so that PSFCH resources are used in a TDM with the LTE V2X transmissions. The efficacy of Alt. 2 is illustrated above by Qualcomm. |
| Xiaomi | Yes | We support the proposal. |
| ZTE,Sanechips | Comments | * + For NR PSFCH (if configured), at least the following alternatives are studied:     - Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.       * FFS: Avoiding PSFCH transmissions can be performed by the UE transmitting PSFCH and/or the UE transmitting PSSCH.     - Alt 2: NR SL UEs use a periodically repeating set of PSFCH slots.       * FFS: periodicities of the set.   We can live with current formulation with some alignment with previous agreement. According to the previous agreement, the wording was to identify and avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions. The current formulation changed that wording into LTE transmissions. However, such modification would risk not identifying not all the LTE SL transmissions. For example, during the preparation time in which the NR module triggers the LTE module to perform sensing and awaits the information from the LTE module, the NR PSFCH feedback which is designed to be transmitted reliably could collide with LTE transmission. Moreover, there could be some inaccurate sensing results due to hidden node or half duplex issues. Thus it's suggested to align the wording with that in previous agreement by saying  We can also add an FFS for the proposed LTE SL transmissions wording   * + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSFCH resources, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources, that overlap with LTE SL ~~transmissions~~ subframes(Both Option 1 and Option 2).**   + **Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.**   + **FFS details.** |
| Toyota | Comments | We support option 3.  Option 4 is not dynamic sharing, but semi-static/static, hence we cannot support this option. |
| Huawei, HiSilicon | Yes,  Support option3 | We agree with option3 of the proposal. But option 4 is unclear to us.  For option4, based on the ETSI ITS specifications (ETSI EN 303 613), all bits of the bitmap for transmit and receive LTE SL resource pools to “1” by default. There is no resource TDMed with LTE V2X resource pool. How the PSFCH resources being (pre-)configured in this case?  For solution Alt2, it is still unclear how Alt2 implemented, especially how LTE-V module find PSFCH transmission slots. Take the same example as QC explained in the reply, considering the basic set is 20 slots. Then, why slots with PSFCH transmission will have higher RSSI measurement results than other slots? Other slots may contain NR SL PSCCH/PSSCH transmission, and thus also have high RSSI measurement. So LTE-V cannot figure out which slots are used for PSFCH transmission only relying on RSSI measurement. Collison between PSFCH and LTE SL transmission would happen.  Furthermore, since overlapping resources are selected, it can be further observed Alt2 would impact LTE SL performance. In QC’s reply, the simulation results in left figure shows that LTE-V has a performance loss comparing with the optimal TDM RP partition when Alt2 is applied.  Thus, we suggest the following proposal:  **Proposal 1-1 (I):**   * **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).** * **For the UE to identify and avoid the overlapping time slots, ~~one of~~ the following option~~s~~ is supported:**   + **~~Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.~~**   + **~~Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.~~**   + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSFCH resources, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources, that overlap with LTE SL transmissions (Both Option 1 and Option 2).**   + **~~Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.~~**   + **FFS details.** * **~~FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).~~** |

### Summary of 2nd Round of Discussions

Based on the responses from companies, 17 companies support the proposal, 5 do not, while 5 have comments. The following is a summary of their views:

* Support proposal
  + Yes – InterDigital, Apple, CMCC, Lenovo, Wilus, Panasonic, Spreadtrum, OPPO, Sony, Transsion, Vivo, ETRI, DCM, Intel, MediaTek, Xiaomi, Huawei (17)
  + No – Qualcomm, NEC, Samsung, Fraunhofer, Ericsson (5)
  + Comments – Lenovo, Wilus, Nokia, ZTE, Toyota (5)
* Support Option 3 – InterDigital, CMCC, Lenovo, Wilus, Panasonic, Sony, Transsion, ETRI, DCM, Nokia, Intel, Toyota, Huawei (13)
* Support Option 4 – Apple, CMCC, Panasonic, OPPO (4)
* Support Alt 2 – Qualcomm, Fraunhofer, Nokia, Ericsson (4)
* Dynamic resource pool sharing is based on fully overlapped NR SL and LTE SL resource pools – NEC (1)
* Consider the case where the NR SL UE transmits only PSCCH/PSSCH and not PSFCH in a time slot configured with PSFCH, which may cause an impact on AGC – Samsung (1)

Responding to Qualcomm’s comments for Alt 2, they seem to have interesting simulation results that show significant gains over any option in Alt 1. Given that there is support from other companies, it is the FL’s view to bring back the FFS, since it would allow other companies to study the solution further and come back with better understanding in the next meeting.

In response to Vivo’s question regarding whether Option 3 means both Option 1 and Option 2 are supported but UE could enable both of them or just one of them, it is the FL’s understanding that the NR SL UE would enable both of them. In this way, the TX UE will ensure that it would avoid selecting resources for PSCCH/PSSCH if its corresponding PSFCH slot is overlapping. Then the RX UE will check for any possible overlaps that may have come about due to a later LTE SL resource reservation and transmission.

To respond to Samsung’s “placeholder” comment, technically Option 3 would cover this. The TX UE would select a resource for its PSCCH/PSSCH ensuring that the corresponding PSFCH resource is not overlapping. After that, when the RX UE has to transmit the feedback, it will continue to transmit the feedback only if it does not detect any overlapping LTE SL transmission.

In response to ZTE’s comment, the FL is unsure on what is intended. The wording of the first main bullet remains exactly the same as what was agreed in the previous meeting. Also, changing “LTE SL transmissions” to “LTE subframes” would imply that the NR SL UE would not transmit on any of the subframes as per the LTE SL resource pool configuration, resulting in Option 4.

The proposal has been updated based on the comment from Lenovo, supported by Wilus and DCM, Option 4 has been removed due to opposition and lack of support, and the FFS on Alt 2 has been brought back. The FL has revised the proposal to reflect the comments of the companies.

### Company Views for 3rd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-1 (II):**

* **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).**
* **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**
  + **~~Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.~~**
  + **~~Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.~~**
  + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSFCH resources, associated with the PSCCH/PSSCH transmission, that overlap with LTE SL transmissions, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources that overlap with LTE SL transmissions in the time domain (Both Option 1 and Option 2).**
  + **~~Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.~~**
  + **FFS details.**
* **FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| Qualcomm | No | We thank the feature lead for taking into consideration our simulation results and bringing back Alt. 2 to the discussion. On the other hand, based on the simulations presented, we do not think that avoiding PSFCH transmissions based on LTE SL reservations (Alt 1) can achieve cochannel coexistence between NR SL and LTE SL when PSFCH is enabled.  In fact, based on Fraunhofer’s comment in the last round on the need to future proof the system design, we propose the following as a possible compromise between the two camps:   * **NR SL UEs use a periodically repeating basic set of PSFCH slots**   + **Within these periodically repeating slots a NR UE may be optionally configured to:**     - **When transmitting PSCCH/PSSCH UE avoid selecting PSFCH resources, associated with the PSCCH/PSSCH transmission, that overlap with LTE SL transmissions,**     - **Or PSCCH/PSSCH RX UE does not transmit on PSFCH resources that overlap with LTE SL transmissions in the time domain.**     - **Or both.**   + **FFS: Periodicity of the basic set of PSFCH slots and the location (in time) of PSFCH slots within the basic set.** |
| Bosch | Comments | First, we think the compromise by Qualcomm is acceptable. The way we understand the compromise is that Alt 1 becomes optionally available at TX UE or RX UE (or also optionally both), while mandating periodically repeating basic set of PSFCH.  Second, we need to confirm deleting Option 4 as it is not achieving any dynamic co-channel coexistence with LTE SL. |
| CMCC | Yes | One clarification is that even in a resource pool configured with PSFCH resource, HARQ-ACK can still be disabled to perform blind retransmission, so we propose to revise the main bullet to address this:  **Proposal 1-1 (II):**   * **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured and when HARQ-ACK is enabled, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).** |
| InterDigital | Yes | We support the proposal |
| Apple | No | According to Qualcomm’s simulation results, Option 3 does not perform well. Hence, we suggest keeping Option 4 within Alt 1.  For Alt 2, it is not guaranteed that SL RSSI measurement-based ranking could always help LTE SL module to identify the slots with PSFCH, since the NR slot with only PSFCH transmission (and without PSSCH transmission) does not always have higher SL RSSI measurement than the slot with PSSCH transmission. Hence, we still do not think the last FFS is needed, but can follow majority view. |
| Lenovo | No | We share the same view as Apple on Alt.2, and support Alt.1. However in legacy sidelink there is no behaviour for the TX UE to select the PSFCH resource, we think that TX UE should select resource for PSCCH/PSSCH transmission considering the associated PSFCH whether overlapping with LTE SL’s reservation or not. So we propose the modification as following   * + **Option 3: The PSCCH/PSSCH TX UE avoids selecting ~~PSFCH~~ resources for~~, associated with the~~ PSCCH/PSSCH transmission with corresponding PSFCH resources~~,~~ that overlap with LTE SL transmissions in the time domain, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources that overlap with LTE SL transmissions in the time domain (Both Option 1 and Option 2).** |
| Wilus | Yes with comments | We support Alt 1 with Option 3.  For Alt 2, we share the same view with Apple. Also, Alt 2 requires large spec changes to PSFCH resource configuration. Moreover, since Alt 2 restricts the candidate resource set of NR SL UE, it is still unclear for performance of NR SL UE when the number of NR Tx increases. Nevertheless, we can accept the proposal for progress. |
| Sharp | Comments | We share the comments from CMCC, and we think disabling HARQ-ACK in SCI is actually one of the options to “**avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions**”. |
| Sony | Yes | We are fine with this proposal. |
| Spreadtrum | Yes |  |
| MediaTek | Yes | We prefer removing the FFS for Alt2, but we can accept the current proposal for progress. |
| OPPO | No | In our view, Option 4 is a straightforward way to address the AGC issue caused by PSFCH of NR SL. Therefore, we share the same view with Apple that Option 4 should be kept in Alt 1.  As for Alt 2, the PSFCH resources are repeated **within the slots of NR SL resource pool** but the RSSI detection is performed **within the subframes that may belong to LTE SL resource pool.** In other words, although both PSFCH resources and RSSI measurements are periodical in time domain, they work periodically in **different level of logical subframe/slots**. Therefore, we don’t understand why RSSI detection is able to detect the PSFCH occasions? |
| vivo | Yes |  |
| Panasonic | Yes |  |
| NEC | No | Alt 1 inevitably leads to a limitation of available resources for NR UE.  We prefer to not configure PSFCH resource within the dynamic sharing resource pool. |
| ETRI | Yes |  |
| Continental Automotive Technologies GmbH | Yes |  |
| Intel | No | We share same view with Apple and OPPO, and also suggest keeping Option 4 as possible solution under Alt.1, and remove the last FFS. |
| Huawei, HiSilicon | Yes with removing FFS | We still have some concerns on Alt2, and the feasibility of Alt2 is unclear.   * How LTE-V module find PSFCH transmission slots is not clear. We provided an example in our previous reply, which the PSSCH/PSCCH slots corresponding to PSFCH can also have higher RSSI measurement results within a basic set and transmitted periodically. How LTE-V module tells which slots belonging to PSFCH transmission? * Alt2 has impact on LTE-V performance. Since LTE-V module cannot distinguished the PSFCH slots based on RSSI measurement. LTE-V could select resources overlapping with PSFCH transmissions, then the LTE-V performance is impacted.   Based on above analysis, we think the FFS should be deleted.  For the wording of option 3, we think some optimization is needed. We think option 3 are saying the candidate resources of PSSCH/PSCCH which corresponding PSFCH overlap with LTE SL transmission in time will not selected. Thus, we suggest the following proposal (changes in purple):  **Proposal 1-1 (II):**   * **For dynamic resource pool sharing, in NR SL resource pools with PSFCH configured, the NR SL UE avoids PSFCH transmissions in time slots that overlap with subframes used for LTE SL transmissions (Alt 1).** * **For the UE to identify and avoid the overlapping time slots, one of the following options is supported:**   + **~~Option 1: The PSCCH/PSSCH TX UE avoids selecting resources where the corresponding PSFCH occasion overlaps with the LTE SL transmission.~~**   + **~~Option 2: The PSCCH/PSSCH RX UE does not transmit feedback on the PSFCH occasion that overlaps with the LTE SL transmission.~~**   + **Option 3: The PSCCH/PSSCH TX UE avoids selecting PSSCH/PSSCH ~~PSFCH~~ resources, associated with the ~~PSCCH/PSSCH~~ PSFCH transmission~~,~~ that overlap with LTE SL transmissions, and the PSCCH/PSSCH RX UE does not transmit on PSFCH resources that overlap with LTE SL transmissions in the time domain (Both Option 1 and Option 2).**   + **~~Option 4: PSFCH resources are (pre-)configured in a TDM manner with LTE V2X resource pool.~~**   + **FFS details.** * **~~FFS: NR SL UEs use a periodically repeating set of PSFCH slots (Alt 2).~~** |
| Samsung | No | When UE transmitting the PSSCH/PSCCH excludes slots based on LTE subframes that overlap with PSFCH, this degrades performance and significantly reduces efficiency.  The UE transmitting PSFCH should check if there is an LTE transmission in the slot and if there is attempts to select resources for PSSCH/PSCCH in the same slot to avoid AGC issue. Only if it can’t find resources for PSSCH/PSCCH would it drop PSFCH.  We also think that in a PSFCH configured slot if UE transmits only PSSCH/PSCCH and not PSFCH, this could have an impact on AGC. That case should also be considered. |

### Summary of 3rd Round of Discussions

TBD

## [*ACTIVE*] Issue 1-2: DRPS – Details of LTE Sensing Information Shared by LTE SL Module

### Summary of Company Views from TDocs

In the previous meeting, details of the LTE sensing information that is to be shared by the LTE SL module to the NR SL module were discussed, culminating with the following proposal that was fairly stable:

|  |
| --- |
| Proposal 2-4b (II):   * For co-channel coexistence in Rel-18, for the study of dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:   + LTE sensing results may include     - Time and frequency locations of ~~reserved~~ LTE transmissions     - Resource reservation periods     - SL RSRP and/or SL RSSI measurement results     - Priority   + Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE.   + ~~FFS other parameters including (but not limited to):~~     - ~~Resource reservation periods~~     - ~~SL RSRP and/or SL RSSI measurement results~~   + FFS details. |

In the case of Type A devices, the LTE SL module that is co-located with the NR SL module shares LTE sensing information to the NR SL module so that it can take it into account during its resource (re)selection procedures.

Based on a summary of the contributions in this meeting, the following is a list of parameters that companies had indicated their support for:

* Time and frequency location of reserved resources by other LTE Ues, determined based on decoded SCIs (10) – [1], [3], [7], [9], [12], [14], [19], [22], [26], [27]
* SL RSRP/RSSI measurement results (9) – [3], [7], [8], [9], [12], [14], [19], [26], [27]
* Resource reservation periods (8) – [3], [8], [9], [12], [14], [19], [21], [26]
* Information on non-monitored subframes (6) – [1], [3], [8], [9], [12], [26]
* Priority (5) – [3], [8], [12], [19], [26]
* Time and frequency location of resources used for own LTE SL transmissions (4) – [8], [21] (initial and retransmissions), [22] (scheduling assignment), [24]
* Time gap between initial transmission and retransmission – [21], [26]
* Candidate resource set (SB) – [2]
* Retransmission index – [26]
* Up to UE implementation – [6]

According to the previous meeting’s near-stable proposal and the contributions from this meeting, the FL has proposed a list of parameters that are commonly agreeable to the companies, along with a list of FFS parameters.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Observation 6: The in-device coexistence framework can be used for co-channel coexistence but with expected resource use efficiency degradation for both LTE and NR.  Observation 7: Enhancements to in-device coexistence information exchange, will have to be enabled with no changes to LTE specifications, i.e. an inter-module interface is left for implementation.  Observation 8: The NR module inside the SL Type A device has to be based on Rel-18 as NR SL specification changes would be needed.  Proposal 6: The LTE module can provide at least to the NR module:  • Its own resource selections;  • Information on non-monitored subframes;  • LTE sensing results. |
| Huawei, HiSilicon | Proposal 2: For resource allocation at NR-V module in Rel-18 co-channel co-existence via dynamic resource sharing,  • In-device LTE-V module shares LTE-V candidate resource set to NR-V module.  • NR-V module obtains NR-V candidate resource set as per legacy NR-V design.  • When NR SL BWP is configured with SCS higher than 15 kHz,   * NR-V module updates the LTE-V candidate resource set by excluding resources overlapping in time with LTE-V’s reservation.   • NR-V module MAC layer takes intersection between LTE-V candidate resource set and NR-V candidate resource set to obtain a final candidate resource set.  • NR-V module MAC layer selects resource from the final candidate resource set as per legacy design. |
| Spreadtrum | Proposal 7: LTE SL module could share the sensing and resource reservation information to NR SL module via the interface, including the time and frequency locations of LTE transmissions, the priority of LTE transmission, RSRP and/or RSSI measurement results, resource reservation periods, and half duplex subframe(s) of LTE module, etc. |
| Panasonic | Proposal 7: As no spec change allowed for LTE, how the LTE SL module shares the information to the NR SL module, exact information shared, timeline etc., would be up to UE implementation. |
| OPPO | Proposal 2: At least one of the following should be included in the information shared from LTE module to NR module:  • SCI monitored by LTE module or reserved resources determined based on the SCI monitored by LTE module  • SL RSRP measurement result  Proposal 3: If LTE module forwards its received SCI to NR module directly, the configuration used to determine the logical subframes of LTE SL need to be shared to NR module as well. |
| CATT, GOHIGH | Proposal 7: LTE SL module could share the half-duplex subframes which are not monitored by the LTE SL module and the sensing/resource reservation information to NR SL module via the interface. The sensing and resource reservation information includes at least the following parameters:  • Priority  • Time and frequency locations of LTE transmissions of the LTE SL module sensed and used for LTE SL transmission of LTE SL module itself  • Resource reservation periods  • RSRP and/or RSSI measurement value  Proposal 8: Resource reservation periods allowed by LTE SL in the shared resource pool and resource reservation periods allowed by NR SL in the shared resource pool are both taken into account for the NR SL module to exclude the skipped slot related to the half-duplex subframes which are not monitored by the LTE SL module. |
| Intel | Proposal 2:  • For co-channel co-existence in Rel.18, in a type A device the information shared by the LTE SL module to the NR SL module contains at least the following parameters:  o Time and frequency locations of reserved LTE transmissions  o Resource reservation periods  o SL RSRP and/or SL RSSI measurement results  o Half-duplex subframes which are not monitored by the LTE SL UE. |
| Transsion | Proposal 5: For co-channel coexistence in Rel-18, for the study of dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:   LTE sensing results include   Time and frequency locations of LTE transmissions   Resource reservation periods   SL RSRP and/or SL RSSI measurement results   Priority   Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE. |
| ETRI | Proposal 3: It is proposed to study the following aspects to pass sensing results from LTE SL module to NR SL module:   Passed sensing results from LTE SL module to NR SL module considering different SCSs   Timeline between when the sensing results are shared and those are used |
| LG | Proposal 2: For the dynamic resource pool sharing, the information of LTE SL sensing results shared by LTE SL module to NR SL module contains at least the followings:   Time and frequency locations of reserved LTE SL transmissions   Resource reservation periods   SL RSRP measurement results   Priority values |
| Apple | Proposal 6: In dynamic resource pool sharing for co-channel coexistence, type A device’s LTE sidelink module at least shares the following information to NR sidelink module:  • Time of reserved LTE sidelink resources  • Frequency of reserved LTE sidelink resources  • Periodicity of reserved LTE sidelink resources |
| Mitsubishi | Proposal 4: For co-channel coexistence on overlapped resource pools, study the feasibility and benefits of at least the following solutions:  - Resource allocation modifications to NR Rel.17 procedure in order to take into account the LTE reservation in overlapping resources  - Solutions for enabling NR with PSFCH enabled to coexist with LTE  - Solutions for coexistence and cross-RAT interpretation of sidelink synchronization signals |
| InterDigital | Proposal 3: LTE SL module indicates resource reservation information of UE’s own LTE transmission and reception. |
| Samsung | Proposal 5: Further study content and timing of information from LTE SL module to NR SL module.  Proposal 6: Further study the use of the sensing and resource reservation information shared by the LTE SL module to NR SL module for:  - Resource exclusion for its NR SL transmission  - Scheme 1 inter-UE co-ordination  - Scheme 2 inter-UE co-ordination |
| Sharp | Proposal 4: For co-channel coexistence in Rel-18, for the study of dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:   LTE sensing results may include:  • Time and frequency locations of reserved LTE transmissions  • Resource reservation periods  • SL RSRP and/or SL RSSI measurement results  • Priority  • Retransmission index  • Time gap between initial transmission and retransmission   Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE. |
| NTT DOCOMO | Proposal 6: For device type A in dynamic resource sharing, when information sharing is triggered at subframe n,  o LTE-SL module shares all reservation information with RSRP/PPPP and all half-duplex slots within a window [n−10×Pstep, n−1] to NR-SL module. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-2:**

* **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:**
  + **Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs**
  + **SL RSRP measurement results**
  + **Resource reservation periods**
  + **Priority**
  + **FFS:**
    - **Time and frequency location of resources used for own LTE SL transmissions**
    - **Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE**
    - **SL RSSI measurements**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes with comments | According to TS36.213, the set of subframes that may belong to a PSSCH resource pool for sidelink transmission mode 3 or 4 is denoted by . When UE determines the reserved/indicated resources in mode 4, all of calculations are performed within the set of logical subframes, i.e., . In order to achieve the resources reserved by other LTE Ues, the parameters associated with  should be shared to NR module as well. Therefore, we suggest to add another FFS for this point:   * + **FFS:**     - **Time and frequency location of resources used for own LTE SL transmissions**     - **Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE**     - **SL RSSI measurements**     - **Parameters associated with** . |
| Toyota | Yes |  |
| Intel | Yes |  |
| vivo | Yes |  |
| Apple | Yes |  |
| Ericsson | See comments | We are in general fine with the intention of the proposal. We would like to clarify if this exchange of parameters is going to be specified for Type A devices. |
| Nokia, NSB | Yes |  |
| InterDigital | Yes |  |
| Samsung |  | Fine in principle |
| NEC | Yes |  |
| Lenovo | Yes |  |
| Panasonic | Yes |  |
| Qualcomm | Comments | We propose to remove the FFS sharing the resources that the LTE SL module determines for its own transmissions. This is a very critical piece of information for the NR SL module as without this the NR (or LTE) transmissions will have to be dropped due to half-duplex conflict on the collocated device. Moreover, the exchange of Tx resources is already a part of the R16 in-device coexistence mechanism.  Hence, we propose the following modification to the FL’s proposal:  **Proposal 1-2:**   * **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:**   + **Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs**   + **SL RSRP measurement results**   + **Resource reservation periods**   + **Priority** * **Time and frequency location of resources used for own LTE SL transmissions**   + **FFS:**     - **~~Time and frequency location of resources used for own LTE SL transmissions~~**     - **Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE**     - **SL RSSI measurements** |
| ETRI | Yes |  |
| Transsion | Yes |  |
| Spreadtrum | Yes |  |
| CMCC | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| ZTE | With comments | The specific information contents will affect NR resource exclusion procedure, therefore, it is necessary to specify the information list. But we think that it is better to firstly discuss from a higher perspective, e.g., the proposed information is about “non-preferred set”, however, LTE SL sensing only generates candidate resource set instead of “non-preferred set”, which will lead to spec.change for LTE SL. Thus, we prefer to consider the candidate resource set, i.e. “Set A” from LTE SL module can be directly reported to NR SL module. |
| Continental Automotive Technologies GmbH | Yes |  |
| NTT DOCOMO | Yes with comments | We wonder why “resources corresponding to LTE half-duplex” is in FFS part, considering the number of companies in favour and previous meeting’s near-stable proposal.  We prefer that “**Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE**” is treated the same as “Priority”, “Resource reservation period” and so on. |
| CATT/GOHIGH | Yes |  |
| Huawei, HiSilicon | No | We don’t agree the current proposal.  The performance of LTE-V system should not be impact when co-existing with NR-V. This is the basic principle to have the design on coexistence between NR-V and LTE-V. More specifically, NR-V module should only use these resources in S\_B determined by its LTE-V module. Otherwise, the LTE-V system performance will be impacted.  The proposal implies NR-V should perform LTE-V spec and determine candidate resources based on shared measurement results in NR-V. However, only relying on proposed parameters are not enough to have same S\_B as determined by LTE-V side. For example, if only RSRP measurements results are transported, how to determine the candidate resource without RSRP threshold? How many times NR-V module should increase the RSRP level to have exact candidate resource? Without considering all aspects comprehensively, NR-V module would select resources out of the S\_B, which means that the NR-V module select a resource outside the available resources of LTE-V module. Thus, system performance of LTE-V will be degraded.  Further, requiring NR-V UE derive the candidate resource set by performing LTE-V spec which is too complicated and bring large amount of spec workload.  Therefore, we think the simplest way is LTE-V shares the candidate resource set S\_B to NR-V, which avoid additional impact on LTE-V system performance, and, we suggest the following proposal:  **Proposal 1-2:**   * **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains candidate resource set SB specified in TS 36.213 Section 14.1.1.6. ~~at least the following parameters:~~**   + **~~Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs~~**   + **~~SL RSRP measurement results~~**   + **~~Resource reservation periods~~**   + **~~Priority~~**   + **~~FFS:~~**      - **~~Time and frequency location of resources used for own LTE SL transmissions~~**     - **~~Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE~~**     - **~~SL RSSI measurements~~** |
| Fraunhofer | Yes |  |
| Bosch | Comment | We are fine if the proposal’s sub-bullets are all for FFS. First of all, it is not clear if we will specify what to be exchanged or we leave all (some) to implementation. Additionally, we need to study if the NR module (at least Type A) is going to include LTE specs for resource exclusion. |

### Summary of 1st Round of Discussions

Based on the responses from companies, 22 companies support the proposal, 5 have comments, while only 1 company does not support it. The following is a summary of their views:

* Support proposal
  + Yes – OPPO, Toyota, Intel, Vivo, Apple, Ericsson, Nokia, InterDigital, Samsung, NEC, Lenovo, Panasonic, ETRI, Transsion, Spreadtrum, CMCC, Sony, Xiaomi, Conti, DCM, CATT, Fraunhofer (22)
  + No – Huawei (1)
  + Comments – OPPO, Ericsson, Qualcomm, ZTE, Bosch (5)

Regarding the first 2 sub-bullets in the FFS, the reason they were moved in the FFS was because companies in their contributions had stated that this information was already provided to the NR SL module by the LTE SL module according to Rel-16 in-device coexistence. Since companies seem to have differing views, the FL has been added them to the main list of parameters.

### Proposal for GTW Session – Tuesday 11th October

**Proposal 1-2 (I):**

* **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module contains at least the following parameters:**
  + **Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs**
  + **SL RSRP measurement results**
  + **Resource reservation periods**
  + **Priority**
  + **Time and frequency location of resources used for own LTE SL transmissions**
  + **Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE**
  + **FFS:**
    - **~~Time and frequency location of resources used for own LTE SL transmissions~~**
    - **~~Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE~~**
    - **SL RSSI measurements**
    - **Candidate resource set SA or SB**

### Summary of GTW Session – Tuesday 11th October

The following agreements were made:

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| --- |
| **Agreement**  For dynamic resource pool sharing, the candidate information shared by the LTE SL module to the NR SL module may include one or more of the following parameters, to be down-selected:   * Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs * SL RSRP measurement results * Resource reservation periods based on decoded SCI and for own LTE SL transmissions * Priority based on decoded SCI and for own LTE SL transmissions * Time and frequency location of resources used for own LTE SL transmissions * Candidate resource set SA or SB * SL RSSI measurements * LTE logical subframe related information * Resources corresponding to half-duplex subframes which are not monitored by the LTE SL UE   **Agreement**  For dynamic resource pool sharing, the NR SL module uses the information shared by the LTE SL module to the NR SL module to determine the set of resources for its own transmission.   * FFS: which layer carries out the resource determination: PHY layer or MAC layer. |

Based on the discussions in the GTW, we have agreed on a broad list of parameters that can be shared by the LTE SL module to the NR SL module. There seems to be two different schools of thought on how the NR SL module can use these parameters.

One option would be for the LTE SL module to provide a set of parameters that the NR SL module would use to identify resources that are being used or reserved to be used by LTE SL transmissions. It would then exclude these resources from its own candidate resource set when performing the resource (re)selection procedure for its own transmissions in the PHY layer.

The second option is for the LTE SL module to provide a candidate resource set, either SA or SB. For the LTE SL module to generate this candidate resource set, it would need information such as the priority of the intended transmission, the selection window, etc., from the NR SL module. The NR SL module can then trigger the LTE SL module to provide it with the required candidate resource set. Once the NR SL module receives this resource set, it can perform an intersection operation to select resources for its own transmissions in the MAC layer.

According to the above understanding, the FL suggests identifying the option with the most consensus in order to move forward.

### Company Views for 2nd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-2 (II):**

* **For dynamic resource pool sharing, the NR SL module uses** **the information shared by the LTE SL module to the NR SL module using one of the following alternatives:**
  + **Alt 1: The LTE SL module provides the NR SL module with the candidate information shared by the LTE SL module (excluding the candidate resource sets SA or SB)**
    - **The NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module.**
    - **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**
    - **The exclusion process is performed in the PHY layer.**
  + **Alt 2: The LTE SL module provides the NR SL module with the candidate resource sets SA or SB shared by the LTE SL module**
    - **The NR SL module provides information, such as the resource selection window and transmission priority of the intended NR SL transmission, to the LTE SL module for generating the candidate resource sets.**
    - **The NR SL module performs an intersection operation with the candidate resource set received from the LTE SL module and the candidate resource set generated by the NR SL module.**
    - **The intersection operation is performed in the MAC layer.**
    - **FFS:**
      * **Details of the information provided by the NR SL module to the LTE SL module.**
      * **How/when the NR SL module triggers the LTE SL module to share the candidate resource sets SA or SB.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of alternatives)** |
| InterDigital | No with comments | Alt 1 doesn’t look quite clear to us. From our perspective, for Alt 1, LTE SL module also needs information related to resource selection window and subchannel size of the intended NR SL transmission to provide relevant information for NR SL module. Thus, it performs the same sensing procedure to acquire the information for both Alt 1 and Alt 2. Thus, we think the same FFS indicated in Alt 2 should apply to Alt 1 as well.   * **For dynamic resource pool sharing, the NR SL module uses** **the information shared by the LTE SL module to the NR SL module using one of the following alternatives:**   + **Alt 1: The LTE SL module provides the NR SL module with the candidate information shared by the LTE SL module (excluding the candidate resource sets SA or SB)**     - **The NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module.**     - **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**     - **The exclusion process is performed in the PHY layer.**     - **FFS:**       * **Details of the information provided by the NR SL module to the LTE SL module.**       * **How/when the NR SL module triggers the LTE SL module.** |
| Apple | No | We support Alt 1 in principle, and are not convinced that Alt 2 could work.  As commented by some company in the GTW session, for LTE SL module to perform resource selection, the Tx data periodicity (P\_{rsvp\_TX}) needs to be used. However, a periodicity supported by NR SL resource pool configuration is likely not supported in LTE SL resource pool configuration.  For Alt 1, since we have not agreed the exact parameters shared from LTE SL module to NR SL module, it is pre-mature to mention them in the alternative. Hence, we propose to modify the first sub-bullet of Alt 1:  **The NR SL module identifies a set of resources based onshared information from LTE SL module ~~that are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module~~.** |
| Qualcomm | Alt 1 with edits | We do not agree with Alternative 2 in principle, as we think that the burden of determining the candidate resource set should not be on the LTE SL module implying LTE specification change.  On the other hand, resource exclusion based on LTE SL reservation cannot lead to a proper balancing on NR and LTE performance in the shared resource pool as shown in our updated contribution (R1-2210397). Also, we are not sure how the sharing of unmonitored slots may benefit in the context of cochannel coexistence. More analysis and studies need to be performed on this.  For the sake of progress, we can accept Alt 1 with the following re-wordings (Alt 1(a)).   * **Alt 1(a): The LTE SL module provides the NR SL module with the candidate information ~~shared by the LTE SL module~~ (excluding the candidate resource sets SA or SB)**   + **~~The NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions,~~ ~~as well as resources that have not been monitored by the LTE SL module~~.**   + **The NR SL module identifies the set of resources that may not be used for its own SL transmissions *based on* the resources that are being used and reserved to be used by LTE SL transmissions along with other sensing results if available.**   + **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**   + **The exclusion process is performed in the PHY layer.** |
| CMCC | Yes | We support Alt 1.  And more clarification is, in Alt 1, LTE module may not also need to do a resource exclusion procedure, it may only provide the resource information and related parameters. |
| Lenovo | Yes |  |
| Wilus | Yes with comment | We do not support Alt 2. Since NR SL supports more values of Tx packet periodicity (i.e., resource reservation period) than that of LTE SL, Alt 2 may not work well. In other words, there is a possibility that LTE SL module excludes inappropriate resources if Alt 2 is applied. Therefore, we support Alt 1. |
| Panasonic | Yes | We prefer Alt. 1 and some further details/clarifications might be needed on the procedures. |
| Spreadtrum | Yes with comments | We prefer Alt 1. Regarding Alt 2, from our understanding, it seems that NR will send the relevant information of NR TB to LTE module when resource (re-)selection triggered and the information will be used by LTE module for determining S\_A/S\_B. If so, whether the timeline discussed in Sec 3.4 can be fulfilled? |
| OPPO | Comments | Our preference is Alt1. And the description of “resources that being used” and “resources that have not been monitored by the LTE SL module” in Alt 1 is not accurate, so we suggest to use Apple’s version.  For Alt 2, it requires the change for LTE spec including both physical layer and higher layer in our view. For example, the resource selection window is determined based on UE implementation with a specified range in current LTE spec but it is indicated by NR module in Alt 2. The similar change of spec may be needed in higher layers on how to achieve the value of priority. Therefore, we do not support Alt 2. |
| Sony | Yes | We support Alt1. Alt2 will impact the LTE specification. |
| Transsion | Yes | We support Alt 1. |
| Vivo | Yes |  |
| NEC | Yes | Alt 1 is preferred. |
| ETRI | Yes | We support Alt 1. |
| Samsung |  | We prefer Alt1, with some changes. We can remove ~~“~~**~~(excluding the candidate resource sets S~~~~A~~ ~~or S~~~~B~~~~)~~**”  We think that NR module should get information about time and frequency resources, RSRP (for decoded SCIs), priority and periodicity of decoded SCIs as well as UE’s own LTE transmission. The details of how this information is transferred is left to the UE’s implementation. |
| Fraunhofer | Yes | We support Alt 1. In our understanding, Alt 1 does not need inputs from the NR SL module since it would simply provide the NR SL module with sensing information that is available to the LTE SL module at a given point in time. |
| NTT DOCOMO | Yes with comments | We support Alt 1 with Qualcomm’s modification and don’t support Alt2 due to LTE spec impact. |
| Nokia, NSB | Yes with comments | Support Alt.1 in principle, but the wording needs to be improved regarding non-monitored slots – the point is not to exclude the resource which have not been monitored, but rather to exclude resources that might have been reserved with a periodic reservation that would have been missed. The proposal doesn’t need to spell out details, just to state that the LTE resource exclusion principle would be reused regarding non-monitored slots.  We oppose Alt.2. As discussed during the GTW session, there are problems e.g. with the resource reservation interval assumed when LTE determines set S\_A. |
| Intel | Yes with comments | We support Alt 1 and prefer QC’s edits. |
| MediaTek | Comment | In our view, the main difference between Alt1 and Alt2 is at which layer the exclusion/intersection operation is performed. We suggest simplifying the proposal by removing sub-bullet points under each alternative. For example:  **Proposal 1-2 (II):**   * **For dynamic resource pool sharing, the NR SL module uses** **the information shared by the LTE SL module to the NR SL module using one of the following alternatives:**   + **Alt 1: The LTE SL module provides the NR SL module with the candidate information ~~shared by the LTE SL module~~ (excluding the candidate resource sets SA or SB)**     - **~~The NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module.~~**     - **~~The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.~~**     - **NR SL module performs ~~The~~ exclusion process ~~is performed~~ in the PHY layer.**     - **FFS details of the exclusion process**   + **Alt 2: The LTE SL module provides the NR SL module with the candidate resource sets SA or SB ~~shared by the LTE SL module~~**     - **~~The NR SL module provides information, such as the resource selection window and transmission priority of the intended NR SL transmission, to the LTE SL module for generating the candidate resource sets.~~**     - **~~The NR SL module performs an intersection operation with the candidate resource set received from the LTE SL module and the candidate resource set generated by the NR SL module.~~**     - **NR SL module performs ~~The~~ intersection operation ~~is performed~~ in the MAC layer.**     - **FFS details of the intersection operation**     - **~~FFS:~~**       * **~~Details of the information provided by the NR SL module to the LTE SL module.~~**       * **~~How/when the NR SL module triggers the LTE SL module to share the candidate resource sets S~~~~A~~ ~~or S~~~~B~~~~.~~** |
| Ericsson | Comments | We prefer Alt. 1. As there is no agreement on all other parameters, it would be good to mention as **“(excluding at least the candidate resource sets SA or SB)”** in Alt. 1. |
| Xiaomi | Yes with comment | We support Alt 1 and do not support Alt 2. We suggest to clarify that we will later downselect one between the two alternatives. |
| ZTE, Sanechips | Yes with comments | Note that the logic of Alt 1 is to share the resource set occupied by LTE SL, however, the legacy LTE SL does not support reporting such a set (just to report the candidate resource sets SA or SB), therefore, Alt 1 will lead to spec.change for LTE SL which seemingly contradics the previous agreement is “For co-channel coexistence in Rel-18, no changes in the LTE SL specifications are allowed”.  Alt 2 is supported |
| Toyota | Yes with comments | We prefer Alt1. Alt2 may require LTE SL changes. |
| Huawei, HiSilicon | Yes, with comments | We support Alt2 in the proposal.  It should be clarified that Alt2 does not require changes on the LTE-V spec. The information for LTE-V PHY layer to generate candidate resource set S\_A or S\_B is provided by its higher layer, but not triggered by NR-V module in PHY. For Type A device, information for resource set generation could be exchanged in higher layer between NR-V module and LTE-V module, and how to exchange this information can be up to UE implementation.  For Alt1, we think there would be some issues on feasibility.  First of all, Alt1 seems requiring LTE-V module to transfer information to NR-V module continuously in time (i.e., always do so in every subframe), such as time and frequency locations of reserved resources, RSRP measurement etc., which is a big challenge for UE implementation.  Secondly, how to identify the resources ‘being used and reserved to be used by LTE SL transmissions’ is unclear. Does it mean NR-V module needs to perform the procedure specified in 36.213 clause 14.1.1.6? Both RSRP threshold used and times to increase RSRP level to meet 20% requirement are not clear, how NR-V module identify such resources.  Additionally, if NR-V module selects many resources out of the available resources of the LTE-V, the performance of LTE-V will be impacted.  Thus, we suggest the following proposal:  **Proposal 1-2 (II):**   * **For dynamic resource pool sharing, the NR SL module uses** **the information shared by the LTE SL module to the NR SL module using one of the following alternatives:**   + **Alt 1: The LTE SL module provides the NR SL module with the candidate information shared by the LTE SL module (excluding the candidate resource sets SA or SB)**     - **The NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module.**     - **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**     - **The exclusion process is performed in the PHY layer.**     - **FFS:**       * **when LTE-V module provides candidate information to NR-V module and the corresponding feasibility, e.g., in every subframe, or based on trigger, etc.**       * **How the NR SL module identifies resources that are being used and reserved to be used by LTE SL transmissions.**   + **Alt 2: The LTE SL module provides the NR SL module with the candidate resource sets SA or SB shared by the LTE SL module**     - **~~The NR SL module provides information, such as the resource selection window and transmission priority of the intended NR SL transmission, to the LTE SL module for generating the candidate resource sets.~~**     - **LTE SL module is provided information to generate a candidate resource set S\_A or S\_B from higher layer based on UE implementation. The resource set S\_A or S\_B is shared to NR SL module.**     - **The NR SL module performs an intersection operation with the candidate resource set received from the LTE SL module and the candidate resource set generated by the NR SL module.**     - **The intersection operation is performed in the MAC layer.**     - **~~FFS:~~**       * **~~Details of the information provided by the NR SL module to the LTE SL module.~~**       * **~~How/when the NR SL module triggers the LTE SL module to share the candidate resource sets S~~~~A~~ ~~or S~~~~B~~~~.~~** |

### Summary of 2nd Round of Discussions

Based on the responses from companies, 18 companies support the proposal, 2 do not, while 12 have comments. The following is a summary of their views:

* Support proposal
  + Yes – CMCC, Lenovo, Wilus, Panasonic, Spreadtrum, Sony, Transsion, Vivo, NEC, ETRI, Fraunhofer, DCM, Nokia, Intel, Xiaomi, ZTE, Toyota, Huawei (18)
  + No – InterDigital, Apple (2)
  + Comments – InterDigital, Wilus, Spreadtrum, OPPO, DCM, Nokia, Intel, MediaTek, Ericsson, Xiaomi, ZTE, Toyota (12)
* Support Alt 1 –Apple, Qualcomm, CMCC, Wilus, Panasonic, Spreadtrum, OPPO, Sony, Transsion, NEC, ETRI, Samsung, Fraunhofer, DCM, Nokia, Intel, Ericsson, Xiaomi (18)
* Support Alt 2 – ZTE, Huawei (2)
  + Do not support Alt 2 – Apple, Qualcomm, Wilus, Spreadtrum, Sony, DCM, Nokia, Xiaomi, Toyota (9)
* Add FFSs in Alt 1 as well – InterDigital, Huawei (2)
* Text update from Apple – OPPO (1)
* Text update from Qualcomm – DCM, Intel (2)

For Alt 1, based on the text changes from Apple and Qualcomm, and the companies supporting them, it is clear that the wording for the first sub-sub-bullet has to be revised to reflect that the set of resources identified by the NR SL UE module, using the information from the LTE SL module, may not be used for its own transmissions. The FL has made the required changes, hopefully to take these comments into account. The revised wording would remove the need for the FFS suggested by Huawei.

For Alt 2, in response to ZTE’s comment, the LTE SL module uses the same interface used for the Rel-16 in-device coexistence framework to send information to the NR SL module. Since this is handled internally within the module, no specification change is expected. This has been clarified by Huawei, one of the proponents of Alt 2. However, only 2 companies support Alt 2, while 9 companies are against it. Hence Alt 2 has been moved to FFS for the revised proposal, giving companies more time to study Alt 2.

### Company Views for 3rd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-2 (II):**

* **For dynamic resource pool sharing, the NR SL module uses** **the candidate information shared by the LTE SL module to the NR SL module using ~~one of~~ the following alternative~~s~~:**
  + **Alt 1: The LTE SL module provides the NR SL module with the candidate information ~~shared by the LTE SL module~~ (excluding at least the candidate resource sets SA or SB)**
    - **The NR SL module identifies a set of resources that are avoided for its own transmissions, based on information shared by the LTE SL module ~~are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module~~.**
    - **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**
    - **The exclusion process is performed in the PHY layer.**
  + **FFS: Alt 2: The LTE SL module provides the NR SL module with the candidate resource sets SA or SB shared by the LTE SL module**
    - **~~The NR SL module provides information, such as the resource selection window and transmission priority of the intended NR SL transmission, to the LTE SL module for generating the candidate resource sets.~~**
    - **The LTE SL module is provided information from the higher layer to generate a candidate resource set SA or SB based on UE implementation. The resource set SA or SB is then shared to NR SL module.**
    - **The NR SL module performs an intersection operation with the candidate resource set received from the LTE SL module and the candidate resource set generated by the NR SL module.**
    - **The intersection operation is performed in the MAC layer.**
    - **~~FFS:~~**
      * **~~Details of the information provided by the NR SL module to the LTE SL module.~~**
      * **~~How/when the NR SL module triggers the LTE SL module to share the candidate resource sets S~~~~A~~ ~~or S~~~~B~~~~.~~**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| Qualcomm | Yes with comments | We agree with the FL’s revised version of Alt. 1.  Given the issue of specification and implementation impact on LTE for Alt 2, we prefer to remove it unless further system analysis is presented showing a clear benefit compared to Alt 1. |
| Bosch | Yes, with comments | We agree with the current proposal supporting Alt 1. We propose to remove the word “alternative” from **module using ~~one of~~ the following ~~alternatives~~:**.  For the FFS we prefer deleting “**from the higher layer**” and replace it with FFS details. In our understanding, “**from the higher layer**” mandates specification impacts and cannot be left to UE implementation. Or this at least needs further discussions. |
| CMCC | Yes |  |
| InterDigital | Yes with comments | We are okay with the proposal.  For Alt 1, the agreed sharing information of “Time and frequency locations of reserved resources by other LTE Ues, determined based on decoded SCIs” will be used in the exclusion. As the sub-frame boundary alignment is achieved by UE implementation (per R16 V2X), the NR SL module is able to determine the overlapping in time domain. Similarly, in frequency domain, an alignment should be considered, given LTE and NR SL resource pools frequency resource configuration may not match, e.g., with different number of RBs per sub-channel. |
| Apple | Yes | Although we are not convinced of the feasibility of Alt 2 based on the argument in last round, we are fine to keep it as FFS for further study. |
| Lenovo | Yes |  |
| Wilus | Yes |  |
| Sharp | Yes |  |
| Sony | Yes | We are fine with this proposal |
| Spreadtrum | Yes |  |
| MediaTek | Comment | With the explanation that Alt.2 does not require LTE specification change, we now think that both alternatives can be supported. Then, UE implementation can choose to support either one of the alternatives. This seems to be more inclusive approach. |
| OPPO | Yes with comments | We still have concern with the first sub-sub-bullet. It is redundant/overlapped for “a set of resources that are avoided for its own transmissions” in the first sub-sub-bullet and “excludes these identified resources” in the second sub-sub-bullet. If UE excludes the identified resources, of course these identified resources are avoided by NR module for transmission. Similarly, if NR module has determined some resources that are avoided for its own transmission, the resource exclusion may not be needed. Therefore, we propose to delete “are avoided for its own transmissions” in the first sub-sub-bullet. |
| Vivo | Yes |  |
| Panasonic | Yes |  |
| NEC | Yes | Alt 1 is preferred. |
| ETRI | Yes |  |
| Continental Automotive Technologies GmbH | Yes |  |
| Intel | Yes |  |
| Huawei, HiSilicon | No | We do not agree to put the Alt2 in FFS. Both options should be supported and make a down-selection in the next meeting.  Alt2 has no LTE-V specification impact. As we explained in the previous reply, all information for candidate resource set generation are provided by LTE-V module high layer, and how to exchange information between LTE-V module and NR-V module in high layer is UE implementation. This point is already aware by companies and they can support Alt2.  In addition, in our contribution R1-2208450 section 4, the simulation results have verified Alt2 can work well and will not bring performance impact on LTE-V. Thus, we believe Alt2 should be supported.    Although how Alt1 works is explained by FL, it is still not clear how UE identify which resources shall be avoided. Does it require NR-V module to perform a resource exclusion as specified in LTE-V? When LTE-V module share the information to NR-V module, e.g. based on trigger or in real-time? Thus, more details should be clarified and FFSs are needed.  **Proposal 1-2 (II):**   * **For dynamic resource pool sharing, the NR SL module uses** **the candidate information shared by the LTE SL module to the NR SL module using ~~one of~~ the following alternative~~s~~:**   + **Alt 1: The LTE SL module provides the NR SL module with the candidate information ~~shared by the LTE SL module~~ (excluding at least the candidate resource sets SA or SB)**     - **The NR SL module identifies a set of resources that are avoided for its own transmissions, based on information shared by the LTE SL module ~~are being used and reserved to be used by LTE SL transmissions, as well as resources that have not been monitored by the LTE SL module~~.**     - **The NR SL module excludes these identified resources from its own candidate resource set when performing the resource (re)selection procedure.**     - **The exclusion process is performed in the PHY layer.**     - **FFS:**       * **How the NR SL module identifies resources that are avoided for its own transmissions.**       * **When LTE-V module provides candidate information to NR-V module and the corresponding feasibility, e.g., in every subframe, or based on trigger, etc.**   + **~~FFS:~~ Alt 2: The LTE SL module provides the NR SL module with the candidate resource sets SA or SB shared by the LTE SL module**     - **~~The NR SL module provides information, such as the resource selection window and transmission priority of the intended NR SL transmission, to the LTE SL module for generating the candidate resource sets.~~**     - **The LTE SL module is provided information from the higher layer to generate a candidate resource set SA or SB based on UE implementation. The resource set SA or SB is then shared to NR SL module.**     - **The NR SL module performs an intersection operation with the candidate resource set received from the LTE SL module and the candidate resource set generated by the NR SL module.**     - **The intersection operation is performed in the MAC layer.**     - **~~FFS:~~**       * **~~Details of the information provided by the NR SL module to the LTE SL module.~~**       * **~~How/when the NR SL module triggers the LTE SL module to share the candidate resource sets S~~~~A~~ ~~or S~~~~B~~~~.~~** |
| Samsung | Yes | We prefer to remove Alt2. |

### Summary of 3rd Round of Discussions

TBD

## [*CLOSED*] Issue 1-3: DRPS – Use of LTE Sensing Information

### Summary of Company Views from TDocs

In the previous meeting, details of how the NR SL module would use the LTE sensing information was discussed, resulting in the following proposal that was fairly stable:

|  |
| --- |
| Proposal 2-4a (II):   * For co-channel coexistence in Rel-18, for the study of dynamic resource pool sharing, the NR SL module in type A devices ~~supports the use of~~ uses the LTE SL sensing and resource reservation information to exclude resources ~~reserved by LTE SL UEs~~ from the set of available resources in its own resource selection procedures.   + FFS details of resource exclusion by NR SL module. |

The discussion was around how the NR SL module would exclude the resources, indicated by the LTE sensing information, that are being used for LTE SL transmissions.

Based on a review of the contributions in this meeting, there was some discussion on whether the PHY or MAC layer is responsible for the resource exclusion process. The following is a summary of the views by different companies on how the NR SL module should use the LTE sensing information.

* PHY layer performs exclusion operation of overlapping LTE reserved resources – [3], [6], [7], [18], [21], [27]
* MAC layer performs intersection operation between candidate resource set of NR and LTE modules, similar to IUC design - [2], [10], [16], [18]
* Exclusion using priority and RSRP threshold - [1], [12], [25], [26],
* Based on the LTE SL candidate resource set SB, exclude subframes where the number of LTE SL candidate resources in the subframe is less than the maximum number of candidate resources – [2]
* Excludes overlapping resources reserved by LTE V2X - [24]
* Uses LTE occupancy metric and basic NR TX resource set (set of periodic PSFCH time slots) – [28]

In the FL’s view, it is better to first understand what kind of operation the NR SL module is expected to perform before deciding on which layer actually performs this action. To this regard, the FL has used the proposal from the previous meeting to achieve a way forward before deciding on the layers.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Proposal 8: A Type A device will consider the LTE reservations similarly as it considers NR reservations, when doing resource exclusion in terms of priority and RSRP threshold. NR will only exclude the overlapped candidate resources. To avoid the AGC issue, the NR module will have to consider the entire slot as non-preferred, if the slot is not starting at the same time as the LTE subframe. |
| Huawei, HiSilicon | Proposal 3: Regarding how to determine whether there is LTE-V’s reservation on a subframe based on LTE-V candidate resource set,  • If the number of LTE-V candidate resource in this subframe is less than the maximum number of candidate resources, it is assumed that this subframe has LTE-V reservation;  • Otherwise, this subframe has no LTE-V reservation. |
| Spreadtrum | Proposal 6: NR SL module can exclude the reserved resource(s) of LTE sidelink in its resource (re-)selection after Step 5a) of Rel-16 TS 38.214 Section 8.1.4  - It can be up to the NR SL module’s implementation whether perform the above procedure of resource exclusion if the candidate resource(s) in S\_A after excluding the reserved resource(s) of LTE sidelink is smaller than X \* M\_total. |
| Panasonic | Proposal 6: Assuming all LTE PHY layer sensing information are transparent to NR module, then the information would be treated same as NR sensing, i.e., non-proper resources from LTE sensing (by priority, SCI, etc.) are excluded to each X%. |
| OPPO | Proposal 4: The sensing and resource reservation information shared by LTE module is used in physical layer of NR module as part of resource exclusion process.  Proposal 5: NR module ought to use the shared sensing and resource reservation information from LTE module for initial selection, re-evaluation and pre-emption checking.  Proposal 6: NR module performs resource exclusion based on the SL grant determined by LTE module to address the in-device coexistence issue in the same frequency channel. |
| Intel | Proposal 4:  • When considering co-channel dynamic resource partitioning between LTE SL and NR SL, at the least the following should be further studied:  o Impact and enhancements to the NR SL sensing and resource selection procedure   RAN1 should study the impact of enhancing the NR SL sensing and resource selection procedure by utilizing all or some of the information retrieved from the LTE module.  o Impact and enhancements to the Rel.17 inter-UE coordination schemes   RAN1 should study the impact of enhancing the Rel.17 inter-UE coordination schemes with the aim to enhance co-existence between LTE SL and NR SL by utilizing all of some of the information retrieved from the LTE module. |
| Transsion | Proposal 4: For co-channel coexistence in Rel-18, for dynamic resource pool sharing, the NR SL module in type A devices use the LTE SL sensing and resource reservation information to exclude resources from the set of available resources in its own resource selection procedures. |
| Fraunhofer | Proposal 5: For dynamic resource pool sharing, the NR SL module can exclude resources being used by LTE V2X transmissions either in Step 5 of the resource selection procedure, or by higher layers. |
| Apple | Proposal 7: In dynamic resource pool sharing for co-channel coexistence, type A device’s NR sidelink module physical layer excludes in its resource selection, candidate single-slot resource(s) obtained after Step 6) of TS 38.214 Section 8.1.4 overlapping with the resources indicated by LTE sidelink module.  • Consider the case of partial overlap between LTE sidelink sub-channel and NR sidelink sub-channel |
| InterDigital | Proposal 4: Study exclusion of overlapping resources (between LTE and NR SL resource pools) in a NR resource selection based on LTE SL sensing result, e.g. Set A. |
| Samsung | Proposal 6: Further study the use of the sensing and resource reservation information shared by the LTE SL module to NR SL module for:  - Resource exclusion for its NR SL transmission  - Scheme 1 inter-UE co-ordination  - Scheme 2 inter-UE co-ordination |
| Sharp | Proposal 5: For co-channel coexistence in Rel-18, for the study of dynamic resource pool sharing, the NR SL module in type A devices uses the LTE SL sensing and resource reservation information to exclude resources from the set of available resources in its own resource selection procedures.   NR SL module excludes the resources overlapping with the reserved resources derived from the shared information by LTE SL module based on RSRP comparison and excludes the resources corresponding to subframes which are not monitored by LTE SL module. |
| NTT DOCOMO | Proposal 7: For device type A in dynamic resource sharing,  o NR-SL module performs resource exclusion as in step 5 and as in step 6 based on information shared from LTE-SL module. |
| Qualcomm | Proposal 5: The NR SL UE-s determine the set of available transmission (Tx) resources for NR SL transmissions based on the estimated LTE channel occupancy metric and the (pre)-configured basic NR Tx resource set.  Observation 2: The proposed dynamic resource sharing between NR SL and LTE SL will not require any change to current LTE specifications  Proposal 6: The NR SL UE, based on the estimation of SL LTE resource pool occupancy metric periodically updates the set of available Tx resources by adding resources to, or removing resources from the current set of available transmission resources for NR SL. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-3:**

* **For dynamic resource pool sharing, the NR SL module uses the LTE SL sensing and resource reservation information to exclude resources from the set of available resources in its own resource selection procedure.**
  + **FFS: which layer carries out the resource exclusion - PHY layer or MAC layer**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | Yes with comments | In mode 4 of LTE SL and mode 2 of NR SL as well as the procedure of IUC, the behaviour of resource exclusion is performed by physical layer rather than mac layer. Hence, we think the FFS ought to be removed. |
| Toyota | Yes with comments | In addition to performing resource exclusion based on the LTE SL sensing and resource reservation information, the NR SL module/UE may send the LTE SCI (for the LTE module to take into account NR SL resource reservation in a backwards compatible way). |
| Intel | Comments | We are generally OK with the proposal, but we are unclear about the FFS, and have similar comments as OPPO. |
| vivo | Yes with clarification | Is the ‘LTE SL sensing and resource reservation information’ referring to the list in Proposal 1-2? If this is the intention, perhaps the terminology can be aligned between the two proposals.  **For dynamic resource pool sharing, the NR SL module uses ~~the LTE SL sensing and resource reservation~~ information shared by the LTE SL module to exclude resources from the set of available resources in its own resource selection procedure.** |
| Apple | Yes with comments | We share the similar view as OPPO and Intel. The resource exclusion is performed at physical layer. |
| Ericsson | Yes |  |
| Nokia, NSB | Yes with comments | Resource exclusion should be handled in the PHY layer |
| InterDigital | Yes | We agree with Apple/OPPO/Intel on exclusion is performed by PHY layer and thus no need to include the FFS. |
| Samsung | Yes with comments | Agree with Oppo to remove FFS |
| NEC | Yes | Resource exclusion should be performed in PHY. |
| Lenovo | Yes with comment | We also support that the resource exclusion is performed by PHY layer |
| Panasonic | Yes | We share similar views as above companies that to confirm PHY as the performing layer and also to remove the FFS. |
| Qualcomm | Comment | In our opinion, this should be considered after we reach some agreement on **Proposal 1-1.** |
| ETRI | Yes with comment | Agree with other companies to remove FFS |
| Transsion | Yes | Resource exclusion should be handled at PHY layer |
| Spreadtrum | Yes | If the contents of LTE sensing and reservation resource information are as the listed parameters in current Proposal 1-2, these contents should be used in PHY. |
| CMCC | Yes with comments | Resource exclusion should be done in PHY layer, and MAC layer only performs the random selection within the candidate resource subset reported by PHY layer. |
| Sony | Yes | The resource exclusion is performed by physical layer |
| Xiaomi | Yes with comment | We support the resource exclusion is done in NR PHY layer. |
| ZTE | With comments | We think that issue 1-3 is related to issue 1-2 as our comments about proposal 1-2, i.e., non-preferred set should be done in PHY layer, preferred set should be done in MAC layer. |
| Continental Automotive Technologies GmbH | Yes |  |
| NTT DOCOMO | Yes with comments | We agree with the exclusion performed by PHY layer. |
| CATT/GOHIGH | Yes |  |
| Huawei, HiSilicon | Yes,  with comments | We have similar concern as Vivo, and support to have corresponding changes.  Furthermore, we think the wording “resource exclusion” is not clear. When S\_B is delivered in NR-V module, UE could have an intersection with its candidate resource set derived from NR-V, and to select a final resource. This shares some similarities in terms of handling sensing results in Rel-17 IUC, where a UE has sensing results of its own and from a coordinating UE (UE-A), and thus we can reuse such “intersection” operation performed in MAC layer in Rel-17 IUC framework on handling of sensing results from two modules in Rel-18.  Thus, we suggest change the following proposal:  **Proposal 1-3:**   * **For dynamic resource pool sharing, the NR SL module uses ~~the LTE SL sensing and resource reservation~~ information shared by the LTE SL module to update ~~exclude resources from~~ the set of available resources in its own resource selection procedure.**   + **FFS: which layer carries out the update ~~resource exclusion~~ - PHY layer or MAC layer** |
| Fraunhofer | Yes | We agree that the exclusion process takes place in the PHY layer. |
| Bosch | Yes, comments | Similar to OPPO comment, we would like to delete MAC layer. We also would like to delete **~~the LTE SL sensing and resource reservation~~** until we agree which information to share. |

### Summary of 1st Round of Discussions

Based on the responses from companies, 22 companies support the proposal, while 2 companies feel that it is dependent on previous proposals. The following is a summary of their views:

* Support proposal
  + Yes – OPPO, Toyota, Intel, Vivo, Ericsson, Nokia, Samsung, NEC, Lenovo, Panasonic, ETRI, Transsion, Spreadtrum, CMCC, Sony, Xiaomi, Conti, DCM, CATT, Huawei, Fraunhofer, Bosch (22)
* Resource exclusion is performed at the PHY layer – OPPO, Intel, Apple, Nokia, InterDigital, Samsung, NEC, Lenovo, Panasonic, ETRI, Transsion, Spreadtrum, CMCC, Sony, Xiaomi, DCM, Fraunhofer, Bosch (18)
* Dependent on previous proposals – Qualcomm, ZTE (2)

Based on the comments from companies, the text in the main bullet has been changed to match the previous proposal. 18 companies also feel that the exclusion process should take place in the PHY layer, and the FFS can be removed. This has also been reflected in the revised proposal.

### Proposal for GTW Session – Tuesday 11th October

**Proposal 1-3 (I):**

* **For dynamic resource pool sharing, the NR SL module uses the ~~LTE SL sensing and resource reservation~~ information shared by the LTE SL module to the NR SL module to exclude resources from the set of available resources in its own resource selection procedure.**
  + **~~FFS: which layer carries out the~~ Resource exclusion is performed in the PHY layer ~~or MAC layer~~.**

## [*ACTIVE*] Issue 1-4: DRPS – Timeline of LTE Sensing Information Shared by LTE SL Module

### Summary of Company Views from TDocs

In RAN1#109-e, when device type A was agreed, there was an FFS on the timeline regarding when the LTE sensing information would be shared to the NR SL module. This is regarding the processing time involved in compiling and transmitting the LTE sensing information by the LTE SL module until the NR SL module receives it, prior to its resource (re)selection, re-evaluation and pre-emption checking procedures.

According to the contributions that were submitted this meeting, the following is a snapshot of the different company views.

* Timing aspect of LTE module providing sensing information to NR module has to be studied/discussed – [17], [23], [24], [25], [27], [29]
  + Up to UE implementation – [6], [9]
  + (Pre-)configured max. time between SCI decoding/RSSI measurement at LTE module and reception at NR module - [1]
  + Reuse Rel-16 timeline, where LTE V2X information is provided to the NR module in advance of T ms, where T≤4 - [2]
  + LTE sensing information is provided before resource (re)selection by NR module - [8]
  + X ms prior to NR resource selection trigger - [21]
  + LTE-SL module shares all reservation information with RSRP/PPPP and all half-duplex slots within a window [n−10×Pstep, n−1] – [27]

Based on the company views, the FL has proposed that the NR SL module has to receive the LTE sensing information at a time T prior to the start of the NR SL resource (re)selection, re-evaluation and pre-emption checking procedures.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Proposal 7: For the sake of evaluation of Type A devices for co-channel coexistence, RAN1 will make an assumption on the maximum time between the LTE SL sub-frame where the SCI decoding or RSSI/RSRP measurement takes place until the associated LTE SL sensing information is available at the NR SL module. |
| Huawei, HiSilicon | Proposal 4: For Rel-18 co-channel co-existence via dynamic resource sharing,  • Rel-16 NR-V timeline for in-device coexistence is reused, i.e., information from LTE-V are delivered to in-device NR-V module in advance of T ms, where T≤4 and is based on UE implementation. |
| ETRI | Proposal 3: It is proposed to study the following aspects to pass sensing results from LTE SL module to NR SL module:   Passed sensing results from LTE SL module to NR SL module considering different SCSs   Timeline between when the sensing results are shared and those are used |
| Apple | Proposal 5: In dynamic resource pool sharing for co-channel coexistence, type A device’s NR sidelink module is not expected to use the information shared by LTE sidelink module if it is within X ms before the resource selection trigger at the NR sidelink module. |
| Toyota | Observation 9: For Type A devices, the NR SL timing requirements may not be valid anymore due to delays from the LTE SL module to the NR SL module.  Proposal 6: RAN1 to study the impact of information sharing delay between the LTE SL module and NR SL module in Type A devices (e.g., impact on NR SL timing requirements/latency for resource (re-)selection). (Note: This is to cope with a vehicle layout where the LTE SL module and NR SL module may be part of two different hardware modules, possibly located at different parts of the vehicle.) |
| InterDigital | Proposal 7: Study the latency aspect of the information exchange over the interface between NR SL and LTE SL module within a UE. |
| NTT DOCOMO | Proposal 6: For device type A in dynamic resource sharing, when information sharing is triggered at subframe n,  o LTE-SL module shares all reservation information with RSRP/PPPP and all half-duplex slots within a window [n−10×Pstep, n−1] to NR-SL module. |
| Bosch | Observation 4: Once the amount of inter-module shared information dropped or not timely present for resource allocation, the performance of dynamic co-channel coexistence is affected  Proposal 4: Study possible mechanisms to avoid performance degradation due to delayed inter-module communication |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-4:**

* **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module is provided at least a time T prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.**
* **T is defined using one of the following options:**
  + **Option 1: T is (pre-)configured.**
    - **FFS: Value of T.**
  + **Option 2: T≤4 ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**
  + **Option 3: Up to UE implementation.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| OPPO | Yes with comments | In both initial selection and re-evaluation/pre-emption checking, higher layer would trigger physical layer to report the candidate resource set in slot n. Therefore, it is better to use slot n as a reference point and modify the first bullet as below:   * **For dynamic resource pool sharing, the information shared by the LTE SL module to the NR SL module is provided at least a time T prior to the triggering of reporting for candidate resource set. ~~NR SL resource (re)selection, resource re-evaluation and pre-emption checking.~~** |
| Toyota | Yes |  |
| Intel | Yes | We are OK with OPPO’s edits and prefer Option 3. |
| vivo | Yes with comments | The first bullet of the proposal seems to force LTE module always to share information at n-T. It is more appropriate to specify a timeline for the use of the shared information than to constrain the time providing the information. Hence, we propose to revise the proposal as:  **Proposal 1-4:**   * **For dynamic resource pool sharing, NR SL module can use the information shared by the LTE SL module to the NR SL module that is provided at least a time T prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.** * **T is defined using one of the following options:**   + **Option 1: T is (pre-)configured.**     - **FFS: Value of T.**   + **Option 2: T≤4 ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**   **Option 3: Up to UE implementation.** |
| Apple | Yes with comments | We think NR SL module is not required to use the information shared by LTE SL module if it is received within T prior to the triggering of NR SL resource (re)selection. Hence, we have the following modification   * **For dynamic resource pool sharing, NR SL module is not required to use the information shared by the LTE SL module to the NR SL module if it is provided within ~~at least~~ a time T prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.**   We need to further discuss the value of T, and prefer not to be restricted to any options for now. |
| Ericsson | See comment | In our view, we should rephrase the proposal. The proposal should be written from the NR SL module, i.e., the modulo receiving the information.  **Proposal 1-4:**   * **For dynamic resource pool sharing, the UE is expected to use any information shared by the LTE SL module ~~the information shared by the LTE SL module to the NR SL module is provided~~ arriving at least a time T prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.**   Additionally, we propose to reuse as much as possible the framework for in-device coexistence (as also indicated by WID), and we are supportive of Option 2.   * **T is defined using ~~one of the following options~~:**   + **~~Option 1: T is (pre-)configured.~~**     - **~~FFS: Value of T.~~**   + **Option 2: T≤4 ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**   + **~~Option 3: Up to UE implementation.~~** |
| Nokia, NSB | Yes with comments | Prefer rephrasing, e.g. Ericsson’s version.  Prefer Option 2; specific value (4 ms in current proposal) could be FFS for now |
| InterDigital | No with comments | In order for us to understand such a timing constraint, we’d like to have a clarification regarding when/how the LTE SL module is triggered to collect such information to share with NR SL module and how this information can be relevant to NR SL resource selection.  Note in the proposal this period of time is relative to NR SL resource selection triggering, therefore we can deduct the LTE SL module has no priori information regarding whether NR SL has a TB to transmit and what PDB/priority this TB has. As a result, the sensing information the LTE SL module can share may be specific to a LTE SL TB (its RSW/priority/sub-channel) transmitted earlier.  Thus, we are wondering whether/how much such information can apply to the NR SL resource selection considering the NR SL TB’s RSW/priority/sub-channel can be different from those of the LTE SL TB triggering the LTE SL sensing. For example, the information regarding **Time and frequency locations of reserved resources by other LTE UEs, determined based on decoded SCIs** as listed in Q 3.2.2. may not apply if the LTE SL RSW doesn’t overlap with NR SL RSW. |
| Samsung |  | Fine in principle. |
| NEC | Yes | Option 3 is preferred. |
| Lenovo | Yes |  |
| Panasonic | Yes |  |
| Qualcomm | No | We do not agree with the first bullet. There need not be a relationship between the LTE SL module reporting reservation information and resource selection procedures on the NR SL module. In fact, the NR SL module should perform resource (re)selection, revaluation and pre-emption based on the LTE SL information available at a given time T prior to triggering of reselection, etc.  Further, more analysis is needed to determine the impact of T on the procedure. Hence, we propose an FFS in the value of T for now.  We propose the following re-wording of the FL’s proposal:   * **For dynamic resource pool sharing, ~~the information shared by the LTE SL module to~~ the NR SL module ~~is provided at least a time T prior to the triggering of~~ performs NR SL resource (re)selection, resource re-evaluation and pre-emption checking using the information shared by the LTE SL module at least a time T prior to the triggering of the (re)selection procedure.** * **FFS: value of T.** * **~~T is defined using one of the following options:~~**   + **~~Option 1: T is (pre-)configured.~~**     - **~~FFS: Value of T.~~**   + **~~Option 2: T≤4 ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.~~**   + **~~Option 3: Up to UE implementation~~.** |
| ETRI | Yes | We are fine with the proposal. |
| Transsion | Yes | Prefer Ericsson’s version. |
| Spreadtrum | Yes with comments | We are fine with the modified version from Ericsson. |
| CMCC | Yes with comments | We agree OPPO’s modification proposal to use slot n as a reference point;  We also think Vivo or Apple’s version is better since it should be clarified that the limitation is on the timeline for NR SL module to take into account the reported reservation information, other than when the LTE module should report the information. |
| Sony | Yes with comments | We prefer Vivo and Ericsson’s view that this proposal should specify the resource using timeline form NR SL module. And we prefer option 2. |
| Xiaomi | Comment | We want to clarify companies understanding on whether partial sensing is considered for dynamic resource pool sharing. If partial sensing is considered, the LTE sensing results after triggering of resource (re)selection can still be useful. |
| ZTE | Yes with comments | The need to discuss this issue is valid, but for co-channel or in-device coexistence, the processing of LTE SL sending and transmission is not obviously different. It is recommended to support option2. |
| Continental Automotive Technologies GmbH | Yes with comments | We also preffer Ericsson’s version. |
| NTT DOCOMO | Yes with comments | We support Option 1 or Option 2 with vivo’s modification version to clarify whether this proposal is related to rules for using LTE information or rules for providing it. |
| CATT/GOHIGH | No | The sharing is in-device and this processing time can be decided by implementation therefore we do not see the need to specify this aspect |
| Huawei, HiSilicon | Yes,  with comments | A simple way is reuse Rel-16 in-device coexistence design. In Rel-16, information from LTE-V are delivered to in-device NR-V module in advance of T ms, where T≤4 and is based on UE implementation. The same timeline, i.e. option 2 can be reused in Rel-18 and no further modification is necessary.  However, it seems how to exchange the information is the internal implementation of UE. So, no explicit timing can be also acceptable.  Therefore, we think both option 2 and 3 can work, maybe concludes it as UE implementation for saving times. |
| MediaTek |  | Option-3 is preferred |
| Fraunhofer | Yes | We prefer to leave the timing up to UE implementation, either within a (pre-)configured time T. Hence Option 2 or Option 3 is fine. |
| Bosch | Yes | Supporting Option 2 only |

### Summary of 1st Round of Discussions

Based on the responses from companies, 21 companies support the proposal, while 3 companies does not support it. The following is a summary of their views:

* Support proposal
  + Yes – OPPO, Toyota, Intel, Vivo, Apple, Nokia, Samsung, NEC, Lenovo, Panasonic, ETRI, Transsion, Spreadtrum, CMCC, Sony, ZTE, Conti, DCM, Huawei, Fraunhofer, Bosch (21)
  + No – InterDigital, Qualcomm, CATT (3)
  + Comments – OPPO, Vivo, Apple, Ericsson, Nokia, InterDigital, Spreadtrum, CMCC, Sony, Xiaomi, Conti, DCM, Huawei (13)
  + Option 1: DCM (1)
  + Option 2: Ericsson, Nokia, Sony, ZTE, DCM, Huawei, Fraunhofer, Bosch (8)
  + Option 3: Intel, NEC, CATT, Huawei, MediaTek, Fraunhofer (6)
* No restrictions on the value of T: Apple, Qualcomm (2)
* Change by OPPO: “prior to the triggering of reporting for candidate resource set. ~~NR SL resource (re)selection, resource re-evaluation and pre-emption checking.~~” – OPPO, Intel, CMCC (3)
* Change by Vivo: “NR SL module can use the information …” – Vivo, CMCC, Sony, DCM (4)
* Change by Apple: “NR SL module is not required to use the information …” – Apple, CMCC (2)
* Change by Ericsson: “the UE is expected to use any information shared by the LTE SL module ~~the information shared by the LTE SL module to the NR SL module is provided~~ arriving at least …” – Ericsson, Nokia, Transsion, Spreadtrum, Sony, Conti (6)
* Change by Qualcomm: “For dynamic resource pool sharing, ~~the information shared by the LTE SL module to~~ the NR SL module ~~is provided at least a time T prior to the triggering of~~ performs NR SL resource (re)selection, resource re-evaluation and pre-emption checking using the information shared by the LTE SL module at least a time T prior to the triggering of the (re)selection procedure.” – Qualcomm (1)

According to the comments made by companies, many feel that the wording of the proposal seems to make it mandatory for the UE to use the shared information from the LTE SL module. This was not the intention of the proposal, the intention was for the NR SL UE to receive the shared information at least T ms prior to the NR SL resource (re)selection procedure. Accordingly, as recommended by the comments from Vivo, Apple, Ericsson and Qualcomm, the proposal has been updated accordingly.

Based on the suggestions by the companies, the FL has proposed a revision below.

### Proposal for GTW Session – Tuesday 11th October

**Proposal 1-4 (I):**

* **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.**
* **T is defined using one of the following options:**
  + **Option 1: T is (pre-)configured.**
    - **FFS: Value of T.**
  + **Option 2: [T≤4] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**
  + **Option 3: Up to UE implementation.**

### Company Views for 2nd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-4 (I):**

* **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T ms prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.**
* **T is defined using one of the following options:**
  + **Option 1: T is (pre-)configured.**
    - **FFS: Value of T.**
  + **Option 2: [T≤4] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**
  + **Option 3: Up to UE implementation.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| InterDigital | No | Need clarification how this is related to Alt 2 in Proposal 1-2. Does this mean that information (RSW, priority) provided by NR SL module to LTE SL module should be sent before the resource selection trigger and the NR SL module should receive setA/setB before a time T prior to the resource selection trigger? |
| Apple | Yes | We are fine with Option 2 to specify an upper bound on T. |
| Qualcomm | Comment | Proposal 1-4 is dependent on the outcome of Proposal 1-3 as this assumes that the NR SL UE is performing resource selection/re-evaluation/pre-emption directly based on the shared LTE SL resource reservation information.  Based on the following agreement made during the GTW session:  Agreement:   * For dynamic resource pool sharing, the NR SL module uses the information shared by the LTE SL module to the NR SL module to determine the set of resources for its own transmission.   + FFS: which layer carries out the resource determination: PHY layer or MAC layer.   We propose the following rewording (in blue) of the current proposal:   * **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T ms prior to determine the set of resources for its own transmissions.** * **FFS: Details and value of T** |
| CMCC | Yes | Both option 2 and option 3 are fine to us. |
| Lenovo | Yes | We prefer Option 2 and Option 3 |
| Wilus | Yes | Option 2 is preferred. At least upper bound should be specified. |
| Panasonic | Yes | We are fine with either option 1 and 2 to have a specific value or boundary. |
| Spreadtrum | Yes | Prefer Option 2. |
| OPPO | Yes with comments | As we commented in round 1, current spec doesn’t capture the timing of the triggering for NR SL resource (re)selection, resource re-evaluation and pre-emption checking. It only captures the slot n in which higher layer triggers physical layer to determine and report the candidate resource set. Hence, it is better to use slot n as a reference point.   * **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T ms prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking (i.e., slot n).** |
| Sony | Yes | We prefer option2 |
| Transsion | Yes | We prefer option 2 and option 3. |
| vivo | Yes | We prefer Option 3. As the shared information and UE capability maybe different, it’s better to leave the definition of T up to UE implementation. |
| NEC | Yes | Option 3 is preferred. |
| ETRI | Yes | We prefer option 1 and option 2. |
| Samsung | Comment | We think that there are three important times for sharing information from LTE SL module to NR SL module.   * T1: The end of the LTE sensing window * T2: The time information is shared from NR to LTE * T3: Slot “n” at which NR SL is triggered for resource (re)selection   We think that this proposal covers the time between T2 and T3. There is also the time between T1 and T2, which is important. Alternatively, we can consider the total time from the end of the LTE sensing window to slot n. |
| Fraunhofer | Yes | We prefer Option 2 or 3. |
| NTT DOCOMO | Yes with comment | We prefer option 1 and option 2 to define specific value or upper bound. And we’d like to study the condition/timing of sharing LTE information (in Issue 1-6: DRPS – Others). We believe it’s important to evaluate/determine the alternatives in Issue 1-2 and the exact parameters of LTE sharing information. |
| Nokia, NSB | Yes with comments | Prefer Qualcomm’s rephrasing.  Regarding timeline, there are two aspects in our view:   1. The aspect covered in the proposal – expectation/requirement on NR side behaviour 2. Requirement or assumption on the total delay from the subframe in which an LTE SCI is transmitted to the information becoming available at the NR module.   The proposal addresses aspect a; aspect b, however, although addressed by some of the proposal cited earlier in the section is missing so far. |
| Intel | Yes | We are OK with the proposal and can accept either option 2 or 3, with slight preference for option 3. |
| MediaTek | Yes | We prefer Option 3. |
| Ericsson | Yes | As mentioned in the previous round (and as also indicated by WID), we prefer to reuse as much as possible the in-device coexistence framework. We prefer option 2. |
| Xiaomi | Yes with comment | We can accept the proposal. |
| ZTE,Sanechips | Yes | We tend to support Option 2. |
| Toyota | Yes | We prefer option 1 and Option 2. Option 3 would lead to the use of obsolete information. |
| Huawei, HiSilicon | Yes,  with comments | The wording “at least” is not clear. “At least a time Tms prior to the trigger” means the information (e.g. candidate resource set S\_A or S\_B) can be shared at any time before T. If the information is delivered too early, it might be outdated and cannot be used for NR-V module. For example, T is equal to 4 and assuming resource selection is triggered at slot n, so based on current proposal, information could be delivered at any time before slot n-4, such as slot n-100, which could be outdated when NR-V perform resource selection in slot n. Therefore, we suggest to delete the wording “at least” in main bullet.  **Proposal 1-4 (I):**   * **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided ~~at least~~ a time T ms prior to the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking.** * **T is defined using one of the following options:**   + **Option 1: T is (pre-)configured.**     - **FFS: Value of T.**   + **Option 2: [T≤4] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**   + **Option 3: Up to UE implementation.** |

### Summary of 2nd Round of Discussions

Based on the responses from companies, 22 companies support the proposal, 1 does not, while 3 have comments. The following is a summary of their views:

* Support proposal
  + Yes – Apple, CMCC, Lenovo, Wilus, Panasonic, Spreadtrum, OPPO, Sony, Transsion, Vivo, NEC, ETRI, Fraunhofer, DCM, Nokia, Intel, MediaTek, Ericsson, Xiaomi, ZTE, Toyota, Huawei (22)
  + No – InterDigital, (1)
  + Comments – Qualcomm, Samsung, DCM (3)
* Support Option 1 – Panasonic, ETRI, DCM, Toyota, (3)
* Support Option 2 – Apple, CMCC, Lenovo, Wilus, Panasonic, Spreadtrum, Sony, Transsion, ETRI, Fraunhofer, DCM, Intel, Ericsson, ZTE, Toyota, (15)
* Support Option 3 – CMCC, Lenovo, Transsion, Vivo, NEC, Fraunhofer, Intel, MediaTek (8)

In response to InterDigital’s comment, the understanding is correct. The NR SL UE needs the information from the LTE SL module at least T ms prior to commencing the resource (re)selection procedure described in Section 8.1.4 of TS 38.214. This proposal deals only with the maximum time before the NR SL UE commences its resource (re)selection procedure. In case Alt 2 in Proposal 1-2(II) is used, and if the NR SL module has to send information to the LTE SL module, it would have to be handled by the higher layers. This would also clarify Huawei’s comment.

Responding to Samsung’s comment, the intention of the proposal is to cover the time between T1 and T3. OPPO’s text would essentially handle such a scenario, and the revised proposal reflects this.

To respond to DCM’s and Nokia’s comment, the aspect in question is the timing delay from the time the LTE SL module sends this information to the time the NR SL module receives it. In the FL’s understanding, since the interface used to send this information is up to UE implementation, as was the case in Rel-16 in-device coexistence, the interface, and hence the delay due to it, can be up to UE implementation here as well. The only aspect that we can mandate is that the NR SL module receives the information at least T ms prior. We can capture this in a later round once we have a base timeline agreed.

Based on the comments made by companies, the changes have been reflected in the revised proposal. Since Option 1 is the least popular option, it has been removed. If the group cannot decide on T, it can be FFS as well, but the FL would like to try the revised proposal due to good support for Option 2 and 3.

### Company Views for 3rd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-4 (II):**

* **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T ms prior to slot n, to determine a set of resources for its own transmission ~~the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking~~.**
* **T is defined using one of the following options:**
  + **~~Option 1: T is (pre-)configured.~~**
    - **~~FFS: Value of T.~~**
  + **Option 2: [T≤4] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**
  + **Option 3: Up to UE implementation.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| Qualcomm | Yes, Option 2 | We agree with the FL’s updates on the first bullet point.  We can accept option 2 as a compromise with the understanding that the bound on the value of **T** is to be further discussed. We do not agree to leave it to UE implementation as without an upper bound the feature may be *non-functioning* (as some UE may decide to use a time that is too large to be useful). We would propose the following change in wording for Option 2:   * **T is defined using one of the following options:**   + **Option 2: [T≤Tmax] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**     - **FFS: Tmax**   + **~~Option 3: Up to UE implementation.~~** |
| Bosch | Yes | We also support Option 2, i.e., to have a specified upper bound. |
| CMCC | Yes | Option 2 can be a good compromise b/w option 1 and option 3. |
| InterDigital | Yes | We support Option 2. |
| Apple | Comment | We are fine with the principle of proposal. However, the slot “n” is used in the first bullet without clear definition. If the definition of “n” is “determine a set of resources for its own transmission”, then we think it is inaccurate.  “determine a set of resources for its own transmission” could take more than 1 slot as a whole procedure. For example, in order to determine a set of resources for its own transmission, NR SL module first requests LTE SL module to provide its sensing results, then waits for LTE SL module to send the information, and then performs resource selection. The whole procedure will likely take more than 1 slot.  Actually, we think the original wording of the first bullet (in Proposal 1-4 (I)) is accurate and wish to revert to it.  Also, if Option 3 is selected, then the intention of this proposal is unclear to us. |
| Lenovo | Yes |  |
| Wilus | Yes | Option 2 is preferred, as mentioned in the previous round. |
| Sharp | Yes | **slot n** can be clarified as **slot n (as defined in clause 8.1.4 of TS 38.214)**. |
| Sony | Yes | We support option2 to specify the upper bound of ‘T’. |
| Spreadtrum | Yes | Prefer to Option 2. |
| MediaTek | Yes | We prefer Option-3. LTE V2X traffic may have long periodicity well over 4ms. Also, we would like to remind that LTE V2X does not have re-evaluation/pre-emption operations. So, we don’t see why LTE SL module should always be required to provide information within the last 4ms if LTE resource reservation is not changing. We agree that LTE SL module needs to provide this information within 4ms in some cases, but not all. It’s better to leave the timeline to UE implementation. |
| OPPO | Yes | We share the same view with Sharp. |
| vivo | Yes | We prefer Option 3. |
| Panasonic | Yes | We prefer option 2. |
| NEC | Yes | Option 3 is preferred. |
| ETRI | Yes | We prefer option 2. |
| Continental Automotive Technologies GmbH | Yes | Support Option 2. |
| Intel | Yes | Either Option 2 or Option 3 are fine for us, with slight preference for Option 3. |
| Huawei, HiSilicon | Comments | We still think the wording “at least” is not clear.  There are two timelines associated with this issue. One is the processing time as explained by some companies. The other is validity of the shared information from LTE-V module. And the latter is not reflected in the proposal. The value of validity time shall be determined according to UE implementation of T. Thus, we suggest to correct it in accordance with 38.213 clause 16.2.4.1.   |  | | --- | | *(copied from 38.213 clause 16.2.4.1)*  If a UE  - would transmit a first channel/signal using E-UTRA radio access and second channels/signals using NR radio access, and  - a transmission of the first channel/signal would overlap in time with a transmission of the second channels/signals, and  - the priorities of the channels/signals are known to both E-UTRA radio access and NR radio access at the UE msec prior to the start of the earliest of the two transmissions, where and is based on UE implementation, |   Thus, we suggest the following proposal (changes in purple):  **Proposal 1-4 (II):**   * **For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module ~~which is provided at least a time~~ T ms prior to slot n, to determine a set of resources for its own transmission ~~the triggering of NR SL resource (re)selection, resource re-evaluation and pre-emption checking~~.** * **T is defined using one of the following options:**   + **~~Option 1: T is (pre-)configured.~~**     - **~~FFS: Value of T.~~**   + **Option 2: [T≤4] ms, and is based on UE implementation, according to the Rel-16 NR SL timeline for in-device coexistence.**   + **Option 3: Up to UE implementation.** |
| Samsung | Comments | We still have concern on the wording  “**For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is provided at least a time T ms prior to slot n,**”  Based on this definition, T seems to be the time between sharing information from LTE to NR and slot n. Which is not the intention based on FL reply. If the intention is that T is time from the end of the LTE sensing window to slot n, we should say so.  Maybe we can say:  “**For dynamic resource pool sharing, the NR SL UE is expected to use the information shared by the LTE SL module to the NR SL module which is ~~provided~~ determined at least a time T ms prior to slot n,**” |

### Summary of 3rd Round of Discussions

TBD

## [*ACTIVE*] Issue 1-5: DRPS – Higher SCS

### Summary of Company Views from TDocs

The following agreement was made in the previous meeting, which defined the study of DRPS with the constraint that the shared NR SL resource pool is configured with a 15 kHz SCS.

|  |
| --- |
| **Agreement**  For co-channel coexistence in Rel-18, dynamic resource pool sharing is studied, with the following constraints:   * + NR SL resource pool is configured with 15 kHz SCS.     - FFS support of NR SL resource pool configured with higher SCS, including other solutions to overcome the AGC issue caused by the differing SCSs between the NR SL and LTE SL resource pools |

The reason behind the restriction of the NR SL resource pool’s SCS is that if different SCSs were used for the NR SL resource pool, it would cause AGC settling issues for the LTE SL Ues that are using the shared resource pool. However, companies had also raised concerns that restricting the SCS to only 15 kHz for NR SL would rob it of providing the significant advantage of lower latency and higher data rates as compared to LTE V2X.

Based on the contributions submitted by the companies, only 7 companies have explicitly stated that they want to maintain the restriction on the 15 kHz SCS, while 17 companies stated that they support higher SCSs for NR SL. The following is a summary of the company views:

* Restrict the SCS to 15 kHz – [6], [8], [11], [15], [16], [21], [29], [30].
* Support higher SCS – [1], [2], [3], [4], [5], [6], [9], [10], [12], [17], [20], [22], [23], [24], [25], [27], [32].

In order to support the higher SCSs for the NR SL resource pools, the following possible solutions were discussed by companies:

* 7 companies supported the use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols within LTE SL subframe of 15 kHz – [1], [3], [5], [10], [12], [23], [25].
* 3 companies support the NR SL UE sending LTE SCI which indicate resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by the NR SL UE – [4], [6], [23].
* Exclude resources overlapping with LTE SL reservations – [2], [25].
* Use SCSs for NR SL that are an integer multiple of LTE SCS – [17].

Since majority of the companies prefer to explore solutions for supporting higher SCS for NR SL transmissions, it is the FL’s view to check whether companies are able to arrive at a common consensus about this direction.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Observation 2: Restricting co-channel coexistence to 15kHz has the following drawbacks:  • Increased latency (that necessary)  • Less robustness to Doppler frequency shifts.  • Complicate the CA design when aggregating the shared ITS carrier with another NR carrier.  Proposal 2: NR SL should support higher SCS than 15 kHz for co-channel coexistence.  Proposal 3: For NR SL using a higher numerology than LTE, slot aggregation is supported such that an NR SL device can reserve and transmit in consecutive NR slots starting with the first NR slot that overlaps an LTE SL subframe. |
| Huawei, HiSilicon | Observation 1: 30 kHz SCS is necessary for a Rel-18 UE to support both co-existing with LTE-V Ues and communicating with legacy Rel-16/Rel-17 Ues within the same SL BWP.  Proposal 1: For NR-V and LTE-V co-channel co-existence via dynamic resource sharing,  • Support 30 kHz and higher SCS in addition to 15 kHz SCS for NR-V.  • To overcome the AGC issue when SCS of NR-V is higher than 15 kHz, all the resources overlapping with LTE-V’s reservation in time are excluded in resource allocation procedure at NR-V module. |
| Spreadtrum | Proposal 4: Multi-consecutive slots (corresponding to an LTE subframe) transmission could be supported for dynamic resource sharing if higher SCS is considered for NR sidelink. |
| ZTE, SANECHIPS | Proposal 1: Higher SCS should be supported.  Proposal 2: To avoid the AGC issue caused by different SCS, multi-slot aggregation can be considered. |
| Panasonic | Proposal 12: For SCS handling in resource pool(s) with dynamic resource sharing between LTE and NR SL:  - if type A devices is signalling its own reservation with both LTE and NR SCIs, it can be ok with different SCS if PSFCH can be resolved  - if type A devices is not signalling its own reservation with both LTE and NR SCIs, to limit the same SCS would be better as LTE SCI cannot indicate NR’s usage |
| Intel | Proposal 5:  • For co-channel co-existence in Rel.18, NR SL should be also configured with 30 kHz SCS.  O RAN1 should at least study the impact and how to exclude slots overlapping with the set of resources reserved for LTE transmissions which may cause AGC issues at the LTE-V Ues for NR SL transmission when the NR system operates at 30 kHz SCS. |
| Sony | Proposal 2: Different SCS configuration between LTE sidelink and NR sidelink in dynamically coexistent resource pool need to be supported.  • NR SL UE can select resource in consecutive slots depending on the SCS configuration to avoid the AGC issue. |
| NEC | Proposal 2: For both solution B (FDM resource pools for the two RATs) and solution C (shared resource pool for the two RATs), the following basic settings should be used for NR sidelink:  − fixed to 15kHz (higher SCS is not supported);  − all symbols in a slot used as sidelink symbols;  − PSFCH is not supported; |
| Transsion | Proposal 1: For co-channel coexistence in Rel-18, NR sidelink resource pool can be configured with 30 kHz SCS.  Proposal 2: An approaches of scheduling multiple PSSCHs by a single PSCCH can be investigated to address the AGC issue. |
| Lenovo | Observation 1: The mixed numerologies of LTE sidelink and NR sidelink will increase the UE complexity.  Observation 2: AGC issue for LTE sidelink is a challenge for co-channel coexistence between LTE sidelink and NR sidelink.  Proposal 3: For dynamic resource sharing the NR sidelink only supports sub-carrier spacing of 15kHz. |
| CMCC | Proposal 3: Do not support to configure NR SL resource pool with the SCS higher than 15kHz at least in Rel-18. |
| ETRI | Proposal 1: It is proposed NOT to limit to the same SCS i.e., 15kHz between LTE sidelink and NR sidelink.  Observation 1: If the resource grids between two RATs are not aligned, it will cause inefficient resource utilization.  Proposal 2: It is proposed to study the resource configuration to support dynamic resource sharing using overlapping resource pools between two RATs with different SCSs:   Aligned resource grids between two RATs with integer multiple relationship |
| MediaTek | Proposal 2: Support higher SCS values above 15 KHz for dynamic resource pool sharing solutions:  • Companies further study potential solutions to mitigate AGC issue due to different SCS values. |
| Apple | Proposal 2: For dynamic resource pool sharing, do not support NR sidelink resource pool configured with SCS higher than 15 kHz. |
| Toyota | Observation 1: For the AGC issue caused by different SCSs, some solutions proposed/discussed at RAN1#110 impose some fixed restrictions on the resource usage patterns. Other solutions (A4: the NR SL UE sends LTE SCI, A5: Multi-slot aggregation where same or different TBs can be transmitted in each slot and A7: NR SL UE avoids slots that may cause AGC issue at LTE SL Rx Ues, by avoiding the LTE subframes) have the capability to adapt to traffic distribution and LTE SL sensing information.  Observation 3: A common solution of NR SL UE sending LTE SCI (to reserve the candidate slot so that the LTE SL UE would exclude the reserved resources slot based on sensing) solves both issues of AGC issues caused by different SCSs and PSFCH.  Observation 4: To solve both AGC issue caused by different SCSs and PSFCH, combining the solutions of NR SL UE sending the LTE SCI, and the multi-slot aggregation where same or different TBs can be transmitted in each slot, seems to strike the best balance between flexibility, complexity, overhead and efficiency.  Proposal 2: To circumvent the AGC issues caused by the PSFCH being configured in NR SL resource pools, and also the AGC issue caused by different SCSs, NR SL UE sends LTE SCI to reserve the slots so that LTE SL Ues would exclude the reserved resources slot based on LTE SCI decoding.  Proposal 3: To circumvent the AGC issues caused by the PSFCH being configured in NR SL resource pools, and also the AGC issue caused by different SCSs, the solution of NR SL UE sending LTE SCI is combined with multi-slot aggregation where same or different TBs can be transmitted in each slot. |
| InterDigital | Proposal 6: Study mechanism to support higher SCS in NR SL resource selection using LTE SL coordination information. |
| Samsung | Proposal 9: Support dynamic resource pool sharing between NR SL and LTE SL, when the NR SL resource pool has a SCS greater than 15 kHz. |
| NTT DOCOMO | Proposal 1: RAN1 should study how to support dynamic resource pool sharing with 30kHz SCS. |
| Bosch | Observation 6: For simplicity, dynamic co-channel coexistence should not consider higher SCS than 15 kHz.  Proposal 6: For dynamic co-channel coexistence consider only 15 kHz SCS. |
| Ericsson | Observation 8 For LTE SL and NR SL co-channel coexistence, SCS is limited to 15 kHz. |
| Continental | Proposal 3: Solutions for co-channel co-existence should support NR SL operating in higher numerologies than 15 kHz. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-5:**

* **For dynamic resource pool sharing, in order to support higher SCS, the following options are supported (possible down-selection):**
  + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**
  + **Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.**
  + **Other options are not precluded.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| OPPO | No | Both Option 1 and Option 2 will cause a significant impact on current spec especially on resource reservation and resource allocation, so we disagree to introduce higher SCS for dynamic resource sharing considering the limited time and high workload for this WI. In addition, based on the guidance from RAN plenary, RAN1 continues the work on dynamic resource pool sharing based on existing agreements and WID with high priority for Type A devices and operating combination A. Since higher SCS has not been agreed yet, we think we should continue to study dynamic resource sharing with the SCS of 15kHz only. |
| Toyota | Yes | We can see benefits with this. Option 2 has advantages, but this does not preclude combining it with Option 1. Option 2 also solves the PSFCH AGC issue and the fairness issue between LTE/NR. |
| Intel | Comments | While we think that it is beneficial to support higher SCS, we also believe that option 1 and 2 may lead to significant spec impact. Given that for dynamic resource pool partitioning we are already considering a solution to exclude resource used for LTE transmission using information retrieved by the LTE SL module, such procedure could be further considered here with some additional constraints and restrictions to mitigate the AGC issue when operating at higher SCS:  **Proposal 1-5:**   * **For dynamic resource pool sharing, in order to support higher SCS, the following options are supported (possible down-selection):**   + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**   + **Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.**   + **Option 3: the NR SL UE uses the LTE SL sensing and resource reservation information in its own resource selection procedure to exclude slots that may cause AGC issues.**   + **Other options are not precluded.** |
| Vivo |  | If higher SCS is to be supported, we support Option 2 as this solution is easy to be implement in the current resource selection framework and it is also feasible for 15 KHz.  Option 1 may not fully resolve this issue. For example, the AGC issue may still occur if different number of aggregated number of slots are used by different Ues, or the aggregated slots are not aligned between different Ues. Moreover, it requires a lot of changes such as the resource selection framework, the TBS/rate-matching, the slot structure, etc. |
| Apple | No | We are not against to support higher SCS if a proper solution can be identified. However, both options in the proposal are not acceptable.  Option 1 has significant specification impact. Furthermore, the latency benefit of using higher SCS is mitigated by using multi-slot transmissions.  Option 2 unnecessarily increases the LTE traffic. This also introduces a lot of inter-module communication. |
| Ericsson | No | We do not support including higher SCS for dynamic resource pool sharing. We should only support 15 KHz. |
| Nokia, NSB | Yes | Support for higher SCS will undoubtedly increase complexity; on the other hand, restricting NR to use 15 kHz SCS only is too restrictive. |
| InterDigital | No | We think Option 1 and Option 2 are both unnecessary, as the support of higher SCS can be done with the NR SL resource selection solution with LTE SL sensing and resource reservation information, which is being discussed. Since the sub-frame boundary is aligned by UE implementation (as indicated in TS 38.213 R16), NR SL resource selection can exclude the slots overlapping with a LTE sub-frame reserved for LTE transmissions. |
| Samsung | Comments | Don’t support option 2, this impacts the LTE specifications. Option 1, can be limited to subframes with LTE transmission. In option 1, the gap symbol between the two slots should be eliminated. A third option to mitigate the impact on AGC is gradual ramping up or down of power over multiple symbols. This would not require multi-slot transmissions. |
| NEC | No | Only 15kHz is supported. |
| Lenovo | No | We support only 15KHz SCS for dynamic resource sharing |
| Panasonic | Yes with comments | If higher SCS to be supported, we prefer option 2.  Additionally, we wish to add “if supported” in the main bullet as we have not confirmed to have higher SCS as per last meeting agreement. |
| Qualcomm | No | Given the current RAN 1 progress and based on the agreement made in the previous RAN 110 meeting, we think that this issue could be taken up once the dynamic coexistence scheme is agreed for the case of NR and LTE both using 15 kHz SCS.  Moreover, based on the contributions and the discussions presented, more system analysis is required on this; including considering the impact on UE implementation complexity. |
| ETRI | Yes with comments | We are supportive of higher SCS, however we think both options are not necessary and will cause significant spec impacts. As commented by Intel and InterDigital, NR SL resource selection with LTE sensing results would be enough to handle the issue with high SCS. |
| Transsion | Yes | Option 2 may have impacts on the LTE specifications. Option 1 is very similar to the potential approach of scheduling multiple PSSCHs by a single PSCCH discussed in SL-U and could reuse the design over there. |
| Spreadtrum | Yes |  |
| CMCC | No | We think more further issue will be generated if we introduce either option 1 or option 2;  For option 1, the further issue is whether the condition for selecting multi-slots is semi-static (fixed as 2μ for example), or based on the information notified by LTE SL module (when there is a detected reserved LTE resource in a same slot, multi-slots resource is selected, otherwise, single-slot resource is selected), and if there are some misdetection, the AGC issue will still occur;  For option 2, the SCI must indicate the whole slot is reserved, which will obviously reduce the resource efficiency;  We also agree with OPPO’s comment that according the guideline from RANP, the work on dynamic resource pool sharing based on existing agreements. Therefore, we propose not to higher SCS. |
| Sony | Yes | We think restricting SCS only support 15kHz is too restrictive and support higher SCS will give benefits on latency reduction. So, we support higher SCS and we are ok with option 1, option2 or other accepted option. |
| Xiaomi | No | Both option 1 and option 2 will have much specification impact and the necessity to support such operation is not clear. |
| ZTE | Yes with comments | We prefer option 1. On the other hand, we think that option 2 doesn’t work well because NR DMRS can not be measured by LTE SL, and waveform are also inconsistent between LTE SL and NR SL. Thus it’s hard for NR SL UE to transmit LTE SCI. |
| Continental Automotive Technologies GmbH | Yes | We consider the use of higher SCS is important for NR sidelink. Unless it is clearly proven that there is no feasible solution for it, we support multiple numerologies for NR-SL. |
| NTT DOCOMO | Yes with comments | We support Intel’s comments and the part of Panasonic’s comments, that is:  **Proposal 1-5:**   * **For dynamic resource pool sharing, if ~~in order to support~~ higher SCSs are supported, the following options are studied ~~supported~~ (possible down-selection):**   + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**   + **Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.**   + **Option 3: the NR SL UE uses the LTE SL sensing and resource reservation information in its own resource selection procedure to exclude slots that may cause AGC issues.**   + **Other options are not precluded.** |
| Wilus | Yes |  |
| CATT/GOHIGH | No | We need to first decide if higher SCSs are supported. |
| Huawei, HiSilicon | See comments | Higher SCS, e.g. 30kHz, is necessary for dynamic resource pool sharing. But we don’t agree with option1 nor option2 to support higher SCS.  For option 1, it will have a large spec impact on NR-V. Such as how a NR-V UE perform LTE-V resource selection procedure, how to deal with multi-slot resource selections, and how to deal with HARQ for the first resource within multi-slot, etc.  For option2, it requires NR-V UE pretends LTE-V for transmission, which NR-V should perform both LTE-V and NR-V spec. This will result in large spec impact on NR-V spec and complicate the design. It can predict lots of issue such as how to reserve resource in both LTE-V and NR-V PSCCH, so we do not think option 2 is a feasible.  Similar to PSFCH issue, if UE always transmit NR-V transmission without overlapping with LTE-V reservation, the problem caused by higher SCS can be easily resolved. Thus, we suggest the following proposal:  **Proposal 1-5:**   * **For dynamic resource pool sharing, in order to support higher SCS, the following option~~s~~ ~~are~~ is supported ~~(possible down-selection)~~:**   + **NR SL UE does not transmit on the slots overlapping with LTE-V’s reservation in time**   + **~~Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.~~**   + **~~Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.~~**   + **~~Other options are not precluded.~~** |
| MediaTek |  | Same view as Huawei. The following sub-bullet as suggested by Huawei can be listed as another option:  o Option-3: NR SL UE does not transmit on the slots overlapping with LTE-V’s reservation in time |
| Fraunhofer | Yes with comments | We support using higher SCS for NR SL resource pools. To this regard, we understand that Option 1 would cause significant specification impact, causing strains on the WI timeline. On the other hand, Option 2 would cause an increase in LTE traffic to indicate the NR SL reserved resources.  For progress, we could support Huawei’s and DOCOMO’s Option 3. |
| Bosch | No | In DRPS, higher SCS should not be used. |

### Summary of 1st Round of Discussions

Based on the responses from companies, 22 companies support the proposal, 5 have comments, while only 1 company does not support it. The following is a summary of their views:

* Support proposal
  + Yes – Toyota, Nokia, Panasonic, Transsion, Spreadtrum, Sony, ZTE, Conti, DCM, Wilus, (10)
  + No – OPPO, Apple, Ericsson, InterDigital, NEC, Lenovo, Qualcomm, CMCC, Xiaomi, CATT, (10)
  + Comments – Samsung (1)
* Support Option 1 – Toyota, ZTE (2)
* Support Option 2 – Toyota, Vivo, Panasonic (3)
* Restrict SCS to only 15 kHz – OPPO, Ericsson, NEC, Lenovo, Qualcomm, CMCC, Bosch (7)
* Support higher SCS, but current options are not acceptable – Intel, Apple, Nokia, ETRI, Huawei, MediaTek (6)
* Include Option 3: the NR SL UE uses the LTE SL sensing and resource reservation information in its own resource selection procedure to exclude slots that may cause AGC issues – Intel, InterDigital, ETRI, DCM (4)
* Include Option 4: NR SL UE does not transmit on the slots overlapping with LTE-V’s reservation in time – Huawei, MediaTek, Fraunhofer (3)

The number of companies supporting and opposing this proposal are the same (10 companies). While 7 companies prefer to restrict the SCS to only 15 kHz, 6 companies feel that higher SCS should be supported, but the mentioned options are not acceptable. Hence these alternatives have also been added to the revised proposal.

### Proposal for GTW Session – Tuesday 11th October

**Proposal 1-5 (I):**

* **For dynamic resource pool sharing, ~~in order to support~~ if higher SCSs are supported, the following options are supported (possible down-selection):**
  + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**
  + **Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.**
  + **Option 3: NR SL UE uses the information shared by the LTE SL module in its own resource selection procedure to exclude slots that may cause AGC issues.**
  + **Option 4: NR SL UE does not transmit on the slots overlapping with LTE SL’s reservation in time**
  + **~~Other options are not precluded.~~**

### Company Views for 2nd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-5 (I):**

* **For dynamic resource pool sharing, ~~in order to support~~ if higher SCSs are supported, the following options are supported (possible down-selection):**
  + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**
  + **Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.**
  + **Option 3: NR SL UE uses the information shared by the LTE SL module in its own resource selection procedure to exclude slots that may cause AGC issues.**
  + **Option 4: NR SL UE does not transmit on the slots overlapping with LTE SL’s reservation in time**
  + **~~Other options are not precluded.~~**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| InterDigital | Yes | We prefer Option 3. |
| Apple | No | We are not convinced by Option 1 and Option 2 with reasons given in last round discussions.  Option 3 may cause the inconsistence between Tx UE and Rx UE. Suppose Rx UE detects the LTE SL transmission on a slot, but Tx UE does not detect LTE SL transmission on the same slot. Then the PSSCH transmission occurs, but Rx UE does not receive it. Further, it could cause AGC issue for LTE SL reception. Finally, the specification impact of this Option is unclear on how to justify “cause AGC issues”.  The difference between Option 4 and Option 3 is unclear. Do you mean in Option 4, NR SL UE does not transmit on the slots overlapping with LTE SL’s configured resources in time? Note that this semi-statice way may result in less number of slots for NR SL transmission, comparing with only support SCS=15 kHz for NR SL. |
| Qualcomm | Comment | We prefer Option 1 though we feel more analysis is required on this topic. We have concern over the (a) extra workload associated with all the options, (b) the implementation complexity, and (c) the system performance since there have not been any evaluation results presented so far. |
| CMCC | No | First, we need to decide whether higher SCS other than 15kHz is supported, and then move to the options when the higher SCS is supported.  In our view, as we replied in the 1st round, all these options may bring more further issue and the specification efforts to solve these issues. For example, in option 1, it has much impact on resource selection procedure and in option 2~4, if miss detection occurs, anyway the AGC issue will still exist.  Considering the workload and RANP guideline, we propose to restrict the SCS only to be 15kHZ. |
| Lenovo | No | We agree with CMCC that to restrict the SCS only to be 15kHz. |
| Wilus | Yes with comment | We prefer Option 2  Is there any difference between Option 3 and Option 4? Resource information shared by the LTE SL module is needed also in Option 4.  Moreover, Option 3 and Option 4 restrict the candidate resource set of the NR SL module, hence there is a risk of resource conflict between NR SL Ues. |
| Panasonic | Yes | Although it has not been decided whether to support higher SCS, we are ok to have all possible solutions for taking into consideration |
| Spreadtrum | Yes with comments | We have the same doubt about whether there exists any difference between Option 3 and Option 4. |
| OPPO | No | We should continue to study dynamic resource pool sharing with the SCS of 15kHz only according to the guidance from RAN plenary. |
| Sony | Yes | We think higher SCS should be support. And we are ok with the possible options. |
| Transsion | Yes | We prefer option 1.  Regarding option 3, it should be clarified how to avoid behaviors that cause AGC issues. |
| Vivo | Yes | We prefer Option 2. Option 1 may not fully resolve this issue as we pointed out in last round. While in Option 3 and Option 4, type A UE might need to decode LTE SL and NR SL signal with different SCS in a same subframe. However, through transmitting LTE SCIs in Option 2, it’s possible to avoid this problem by LTE resource selection. |
| NEC | No | Only 15kHz is supported. |
| ETRI | Yes | We prefer option 3 and 4. In case of option 1 and 2, additional specification work load will be necessary. |
| Samsung | Comments | Don’t support option 2, this impacts the LTE specifications. Option 3 is vague. Option 1, can be limited to subframes with LTE transmission. In option 1, the gap symbol between the two slots should be eliminated. Option 4, can be limited to cases when UE can’t find resources in all slots that overlap an LTE SL transmission.  Therefore, we prefer this option  In slots that don’t overlap an LTE SL transmission, NR SL UE can transmit in one or more of these slots.  In slots that overlap an LTE transmission, NR SL UE uses multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz |
| Fraunhofer | Yes with comments | Unfortunately, the options listed here each have their own significant downsides.  Option 1 requires detailed specification work and, given the current time constraints, might not be feasible to implement.  Option 2 would result in the system being flooded by LTE SCIs being transmitted by the NR SL module.  Option 3 can be used, but if the NR SL UE keeps on avoiding overlapping resources, the NR SL UE would not have adequate or enough resources left for its own transmissions.  Option 4, in our understanding, is based on (pre-)configuration, which makes it essentially a semi-static solution, which comes with its own issues.  In summary, we support Option 1, but are not sure whether it can be done within this release. |
| NTT DOCOMO | Yes with comment | We support either Option 3 or Option 4 although we cannot find a difference between Option 3 and Option4 as some companies pointed out. |
| Nokia, NSB | Yes with comments | Other options should not be precluded at this point |
| Intel | Yes | Our preference is for either option 3 or option 4. Option 1 can be also pursued but may require a large spec impact and may be conditional to the progress/design in SL-U if RAN1 wants to harmonize the two design. Option 2 is the least acceptable solution since it will massively increase congestion for LTE. |
| MediaTek | Yes with comment | We do not support Option 1 and Option 2. In our view, both of these options will bring high amount of workload. Given the time constraints, we suggest removing them.  We support both Option-3 and Option-4 together, preferably without further down-selection. |
| Ericsson | No | We are supportive on only supporting 15KHz for dynamic co-channel coexistence.  Moreover, we do not need the necessity to agree on this proposal since only 15 kHz has been agreed and here the different options are really convergent among the different companies. |
| Xiaomi | No | We support to only consider 15KHz for dynamic resource sharing. |
| ZTE,Sanechips | Yes with comments | As we suggested in round 1, we prefer option 1. |
| Toyota | Yes with comments | Option 2 \*avoids\* changes to LTE specifications, because the LTE Module just reads the LTE SCI (sent by the SL NR module).  Option 2 does not make use of internal inter-module communication, hence does not increase the inter-module traffic.  What is the difference between option 3 and option 4 ? |
| Huawei, HiSilicon | Yes | Higher SCS, e.g. 30kHz, shall be supported for dynamic resource pool sharing. This is not only related to benefits introduced by higher SCS, but also the compatibility, which is essential, with legacy Rel-16/17 SL. In Rel-16/17, only 30kHz is mandatory. If Rel-18 UE only supports 15kHz SCS, it cannot communication with other Rel-16/17 Ues which only supports 30kHz SCS.  For the options, we think either option 3 and option 4 can work well. ‘does not transmit on the slots’ in option 4 (or ‘excluding the slots’ in option 3) is a simple way to solve the AGC issue caused by higher SCS. |

### Summary of 2nd Round of Discussions

Based on the responses from companies, 16 companies support the proposal, 7 do not, while 2 have comments. The following is a summary of their views:

* Support proposal
  + Yes – InterDigital, Wilus, Panasonic, Spreadtrum, Sony, Transsion, Vivo, ETRI, Fraunhofer, DOCOMO, Nokia, Intel, MediaTek, ZTE, Toyota, Huawei (16)
  + No – Apple, CMCC, Lenovo, OPPO, NEC, Ericsson, Xiaomi (7)
  + Comments – Qualcomm, Samsung (2)
* Support Option 1 – Qualcomm, Transsion, (Samsung), Fraunhofer, (Intel), ZTE (6)
  + Do not support – Apple, Vivo, ETRI, MediaTek (4)
  + 6 companies support it, while 4 companies do not.
* Support Option 2 – Wilus, Vivo, Toyota (3)
  + Do not support – Apple, ETRI, Samsung, Fraunhofer, Intel, MediaTek (6)
  + 3 companies support it, while 6 companies do not.
* Support Option 3 – InterDigital, ETRI, DCM, Intel, MediaTek, Huawei (6)
  + Do not support – Apple, Wilus, Vivo, Samsung, Fraunhofer (5)
  + 6 companies support it, while 5 companies do not.
* Support Option 4 – ETRI, (Samsung), DCM, Intel, MediaTek, Huawei (6)
  + Do not support – Apple, Wilus, Vivo, Fraunhofer (4)
  + 6 companies support it, while 4 companies do not.
* Support Option 1 + Option 4 – Samsung
* Restrict to only 15 kHz SCS – CMCC, Lenovo, OPPO, Ericsson, Xiaomi,

Few companies had stated that the difference between Option 3 and 4 is not clear. Option 3 is where the NR SL module uses the information from the LTE SL module to exclude time slots where LTE SL transmissions take place, causing AGC issues. This is inclusive of even PSFCH transmissions by the NR SL UE, which is covered by Proposal 1-1. Option 4, on the other hand, is configuration based, where the NR SL resource pool does not overlap with slots included in the LTE SL resource pool, which is essentially a semi-static pool partitioning system.

Among the list of options, only Option 2 had more opposing companies than supporting companies. Hence this option has been removed. Due to lack of clarity between Option 3 and 4, Option 3 has been retained. Based on the comments from companies, the FL has revised the wording in Options 3 and 4 to be more clear.

### Company Views for 3rd Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-5 (II):**

* **For dynamic resource pool sharing, ~~in order to support~~ if higher SCSs are supported, the following options are supported (possible down-selection):**
  + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**
  + **~~Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.~~**
  + **Option 3: NR SL UE uses the information shared by the LTE SL module in its own resource selection procedure to exclude slots overlapping with LTE SL transmissions ~~that may cause AGC issues~~.**
  + **Option 4: NR SL UE ~~does~~ is (pre-)configured not to transmit on the slots overlapping with LTE SL’s reservation (pre-)configured resources in time.**
  + **~~Other options are not precluded.~~**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (Indicate preference of options)** |
| Qualcomm | Comments | We do not believe that this proposal should be taken up at this moment. RAN 1 should finalize the design of the DRPS scheme and revisit this. We have the following comments about the three options:   * Option 1: We think that further analysis and simulations are needed before adopting this option as we indicated in the previous round of discussion. * Option 3: This to us seems like the same mechanism as PSFCH Alt 1 in Proposal 1-1 which had performance issues even when both NR and LTE are configured with 15 kHz. Given this issue we do not think Option 3 should be adopted. * Option 4: The text in the proposal is unclear to us. If this is indeed a semi-static RP partition scheme, that will require both NR and LTE SL UE-s to be pre-configured with the resource partition and this is not in the purview of DRPS. |
| Bosch | Comment | We prefer to postpone this discussion until DPRS is more mature. As Qualcomm says, PSFCH should be a guided example when agreed. |
| CMCC | Comment | We still prefer to limit the SCS to be 15kHz, in order to avoid more workload and complexity, we are also fine with QC’s comment to postpone this discussion. |
| Interdigital | Yes | We support Option 3. We think it can be readily built into the resource exclusion procedure discussed in Issue 1-3 Use of LTE Sensing information.  Option 1 will result in considerable design and spec impact. Regarding Option 4, we’d like to have further information to understand how it works. |
| Apple | No | Overall, we are not in favour of supporting higher SCS than 15 kHz unless an acceptable approach is identified.  At this moment, we are only open to further study Option 4 if the NR SL time resources are semi-statically determined. In Option 4, due to co-existence with LTE SL, the total number of slots for NR SL resource pools may be largely reduced. It may not be even worth to support higher SCS for NR SL, by comparing with the total number of slots in the NR SL resource pool with 15 kHz SCS. |
| Lenovo | No | We also still prefer to limit the SCS to be 15kHz, and if most companies support higher SCS than 15kHz, we think Option 3 may be acceptable considering the workload |
| Wilus | No | We don’t think that Option 2 does not require LTE spec changes because Type C Ues just receive and decode the LTE SCI from type A Ues. Hence, we think it should be further studied with other options, since Option 2 makes type C Ues to avoid using the subframe that overlaps with slots in case of higher SCSs. However, we share the similar view with QC that this discussion should be postponed until the discussion for PSFCH configuration in DRPS is agreed. |
| Sharp | No | We prefer to postpone the discussion on supporting higher SCSs. |
| Sony | Yes | Our preference is option 1 and we can compromise with option 3. |
| Spreadtrum | Yes |  |
| MediaTek | Yes with comment | We support Option-3 and Option-4. We have concern for Option-1.  For the main bullet, we have small wording suggestion to include “some of” wording to clarify that down-selection is possible:  **For dynamic resource pool sharing, ~~in order to support~~ if higher SCSs are supported, some of the following options are supported (possible down-selection):** |
| OPPO | No | We still think we should continue to study dynamic resource pool sharing based on existing agreements. That is, 15kHz only. |
| Vivo | No | For Option 1, the AGC issue may still occur if different number of aggregated slots are used by different Ues, or the aggregated slots are not aligned between different Ues. Moreover, it requires a lot of changes such as the resource selection framework, the TBS/rate-matching, the slot structure, etc. For Option 3, type A UE might need to decode LTE SL and NR SL signal with different SCS in a same subframe. And Option 4 should be removed since it’s essentially a semi-static pool partitioning system as FL said.  Option 2 does not need any LTE spec change as it just transmit LTE SCI along with data. And transmitting LTE SCIs won’t impact the congestion level too much compared with the transmitted data.  Hence, we prefer to keep Option 2. |
| Panasonic | Yes |  |
| NEC | No | Only 15kHz is supported. |
| ETRI | Yes with comments | Considering FL’s clarification between option 3 and option 4, we are not sure how to operate option 4 for dynamic resource pool shaing. |
| Continental Automotive Technologies GmbH | Yes, with comments. | Option 3 would be supported, however, the use of higher SCS should be confirmed before discussing further details. |
| Intel | Yes with comments | We are OK with the proposal and to down-select a specific option at a later stage. Our preference is for option 3. |
| Huawei, HiSilicon | Yes with comments | The higher SCS, e.g. 30kHz, shall be supported for dynamic resource pool sharing. Otherwise, Rel-18 UE cannot communication with Rel-16/17 UEs.  In sidelink, only one SL BWP is supported and 30kHz is mandatory for Rel-16/17 UE. For a Rel-18 SL UE, it needs to coexist with LTE-V UE, for example in RP1, and also communicate with legacy UE, for example in RP2. If legacy UEs only support 30kHz SCS and only allowed 15kHz SCS for co-channel coexistence, how does R18 UE support both of them in this only one SL BWP? Therefore, 30kHz shall be supported for backward compatibility.    We are fine with option 3 in this proposal.  For the option 4, as FL explained, it implies semi-static resource pool partitioning, so our question is that it should be already covered by the following conclusion.   |  | | --- | | **Conclusion**  For co-channel coexistence in Rel-18, RAN1 concludes that the TDM-based semi-static resource pool partitioning based on Rel-16/17 specifications is one possible solution to ensure co-channel coexistence between LTE-V UEs and NR-V UEs.  … |   So we suggest to have further clarification on option 4 (or delete it) and having following changes (in purple) on the proposal.  **Proposal 1-5 (II):**   * **For dynamic resource pool sharing, ~~in order to support~~ ~~if~~ higher SCSs are supported, and the following options are further supported (possible down-selection):**   + **Option 1: Use of multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz.**   + **~~Option 2: NR SL UE transmits LTE SCIs (SCI format 0 or 1), indicating resources reserved by NR SL transmissions, informing the LTE SL Ues about the resource reservations used by NR SL Ues.~~**   + **Option 3: NR SL UE uses the information shared by the LTE SL module in its own resource selection procedure to exclude slots overlapping with LTE SL transmissions ~~that may cause AGC issues~~.**   + **Option 4: NR SL UE ~~does~~ is (pre-)configured not to transmit on the slots overlapping with LTE SL’s reservation (pre-)configured resources in time.**   + **~~Other options are not precluded.~~** |
| Samsung | Comments | We would like to consider an option that combines option 1 and 4:  In slots that don’t overlap an LTE SL transmission, NR SL UE can transmit in one or more of these slots.  In slots that overlap an LTE transmission, NR SL UE uses multi-slot transmissions or slot aggregation, where the NR SL transmissions of higher SCSs occupy all symbols (across multiple time slots) within a LTE SL subframe of 15 kHz |

### Summary of 3rd Round of Discussions

TBD

## [*INACTIVE*] Issue 1-6: DRPS – Others

### Summary of Company Views from TDocs

In this section, the FL has covered other topics of interest that were covered by company contributions related to DRPS.

* LTE SL reservation information is used for IUC scheme 1 and 2 – [3], [6], [14], [25], [27]
* Type A devices can obtain LTE sensing information from IUC messages – [6], [17], [18], [21]
* Trigger or condition based sharing of LTE sensing information by LTE module – [9], [21], [25]
  + Trigger based on when NR SL resource (re)selection is triggered – [24]
  + Up to UE implementation – [9]
* NR SL UE sends LTE SCI indicating resources reserved by LTE transmissions – [6], [23]
* Enable/disable sharing of common resources between LTE SL and NR SL – [24], [25]
* Introduce SL LTE RP occupancy metric calculated by NR SL UE over a time window – [24], [28]
* How to determine overlapping resources/detection of LTE V2X transmissions
  + If number of candidate resources in a subframe is less than the max. number of candidate resources, the resource has been occupied/reserved – [2]
  + Detection of absence of energy in first symbol of LTE subframe to determine resource availability – [25]
* Clarity on the amount of overlap between the NR SL and LTE V2X resource pools, where only complete overlap is to be considered – [11]
* In the absence of LTE resource allocation information, the NR SL module can use configuration-based solutions to decrease the probability of resource collisions between LTE V2X and NR SL transmissions – [18]
* NR SL module provides LTE V2X module with information such as resource selection window, LTE priority and sub channel number, so that LTE module can provide the required sensing information – [24]
* Combine DRPS and TDM, restrict such resource pools to only 15 kHz, within the same BWP – [29]
* Study the impact of limited LTE sensing information received by NR SL module – [29]
* Simulation observations – [8], [22], [28]

One of the more popular topics was for the NR SL module to use the received LTE sensing information and include it in IUC messages. In the case of IUC scheme 1, the set of LTE SL resources that are being used by LTE SL transmissions can be included in a non-preferred resource set. In scheme 2, collision indication can be used to indicate to other Ues about the presence of LTE SL transmissions. The objective of using IUC messages is to avoid the hidden node problem, where the NR SL module is unaware of resources being used by an LTE SL transmission which is spatially distant from the device. The FL has proposed an agreement for this aspect.

Another aspect that was discussed was a trigger-based on condition-based sharing of the LTE sensing information to the NR SL module. However, the views seem divergent at this point.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Huawei, HiSilicon | Proposal 3: Regarding how to determine whether there is LTE-V’s reservation on a subframe based on LTE-V candidate resource set,  • If the number of LTE-V candidate resource in this subframe is less than the maximum number of candidate resources, it is assumed that this subframe has LTE-V reservation;  • Otherwise, this subframe has no LTE-V reservation. |
| Spreadtrum | Proposal 8: IUC-based solution, i.e., a Rel-18 UE could provide assist information to another UE for supporting its dynamic resource sharing, can be an alternative solution. |
| Vivo | Observation 1: One straightforward solution for the resource collision problem is to allow LTE always pre-empting NR resources, but the performance of NR RAT might be affected seriously in some cases.  Observation 2: Alternatively, the LTE SL modules of the UE can reserve the resources used by its NR SL by sending the LTE SCI with resource reservation indication, so that the other legacy LTE SL UE can avoid resource collision according to Rel-14 resource selection procedure.  Observation 3: There is an obvious gain in Option 2 (LTE SCIs containing NR resource reservation) compared with Option 1 (avoid overlapping resources).  Proposal 1：If dynamic resource sharing is supported, the Rel-16 LTE/NR coexistence principle should be reused for solving the resource collision between LTE and NR SL transmissions. |
| Panasonic | Proposal 5: The configuration of the dynamic sharing resource pools may have two possibilities: – 1) same resource pool for LTE SL and NR SL, and 2) overlapped but separated configuration for LTE and NR SL. The kind of resource pool configuration needs to be clarified.  Proposal 8: Inter-UE coordination can be used for there are both Type B UE and Type A UE in the resource pool (e.g., if RSU is Type A device and others are Type B devices in rel.17). Type A devices may broadcast its LTE sensing results (from other LTE Ues) as “non-preferred resource” as inter-UE coordination so that other Type A devices and Type B devices would try to avoid such resources. Type B devices may have lower priority compared with type A devices.  Proposal 9: For Type A devices, it may indicate their own reservation with both LTE and NR SCIs (at least for type C devices). Alternatively, for in-coverage Ues, they can use gNB to relay the information via UL and DL.  Proposal 10: For in-coverage Ues, they can use gNB to relay the sensing information via UL and then DL to targeted Ues.  Proposal 11: For an LTE/NR shared resource pool, it could be specified that periodic reservation of LTE V2X is used for LTE V2X, and the remaining resource is used for NR V2X. The dynamically scheduled NR SL transmissions may be prioritized over LTE even with lower priority. |
| CATT, GOHIGH | Observation 2: The performance of LTE SL transmission will degrade a lot if the resource reservation period of NR SL transmission don’t match RSSI measurement period of LTE SL.  Observation 3: There is almost no performance degradation of LTE SL for dynamic resource pool sharing solution comparing with TDM-based semi-static resource pool partition solution.  Observation 4: There is notable performance improvement of NR SL for dynamic resource pool sharing solution comparing with TDM-based semi-static resource pool partition solution.  Proposal 10: Dynamic resource sharing solution for co-channel coexistence for LTE sidelink and NR sidelink should be further studied in Rel-18 due to the notable performance improvement of NR SL and almost no performance degradation of LTE SL. |
| Intel | Proposal 3:  • For co-channel co-existence in Rel.18, in a type A device the timing aspects and triggering conditions of when the LTE SL module shares the sensing and resource reservation information to the NR SL module is up to UE’s implementation.  Proposal 4:  • When considering co-channel dynamic resource partitioning between LTE SL and NR SL, at the least the following should be further studied:   1. Impact and enhancements to the NR SL sensing and resource selection procedure    RAN1 should study the impact of enhancing the NR SL sensing and resource selection procedure by utilizing all or some of the information retrieved from the LTE module.   1. Impact and enhancements to the Rel.17 inter-UE coordination schemes    RAN1 should study the impact of enhancing the Rel.17 inter-UE coordination schemes with the aim to enhance co-existence between LTE SL and NR SL by utilizing all of some of the information retrieved from the LTE module. |
| Sony | Proposal 1: Reuse inter-UE coordination scheme to exchange LTE/NR sidelink resource allocation information. |
| NEC | Observation 1: In the case that an LTE sidelink resource pool and an NR sidelink resource pool are partially overlapped, extra complexity may be introduced for the discussion of sidelink co-existence.  Proposal 1: Dynamic co-existence should be discussed based on resource pool level sharing, i.e., solution C, a resource pool should be configured for both the two RATs as a whole. |
| CAICT | Observation1: In the co-channel coexistence pool with LTE PSSCHs being non-adjacent with the associated PSSCHs, it would cause resources fragment issue and introduce inferences to LTE PSCCHs if NR SL dynamically coexists with LTE PSCCHs in the same pool.  Proposal4: For LTE SL and NR SL co-channel coexistence in same resource pool, if LTE PSCCH is configured non-adjacent to the corresponding PSSCH, the resource pool for NR SL should only cover the position of PSSCH resources of LTE SL for causing less resource fragment. |
| Lenovo | Proposal 6: Enhance the resource selection procedure of NR sidelink mode 2 to enable dynamic resource sharing considering:   Avoid the TX/TX and RX/TX collision between LTE sidelink and NR sidelink in the same device.   Avoid the resource collision between NR sidelink and LTE sidelink in different devices. |
| CMCC | Proposal 4: If the LTE SL resource pool is configured as non-adjacent, the configuration should ensure that NR resource pool does not contain the resource in the LTE SL PSCCH resource pool in frequency domain.  Proposal 5: Rel-17 inter-UE coordination mechanism can be used as a reference to design:   How the NR SL module uses the resource reservation information notified by LTE SL module;   How the LTE SL module shares this information to the NR SL module. |
| ETRI | Proposal 4: It is proposed to study the utilization of Rel-17 ICU schemes for dynamic resource sharing. |
| Fraunhofer | Proposal 3: For dynamic resource pool sharing, the NR SL module can obtain LTE V2X resource allocation and scheduling information  • From the co-located LTE V2X module,  • By performing basic LTE measurements,  • By receiving IUC messages from other Ues that are aware of LTE V2X sensing information.  Proposal 4: For dynamic resource pool sharing, in the absence of LTE resource allocation information, the NR SL module can use configuration-based solutions to decrease the probability of resource collisions between LTE V2X and NR SL transmissions. |
| Apple | Proposal 4: In dynamic resource pool sharing for co-channel coexistence, consider that type A device’s LTE sidelink module shares the LTE sidelink sensing and resource reservation information with its NR sidelink module, at the request from the NR sidelink module or at certain conditions.  Proposal 8: In dynamic resource pool sharing for co-channel coexistence, support that device type A receives LTE sidelink sensing and resource reservation information via inter-UE coordination. |
| Mitsubishi | Observation 2: static TDD has fair performance only when the traffic corresponds to the resource pool splitting. Performance severely degrades when the traffic evolves, which shows the incapacity of static partitioning to adapt to real evolving deployments.  Observation 3: Dynamic solutions constantly achieve a fair tradeoff between the ignallin of the two RATs. |
| Toyota | Observation 5: A fairness issue in terms of channel access occurs between Rel-14/15/18 LTE SL and Rel-18 NR SL in dynamic resource sharing due to a lack of NR SL SCI decoding capability in Rel-14/15 Type C devices.  Observation 6: A fairness issue in terms of channel access occurs within Rel-18 Type A devices between LTE SL and NR SL due to the asymmetrical use of module information transfer.  Observation 7: Rel-14/15/18 LTE SL may use resources reserved by Rel-18 NR SL, which causes resource collisions between LTE SL and NR SL and degrades the system performance of both LTE SL and NR SL.  Observation 8: To circumvent the fairness issue, one solution would be that Rel-18 device sends LTE SCI to reserve the slots so that LTE SL Ues would exclude the reserved resources based on LTE SCI decoding. This solution would also solve the PSFCH AGC issue and the SCS AGC issue in Clause 2. So, the same solution solves three issues.  Proposal 4: To circumvent the fairness issue, the AGC issue caused by different SCS, and the AGC issue caused by PSFCH: Rel-18 NR SL UE sends LTE SCI to reserve the slots so that LTE SL Ues would exclude the reserved resources based on LTE SCI decoding.  Proposal 5: To circumvent the fairness issue, the AGC issue caused by different SCS, and the AGC issue caused by PSFCH, the solution of NR SL UE sending LTE SCI is combined with multi-slot aggregation where same or different TBs can be transmitted in each slot. |
| InterDigital | Proposal 1: LTE SL module sharing of LTE SL resource coordination information is initiated when a NR SL resource (re)selection is triggered.  Proposal 2: LTE SL module performs sensing using parameters provided by NR SL module.  Proposal 8: Study enable/disable the use of overlapping resources in a NR SL resource pool based on an estimate of the LTE SL activities in those resources. |
| Samsung | Proposal 3: Further study conditions to enable or disable sharing of common resources between LTE SL transmissions and NR SL transmissions.  Proposal 4: Further study mechanisms for the provision of sensing and resource reservation information from LTE SL module to NR SL module including:  - NR SL module triggers LTE SL module  - Based on a condition in the LTE module  Proposal 7: Study solutions based on energy detection to assist in co-existence between LTE and NR. |
| NTT DOCOMO | Proposal 5:  • For dynamic resource pool sharing, LTE-SL reservation information is used for IUC scheme 1 and scheme 2. |
| Qualcomm | Proposal 1: The LTE SL module of a Type A device shares the resource reservation information decoded from LTE SCI as well the resources selected/used for its own transmissions (meeting certain constraints of RSRP, priority, etc.) over the shared interface with the collocated NR SL module.  Proposal 2: The NR SL module estimates a SL LTE resource pool occupancy metric by aggregating the LTE SL resource reservation information over a time window (T\_win), where this time window is large compared to the periodicities of the traffic over the system.  Proposal 3: The size of the time window (T\_win) may either be a part of the NR SL UE (pre)-configuration or may be calculated at the NR SL module based on NR and LTE traffic patterns.  Observation 1: The LTE SL module of a Type A UE is not precluded from sharing other sensing information in addition to or instead of the LTE SL resource reservation information with the collocated NR SL module.  Observation 5: The proposed dynamic resource pool sharing scheme achieves a balance between NR SL and LTE SL performance when both NR SL and LTE SL share a common resource pool.  Observation 6: The proposed dynamic resource sharing scheme adapts to changing system and traffic conditions without requiring any update to its configurations.  Observation 7: The proposed dynamic resource pool sharing scheme can achieve high reliability SL transmissions for both NR and LTE under a range of system and traffic conditions. |
| Bosch | Observation 1: Dynamic co-channel coexistence overcome semi-static co-channel coexistence disadvantages at the expense of inter-module sharing complexity.  Proposal 1: For the study of dynamic LTE SL and NR SL co-channel coexistence, identify different inter-module cooperation level and inter-module communication latency  Proposal 2: For the dynamic co-channel coexistence to protect Type C devices, study the impact of limiting NR transmission to periodic reservations using the LTE reservation intervals in the shared resource pool.  - FFS whether/how to consider the channel congestion  Observation 3: For dynamic co-channel coexistence, different devices may have different level of the inter-module shared information and/or timely sufficient inter-module coordination parameters/sensing information.  Proposal 3: For the supported device of the dynamic co-channel coexistence solution, study the impact if the device acquire limited inter-module coordination parameters /sensing information.  Observation 7: If TDM-based resource pool partitioning and dynamic co-channel coexistence are allowed simultaneously in the same channel, it is recommended to configure 15 kHz only numerology for all NR devices to avoid multiple BWP configuration for the different devices.  Proposal 7: If TDM-based resource pool partitioning and dynamic co-channel coexistence are allowed simultaneously in the same channel, consider only one BWP with 15 kHz for all NR devices. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-6:**

* **For dynamic resource pool sharing, the NR SL module uses the LTE SL sensing and resource reservation information to generate IUC messages.**
  + **NR SL UEs can obtain a set of non-preferred resources that include resources being used by LTE SL transmissions, which have to be avoided for NR SL transmissions.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| OPPO | No | IUC is a partial solution of cochannel coexistence because there could be no UE A providing the IUC message. The basic solution for dynamic resource pool sharing should be studied first. |
| Toyota | Yes with comments | The IUC can mitigate the hidden terminal issue, but this does not solve the full issue as Type A Ues can not always be nearby. |
| Intel | Yes | We see values in allowing a type A device to update the IUC messages based on the LTE SL sensing and resource reservation information since this may serve as a complementary solution to mitigate co-existence in case of hidden node terminal and for legacy devices that may not mount the LTE module. |
| Vivo | No | 1.Same comments as Proposal 1-3: ‘**the LTE SL sensing and resource reservation information**’ should be changed to **‘the information shared by the LTE SL module’**  2. first, Type A device can rely on LTE module to obtain LTE reservation information and thus avoid collision with LTE. Secondly, IUC messages generated by UE-A based on shared LTE SL information may only be helpful in limited use cases, e.g., in the case of hidden nodes. But the transmission of IUC message needs additional resources and can lead to higher system congestion and thus more frequent resource re-selections. |
| Apple | Yes | IUC can mitigate the hidden node issue, and IUC information includes LTE sensing results could further enhance the resource selection reliability.  Since the IUC transmission mechanism is already supported in Rel-17 NR SL, there is no additional ignalling design for IUC request and IUC message beyond Rel-17 NR SL. Hence, we do not see significant spec. impact here. |
| Ericsson | No | In our view, this is an optimization that does not help with the dynamic coexistence between NR and LTE Ues. We propose to focus on the main issues between LTE and NR, and if there is time, discuss about this or other optimizations. |
| Nokia, NSB | Yes | If Proposal 1-3 is agreed (LTE sensing etc information is taken into account in NR resource exclusion) then it will be quite natural that this LTE information is also taken into account when a preferred or non-preferred set for IUC is generated. |
| InterDigital | Yes | We think IUC is a beneficial supplement to the solution of NR resource selection (for Type A device) based on LTE sensing and resource reservation information to address issues due to hidden node and non-monitored LTE resources. Also, it can benefit Type B device if it has Type A device in proximity. In addition, we agree with Apple that the required design and spec impact is not significant given the R17 IUC framework. |
| Samsung |  | Fine in principle. |
| NEC | Yes |  |
| Lenovo | Yes |  |
| Panasonic | Yes |  |
| Qualcomm | Comments | While we agree with the technical merits of the proposal, we feel that RAN 1 should first focus on agreeing and specifying on the basic DRPS scheme before discussing optimization techniques like IUC. |
| ETRI | Yes | We agree with Apple and InterDigital’s comments. |
| Transsion | No | Type A UE can rely on LTE sensing results provided by LTE module to avoid resource collision. Therefore, this proposal is an optimization method that can be further investigated if we have time. |
| Spreadtrum | Yes with comments | We are ok in principle. In addition, we would like to clarify whether only LTE sensing and reservation resource information is used for determining the IUC message or both this information and sensing results of the NR module. |
| CMCC | No | IUC mechanism should be studied carefully for this co-existence case since it requires more resource for transmitting IUC, which may make the AGC issue caused by PSFCH and higher SCS even worse, so we think the basic solution should be discussed first. |
| Sony | Yes | We are ok with this proposal. |
| Xiaomi | Yes |  |
| ZTE | No | In our understanding, IUC-based is just an alternative for dynamic resource pool sharing. We are not inclined to consider them jointly. |
| Continental Automotive Technologies GmbH | No |  |
| NTT DOCOMO | Yes with comments | We agree with supporting IUC with shared LTE information.  And we would like to confirm the intention of FL’ proposal. If second bullet is about details of first bullet regarding generating IUC messages, we prefer to add the perspective of the preferred resources in IUC scheme 1 and the collision indication (IUC scheme2) as:   * **For dynamic resource pool sharing, the NR SL module uses the LTE SL sensing and resource reservation information to generate IUC scheme 1 and scheme 2 messages**   + **NR SL UEs can generate ~~obtain~~ a set of non-preferred resources that include resources being used by LTE SL transmissions, which have to be avoided for NR SL transmissions and a set of preferred resources vice versa.**   + **NR SL UEs can generate a conflict indication between LTE SL and NR SL transmissions.**   If second bullet is about IUC Rx UEs behaviour, we can delete the second bullet because of no spec impact. |
| Wilus | Yes with comments | We share the same view with DCM. |
| CATT/GOHIGH | Comments | This seems to be an enhancement discussion. |
| Huawei, HiSilicon | No | We do not think such discussion is needed.  The agenda is going to discuss how to support coexistence between NR SL and LTE SL, not optimize IUC.  Then, the intention is not clear. For type A device, UE can know the LTE-V information from its LTE-V module, no IUC with LTE-V information is needed. |
| MediaTek | No |  |
| Fraunhofer | Yes | We are supportive of the FL’s proposal. |
| Bosch | No | IUC is an optimization that should not be discussed with our limited TUs. We prefer to save the time to discuss co-channel coexistence fundamental issues:   * Possibly study Type B (with lower priority) * If type A shared information is limited, study the impact of limited LTE sensing information received by NR SL module * Combine DRPS and TDM, restrict such resource pools to only 15 kHz, within the same BWP – [29] |

### Summary of 1st Round of Discussions

Based on the responses from companies, 16 companies are in favour of the proposal, while 12 companies are not. The proponents of this proposal see that this can help to mitigate the hidden node issue, and that this would be a natural way to use sensing results, e.g., in taking into account sensing information for NR resource exclusion when generating a preferred or non-preferred set for IUC.

The opponents of this proposal see this as further optimization and the focus should be on agreeing to the basic mechanisms of DRPS first.

Hence, it is the FL’s opinion that although there is a significant number of supporting companies, many also feel that this proposal is an enhancement that can wait to be discussed until after dynamic resource pool sharing is complete.

## [*INACTIVE*] Issue 1-7: Semi-static Resource Pool Partitioning

### Summary of Company Views from TDocs

In the previous meeting, it was concluded that TDM-based SRPP can be used as a solution for co-channel coexistence.

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| **Conclusion**  For co-channel coexistence in Rel-18, RAN1 concludes that the TDM-based semi-static resource pool partitioning based on Rel-16/17 specifications is one possible solution to ensure co-channel coexistence between LTE-V UEs and NR-V UEs.   * + Note: The LTE and NR resource pools do not overlap in time with each other in the TDM-based semi-static resource pool partitioning.   + Note 2: Rel-16 in-device coexistence framework can ensure alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe   + FFS: potential enhancements for synchronization can be further investigated |

While many companies are fine with the conclusion, some companies had commented on the FFS regarding potential enhancements for synchronization, and have unanimously voiced that there is no need for any further optimization.

On the other hand, there were a few companies who also stated that TDM-based SRPP is not practically feasible due to deployment challenges.

The following is a summary of the company views based on their respective contributions.

* No further optimization for TDM – [8], [13], [19], [21], [25]
* TDM is not practically feasible – [18], [22]
* Allow TDM with higher SCS - [29]

In the case of FDM-based SRPP, it was discussed intently in the previous meeting, with the group arriving at the following proposal, which was fairly stable at the time.

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| Proposal 2-2 (II):   * For co-channel coexistence in Rel-18, RAN1 assumes that the FDM-based semi-static resource pool partitioning can be used based on Rel-16/17 specifications, and can be studied with the following constraints:   + NR SL resource pool is configured with only 15 kHz SCS.     - ~~FFS other solutions to overcome the AGC issue caused by the differing SCSs between the NR SL and LTE SL resource pools.~~   + ~~Transmission/reception~~ Configuration of PSFCH in resources overlapping with LTE SL subframes is not permitted.     - ~~FFS other solutions to overcome the AGC issues caused due to PSFCH being configured in NR SL resource pools.~~   + FFS ~~other constraints~~ whether a guard band is required ~~requirement~~.   + Note: The LTE and NR resource pools do not overlap in frequency with each other in the FDM-based semi-static resource pool partitioning. |

While a decent number of companies seem fine to accept the proposal, and include restrictions such as the use of only 15 kHz SCS in the NR SL resource pool without PSFCH configured, some companies did not support the use of FDM-based SRPP.

The following is a summary of the company views based on their contributions.

* Support FDM – [6], [9], [11], [14], [18], [26]
  + With 15 kHz SCS restriction – [6], [9], [11], [14], [18], [26]
  + No PSFCH configured – [3], [6], [9], [11], [14], [26]
* Do not support FDM - [1], [8], [29]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” and can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Proposal 1: RAN1 does not further discuss an FDM semi-static approach to co-channel coexistence as a TDM approach is already agreed to be feasible. |
| Spreadtrum | Proposal 2: Multi-consecutive slots (corresponding to an LTE subframe) transmission could be supported for FDM semi-static resource pool separation if a higher SCS is considered for NR sidelink.  Proposal 3: Configuration of PSFCH in resources overlapping with LTE SL subframes is not permitted, if HARQ-ACK feedback is supported for FDM semi-static resource pool separation. |
| ZTE, SANECHIPS | Observation 1: TDM based semi-static resource pool partitioning can support all of Rel-16/17/18 NR sidelink to coexist with LTE sidelink and allow flexible SCS configuration without causing interference and AGC issues to LTE and NR sidelink.  Proposal 4: Besides dynamic co-channel coexistence with high priority, semi-static co-channel coexistence such as TDM based approach should be further studied and completed.  Proposal 5: To configure orthogonal resource pools for NR and LTE SL in time domain, at least the following conditions need to be met:  • The same time position and number of slots/subframes for NR S-SSB and LTE synchronization signals,  • The same number of reserved slots, and  • Aligned slot boundary by common synchronization procedure. |
| Panasonic | Proposal 1: For FDMed LTE and NR SL resource pools with semi-static resource pool partitioning, to fix SCS being 15kHz to avoid non-orthogonality between different SCS, and not to have FDMed PSFCH in NR to avoid AGC issue. (Note we are also ok with different SCS if the issue caused by PSFCH can be resolved) |
| CATT, GOHIGH | Proposal 5: There is no need to further study the potential enhancements for synchronization or consider it as low priority since the existing Rel-16 in-device coexistence framework can ensure alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe.  Proposal 6: FDM based semi-static resource pool partition solution is not adopted for co-channel coexistence mechanism between LTE sidelink and NR sidelink in Rel-18. |
| Intel | Observation 1:  • For co-channel coexistence in Rel.18, there is no need to define any enhancements for synchronization and the Rel.16 in-device coexistence framework is sufficient to ensure alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe.  Proposal 1:  • For co-channel coexistence in Rel.18, RAN1 concludes that the FDM-based semi-static resource pool partitioning based on Rel.16/17 specifications is one possible solution to ensure co-channel coexistence between LTE-V UEs and NR-V UEs.  o NR SL resource pool is configured with only 15 kHz SCS.  o Transmission/reception of PSFCH in resources overlapping with LTE SL subframes is not permitted.  o Note: The LTE and NR resource pools do not overlap in frequency domain with each other in the FDM-based semi-static resource pool partitioning. |
| CAICT | Proposal2: Propose to confirm the conclusion that TDM-based semi-static resource pool partitioning based on Rel-16/17 can be applied for co-channel coexistence between LTE-SL UEs and NR-SL UEs.  Proposal3: The SCS configuration in Rel-16/17 for NR-SL in the co-channel resource pool which is TDM-partitioned with LTE-SL can be supported. |
| Xiaomi | Proposal 2: For FDM based resource pool partitioning, only 15KHz SCS is considered for NR SL.  Proposal 3: For FDM based resource pool partitioning, NR SL and LTE SL shall be synchronized  - the subframe and slot boundary of two RATs shall be aligned.  Proposal 4: For FDM based resource pool partition, if PSFCH is (pre)configured in NR SL resource pool, the time domain configuration of LTE SL resource pool shall avoid the slots that occupied by NR SL PSFCH. |
| Fraunhofer | Observation 1: Based on the ETSI and SAE specifications, LTE SL resource pools having time-continuous bitmap configurations would make it difficult to use TDM-based resource pool partitioning as a solution for co-channel coexistence.  Proposal 1: For semi-static resource pool partitioning, we propose to support FDM-based resource pool partitioning only if the SCS for NR SL resource pools is restricted to 15 kHz, in order to overcome AGC issues. |
| LG | Proposal 3: No enhancement of synchronization procedure is needed to support the TDM-based semi-static resource pool partitioning. |
| Apple | Proposal 1: For TDM-based semi-static resource pool partitioning, no enhancement for synchronization is needed.  • Rel-16 in-device framework is reused for the synchronization between LTE sidelink and NR sidelink. |
| Mitsubishi | Observation 1: In ITS spectrum, static TDM solutions are unable to adapt to the traffic changes between the two RATs and cannot respond to the need for a flexible technology transition path from LTE to NR. |
| Samsung | Observation 1: No further optimization is needed for TDM-based semi-static resource pool partitioning. |
| Sharp | Proposal 2 (for conclusion):  • For co-channel coexistence in Rel-18, RAN1 assumes that the FDM-based semi-static resource pool partitioning can be used based on Rel-16/17 specifications, and can be studied with the following constraints:  o NR SL resource pool is configured with only 15 kHz SCS.  o Configuration of PSFCH in resources overlapping with LTE SL subframes is not permitted.  o FFS whether a guard band is required.  o Note: The LTE and NR resource pools do not overlap in frequency with each other in the FDM-based semi-static resource pool partitioning. |
| Bosch | Observation 5: If only TDM-based resource pool partitioning is allowed for co-channel coexistence, NR sidelink may have different numerology in their dedicated resource pool (RP) partition.  Proposal 5: If TDM-based resource pool partitioning is the only configured co-channel coexistence in a channel, allow NR SL with higher SCS  Observation 7: If TDM-based resource pool partitioning and dynamic co-channel coexistence are allowed simultaneously in the same channel, it is recommended to configure 15 kHz only numerology for all NR devices to avoid multiple BWP configuration for the different devices.  Proposal 7: If TDM-based resource pool partitioning and dynamic co-channel coexistence are allowed simultaneously in the same channel, consider only one BWP with 15 kHz for all NR devices.  Observation 8: FDM-based resource pool partitioning implementation with narrowly frequency separated resource pools can be very challenging for co-channel coexistence of LTE V2X and NR SL.  Proposal 8: Do not support FDM-based semi-static resource pool partitioning for co-channel coexistence of LTE V2X and NR SL in Rel-18 WI. |

# Device Types and their Coexistence

For both LTE SL and NR SL to co-exist within the same frequency channel, it is important to limit the scope of the study based on the inputs of the companies as well as on the permitted time allocated for this topic. This includes the type of devices that are considered – devices that contain both LTE SL and NR SL modules, which was considered in the Rel-16 in-device coexistence topic and devices that contain only NR SL modules.

## [*INACTIVE*] Issue 2-1: Type A Devices

### Summary of Company Views from TDocs

The following working assumption was made in the previous meeting, which defines the type A device with respect to the feasibility of dynamic resource pool sharing.

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| --- |
| **Working assumption**  Co-channel coexistence between LTE SL and NR SL is supported for device type A. Device type A contains both LTE SL and NR SL modules. For device type A, the NR SL module may use the sensing and resource reservation information shared by the LTE SL module. |

Based on the contributions from different companies, 7 of them wanted to confirm the working assumption, while 2 other companies had stated that the focus of the AI should be restricted to only type A devices. One company wanted the device type to use energy detection for LTE SL transmission detection [25], while another had brought up the necessity of inter-RAT conflict avoidance and mitigation [28].

The following is a summary of the company views:

* Confirm the working assumption – [5], [8], [11], [13], [14], [20], [25] (with update)
* Type A devices may use energy detection to detect LTE SL transmissions – [25]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” since we already have a working assumption in place for Type A devices and it can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Spreadtrum | Proposal 1: The study of co-channel coexistence for LTE sidelink and NR sidelink should only focus on Device type A and LTE devices. |
| ZTE, SANECHIPS | Proposal 7: Confirm the working assumption about device type A made in the latest meeting. |
| Panasonic | Proposal 3: Type A devices should be capable to receive both LTE SL and NR SL simultaneously  Proposal 4: For SL UEs capable to perform simultaneous TX of LTE and NR SLs, some optimization on dynamic power sharing may also be considered |
| CATT, GOHIGH | Proposal 2: Confirm the working assumption in RAN1#110 as follows:  • Co-channel coexistence between LTE SL and NR SL is supported for device type A. Device type A contains both LTE SL and NR SL modules. For device type A, the NR SL module may use the sensing and resource reservation information shared by the LTE SL module. |
| NEC | Proposal 5: Confirm the WA in the last meeting, i.e., Type A UE (with LTE SL and NR SL modules) should be considered to work in solution C (shared resource pool for the two RATs). |
| CAICT | Proposal1: Propose to confirm the working assumption to support device type A for dynamic resource sharing and FFS the co-channel coexistence between device type B/D/E and device type C, for which semi-static resource pool sharing can be applied. |
| Xiaomi | Proposal 1: The working assumption in RAN1#110 on device type A shall be confirmed. |
| CMCC | Proposal 1: RAN1 continues the work on dynamic resource pool sharing based on existing agreements and WID only for Type A devices and operating combination A.   Other UE types and operating combinations should not be considered at least in Rel-18. |
| MediaTek | Proposal 1: Confirm the following working assumption from RAN1-110:  • Co-channel coexistence between LTE SL and NR SL is supported for device type A. Device type A contains both LTE SL and NR SL modules. For device type A, the NR SL module may use the sensing and resource reservation information shared by the LTE SL module. |
| Samsung | Proposal 1: For the definition of Type-A devices, agree to the working assumption made in RAN1#110 with the update in red:  Co-channel coexistence between LTE SL and NR SL is supported for device type A. Device type A contains both LTE SL and NR SL modules. For device type A, the NR SL module may use the sensing and resource reservation information shared by the LTE SL module. Device type A may use energy detection to detect the presence of LTE transmissions. |
| Qualcomm | Observation 3: Type A devices, which contains both NR SL and LTE SL modules, need to implement a mechanism to resolve inter-RAT Tx-Tx and Tx-Rx conflicts for co-channel coexistence.  Observation 4: Dropping of transmission and reception based on a priority associated with a RAT will severely degrade the reliability of the transmission over the lower priority RAT.  Proposal 7: RAN 1 specifies technique for inter-RAT conflict avoidance and mitigation for Type A devices.  Observation 8: Avoiding inter-RAT Tx-Tx and Tx-Rx conflicts in a Type A UE using option 1, i.e., LTE SL module excluding the NR SL Tx resource set from its set of transmission resources, performs better than Type A UE using option 2, i.e., resolving conflicts based on half-duplex constraints with Tx prioritized over Rx. |

## [*INACTIVE*] Issue 2-2: Type B Devices

### Summary of Company Views from TDocs

In the previous meeting, device type B was discussed by different companies, and the following proposal was discussed.

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| Proposal 1-2a (II):   * For co-channel coexistence solutions in Rel-18, RAN1 is to study device type B which contains:   + Alt 1: Only an NR SL module.   + Alt 2: a co-located LTE SL and NR SL module, but the LTE SL module does not share any LTE sensing and resource reservation information. |

Based on the contributions, there are 7 companies that support type B devices. They had discussed the different means of how the type B device can be aware of the LTE SL transmissions, which included the performing of energy-based sensing to determine resources that are being occupied by LTE SL transmissions, the use of LTE SL SCIs and IUC messages.

The following is a summary of the company proposals.

* Support Type B devices – [1], [15], [18], [23], [30], [32], [29]
  + Do not support Type B devices – [26]
* How Type B devices obtain LTE sensing information
  + Device capability to detect ongoing LTE transmissions - [1]
  + Conduct energy-based sensing of LTE transmissions – [1], [18], [22], [23], [30]
  + Receive LTE PSCCH (incl SCI) signals/explicit signaling – [1], [22], [30], [32]
* Support IUC for Type B devices – [1], [6], [8], [15], [18], [22]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” and can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
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| **Company** | **Company proposal related to this issue** |
| Nokia | Proposal 9: For co-channel coexistence, Type B devices should be supported. A Type B device is a Release-18 NR only device which does not have the sensing information shared by the LTE module (if present).  Proposal 10: A Type B device should support at least one of the following LTE detection or sensing capabilities:  • Capability A: NR SL device capability to detect ongoing LTE transmissions.  • Capability B1: NR SL device capability to conduct energy-based sensing of LTE transmissions.  • Capability B2: NR SL device can receive LTE PSCCH (incl SCI) signals  • FFS whether to include the measurement of the corresponding PSSCH RSRP.  Proposal 11: A Type B device should be able to discover when a Type A device capable of providing IUC support is nearby.  Proposal 12: Both IUC Scheme 1 and Scheme 2 should be supported for NR SL Type B devices. |
| CATT, GOHIGH | Proposal 3: For co-channel coexistence solutions in Rel-18, RAN1 should study both device type B1 and device type B2 as follows:  • Device type B1 contains only an NR SL module.  • Device type B2 contains a co-located LTE SL and NR SL module, but the LTE SL module cannot share any LTE sensing and resource reservation information to NR SL module. |
| NEC | Observation 2: Both type A UE (with LTE SL and NR SL modules) and type B UE (with NR SL module only) can work in SL co-existence solution A (TDM resource pools for the two RATs) and solution B (FDM resource pools for the two RATs).  Proposal 4: SL co-existence solution A (TDM resource pools for the two RATs) and solution B (FDM resource pools for the two RATs) should be used as basic schemes for both type A UE (with LTE SL and NR SL modules) and type B UE (with NR SL module only). |
| Lenovo | Proposal 1: Support device type B with only NR SL module for co-channel coexistence. |
| Fraunhofer | Proposal 3: For dynamic resource pool sharing, the NR SL module can obtain LTE V2X resource allocation and scheduling information  • From the co-located LTE V2X module,  • By performing basic LTE measurements,  • By receiving IUC messages from other UEs that are aware of LTE V2X sensing information.  Proposal 6: Study how type B devices containing only an NR SL modem can be used for co-channel coexistence with LTE V2X. |
| Mitsubishi | Proposal 2: Co-channel coexistence between LTE SL and NR SL is supported for NR devices aware of resources being occupied by LTE SL. This includes dual module devices where the NR module uses the sensing and resource reservation information shared by the LTE module. FFS other method(s) for the NR module to be aware of resources being occupied by LTE SL. |
| Toyota | Observation 10: Type B devices can be of two sub-types: one that contains only an NR SL module, and one that contains a co-located LTE SL and NR SL modules but the LTE SL module does not share any LTE sensing and resource reservation information.  Observation 11: From the RAN1 viewpoint, the co-channel coexistence design to support both sub-types of Type B devices would be the same regardless of whether a Type B device contains a co-located LTE SL module or not.  Observation 12: Excluding Type B devices would result in the need to replace a Type C device with a Type A device which contains a LTE SL and NR SL modules with information sharing from the LTE SL module, and it could discourage the market from adopting today’s LTE SL modules (Type C devices).  Observation 13: How the NR SL UE of a Type B device is expected to get the information on LTE SL resource usages could be achieved by RSSI measurements (which the NR SL UE already needs to do anyway) and resource exclusion based on RSSI.  Observation 14: If NR SL UE of a Type B device sends LTE SCI to reserve the slots, LTE SL UEs would be able to exclude the NR SL reserved resources slots based on LTE SCI decoding.  Proposal 7: RAN1 to study co-channel coexistence solutions to support Type B devices. |
| Sharp | Observation 1: There is no need to mention the release of a device in the definition of a device type.  Proposal 1 (for conclusion): From RAN1 perspective, no specification work is envisioned for Type B devices (that contain only NR SL module, or contain a co-located LTE SL and NR SL module but the LTE SL module does not share any LTE sensing and resource reservation information). |
| Ericsson | Proposal 2 In the study of LTE-NR coexistence, devices of Type B are considered in addition to type A devices.  Observation 14 Detection of LTE SL transmissions can be direct, indirect or by means of explicit signalling.  Proposal 8 RAN1 to study:  • Indirect detection and explicit signalling for detecting LTE SL transmissions without implementing LTE SL features.  • The use of direct detection, as an optimization, for devices implementing NR SL and LTE SL. |
| Continental | Proposal 2: Both Type A and B should be considered in the study of co-channel coexistence.  Proposal 5: Type B devices should support receiving and decoding LTE signals, e.g., SCI. |

## [*INACTIVE*] Issue 2-3: Device Type Coexistence

### Summary of Company Views from TDocs

In RAN1#109-e, the following device types were discussed.

* Type A devices are Rel-18 devices that contain both LTE SL and NR SL modules
* Type B devices are Rel-18 devices that contain only NR SL modules
* Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules
* Type D devices are Rel-16/17 devices that contain only NR SL modules
* Type E devices are Rel-16 devices that contain both LTE SL and NR SL modules based on in-device coexistence framework

In the previous meeting, the topic of device type coexistence was discussed, and the following proposal was achieved.

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| Proposal 1-3 (II):   * For co-channel coexistence solutions in Rel-18, the supported device type(s) Type A (and Type B, if agreed to be supported) ~~(type A and/or type B)~~ has to ~~at least~~ coexist at least with LTE SL devices.   + RAN1 does not pursue any ~~further~~ potential enhancements for device type other than A ~~and/or B~~ (and B if agreed). |

According to the WID’s justification, the coexistence solution should consider the “***V2X deployment scenario where both LTE V2X and NR V2X devices are to coexist in the same frequency channel***”. In the FL’s view, the WID requires new Rel-18 SL devices to be able to coexist with other Rel-14/15 LTE SL devices, in the same frequency channel. Hence, evaluation of all co-channel coexistence solutions applied to any new Rel-18 SL device should be evaluated to coexist with at least Rel-14/15 LTE SL devices.

However, the WID, under objectives, also state that “***Rel-18 sidelink should be able to coexist with Rel-16/17 sidelink in the same resource pool.***” to ensure backward compatibility. It was pointed out that the coexistence with Rel-16/17 for backward compatibility is a high level guidance from the plenary for all the Rel-18 objectives, and need not be captured explicitly.

Based on the summary of the contributions from companies, the topic was not hotly debated. Only 4 companies had mentioned this aspect, and their views are captured below.

* Support Type C – [13], [25], [29], [30]
* Support Type D – [13], [20], [25]
* Support Type E – [13], [20], [25], [30]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” and can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Panasonic | Proposal 2: For V2X usage perspective, co-existence of type A and type C are sufficient (with the high priority). The co-existence among type A, B and C can be considered for SL use cases other than V2X (with lower priority). |
| CAICT | Proposal1: Propose to confirm the working assumption to support device type A for dynamic resource sharing and FFS the co-channel coexistence between device type B/D/E and device type C, for which semi-static resource pool sharing can be applied. |
| MediaTek | Proposal 4: Study potential enhancements to make sure that Rel-18 NR sidelink UE can achieve dynamic co-channel coexistence with LTE sidelink while simultaneously maintaining backward compability with Rel-16/Rel-17 NR sidelink. |
| Samsung | Observation 2: A resource pool shared between LTE SL UEs and NR SL UEs can include:  - Type A devices  - LTE only devices  - Rel-16 or Rel-17 NR devices. |
| Ericsson | Observation 6 Coexistence solutions for both Type C and Type E are required. A common design is preferable.  Observation 7 Coexistence with type D UEs is not the focus of this work, but it must be guaranteed too. |
| Bosch | Observation 2: For dynamic co-channel coexistence, Type C devices should not be severely impacted.  Proposal 2: For the dynamic co-channel coexistence to protect Type C devices, study the impact of limiting NR transmission to periodic reservations using the LTE reservation intervals in the shared resource pool.  - FFS whether/how to consider the channel congestion |

# Others

## [*INACTIVE*] Issue 3-1: Operational Modes

### Summary of Company Views from TDocs

In RAN1#109-e, the following combinations of operational modes were considered:

* Combination A : Mode 2 NR SL + Mode 4 LTE SL
* Combination B : Mode 1 NR SL + Mode 4 LTE SL
* Combination C : Mode 2 NR SL + Mode 3 LTE SL
* Combination D : Mode 1 NR SL + Mode 3 LTE SL

The corresponding agreement made in RAN1#109-e is as follows:

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| --- |
| **Agreement:**  For the study of co-channel coexistence solutions in Rel-18, the combination of operational modes Mode 2 NR SL with Mode 4 LTE SL (Combination A) is considered with high priority.   * FFS: Whether/how to support Mode 1 NR SL + Mode 4 LTE SL (Combination B) and/or Mode 2 NR SL + Mode 3 LTE SL (Combination C). |

Based on the inputs from the company contributions, only 8 companies had voiced their views on this topic. The following is a brief of their views.

* 2 companies prefer to support only combination A, and not B and C – [11], [25]
* 4 companies prefer to include combination B – [8], [15], [22], [32]
* 5 companies prefer to include combination C – [5], [8], [15], [22], [32]
* 1 company wants to specify solutions that leverage network deployment – [30]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” and can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| ZTE, SANECHIPS | Observation 2: The solution of combination A can be reused for combination C because there is no essential difference for combination C comparing to combination A.  Proposal 8: Combination C should have the same priority as Combination A.  Proposal 9: Combination B can be further considered after the competition of combination A, and the legacy mechanism in Rel-15 (sensing and reporting the sensing results to network) can be taken as starting point. |
| CATT, GOHIGH | Proposal 4: For the study of co-channel coexistence solutions in Rel-18, the combinations of operational modes Mode 1 NR SL + Mode 4 LTE SL (Combination B) and Mode 2 NR SL + Mode 3 LTE SL (Combination C) should also be considered at the earlier stage. |
| NEC | Proposal 3: Combination B (NR mode 1 and LTE mode 4) and combination C (NR mode 2 and LTE mode 1) are not supported for sidelink co-existence. |
| Lenovo | Proposal 2: Support both Combination B which is Mode 1 NR SL+ Mode 4 LTE SL and Combination C which is Mode 2 NR SL + Mode 3 LTE SL for co-channel coexistence. |
| Mitsubishi | Proposal 3: For the study of co-channel coexistence solutions in Rel-18, combination of operational modes B and C are also considered. |
| Samsung | Proposal 8: For the study of co-channel coexistence solutions in Rel-18, the combination of operational modes “Mode 2 NR SL with Mode 4 LTE SL” (operating combination A) is the only combination considered. |
| Ericsson | Proposal 1 RAN1 specifies solutions that leverage on NW deployment in addition to other solutions. FFS whether Mode 1 (NR) and/or Mode 3 (LTE) are addressed by such solutions.  Observation 1 Combination A, where LTE SL UE and NR SL UE are selecting radio resources autonomously, is a relevant case, e.g., for operation in ITS band.  Observation 2 Information about the presence of LTE UEs allows for addressing Combination B by means of scheduling restrictions applied by the gNB.  Observation 3 Information about reservations by LTE UEs requires dynamic and costly reports from the NR UE.  Observation 4 Optimizations for Combination C are not feasible given the agreement precluding changes to LTE specifications.  Observation 5 Specific optimizations for Combination D are not needed. |
| Continental | Proposal 1: The study of co-channel coexistence should prioritize Combination A, but should also consider enhancements applicable to Combinations B and C. |

## [*INACTIVE*] Issue 3-2: Synchronization

### Summary of Company Views from TDocs

Companies had covered the synchronization aspects in their contributions, with the following aspects highlighted.

* Slot boundary alignment between LTE SL and NR SL is based on Rel-16 in-device framework, and they are assumed to be aligned – [1], [17]
* In the case where the NR SL UE is not synchronized, it uses the LTE SLSS as the synchronization reference – [4], [5], [14], [30]
* Study the case where the slot boundary is misaligned between LTE SL and NR SL – [22], [25], [32]

However, in the previous plenary RAN#97-e, it was decided that the work in RAN1 should focus on the dynamic resource pool sharing, with high priority given to solutions catering to type A devices and operating combination A. Hence, in consultation with the rapporteur, the FL has currently marked this section as “Inactive” and can be considered when the primary focus of dynamic resource pool sharing is nearing completion.

#### Company Proposals:

The above summary is based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia | Observation 9: For any co-channel coexistence mode slot and subframe boundary alignment between LTE and NR SL is assumed  Proposal 13: When non-overlapping resource pools are configured for semi-static TDM based co-channel coexistence, DFN/SFN and subframe/slot alignment between NR SL and LTE SL is assumed.  Proposal 14: Type A device should support transmitting NR S-SSB that is based on reception of LTE S-SSB in co-channel coexistence operation.  Proposal 15: RAN1 should discuss how a Type B NR SL UE can be synchronized with nearby LTE SL UEs and if Type B device should have LTE S-SSB reception and/or transmission capabilities |
| Vivo | Observation 7: The design of the synchronization signal is different between LTE SL and NR SL, so there might be a collision between the synchronization signal of one RAT and PSSCH transmission of the other RAT.  Proposal 4: If dynamic resource sharing is supported, the collision between the synchronization signal and the resource pools of different RATs should be solved, e.g., by configuring FDMed LTE SL and NR SL synchronization signals, or adopting LTE SL synchronization signals for NR SL, etc. |
| ZTE, SANECHIPS | Proposal 6: The slot boundary can be aligned between NR SL and LTE SL by requiring NR SL to perform synchronization procedure according to the synchronization priority selection order of LTE SL. |
| Xiaomi | Proposal 6: For dynamic resource sharing, NR SL synchronization resource is not configured in the carrier shared by LTE and NR SL  - NR SL communication can select LTE SLSS as the synchronization reference.  Proposal 7: NR SL logic slots shall exclude the slots which have time domain overlapping with LTE synchronization resources. |
| ETRI | Proposal 6: It is proposed to reuse Rel-16 in-device framework can be reused to ensure alignment between NR slot boundary and LTE subframe boundary. |
| Mitsubishi | Proposal 4: For co-channel coexistence on overlapped resource pools, study the feasibility and benefits of at least the following solutions:  - Resource allocation modifications to NR Rel.17 procedure in order to take into account the LTE reservation in overlapping resources  - Solutions for enabling NR with PSFCH enabled to coexist with LTE  - Solutions for coexistence and cross-RAT interpretation of sidelink synchronization signals |
| Samsung | Observation 3: In case of LTE/NR SL co-existence, unsynchronized LTE/NR SL transmissions can suffer a greater performance loss.  Proposal 2: Further study how to achieve synchronization between NR and LTE SL transmissions when sharing common resources. |
| Ericsson | Proposal 9 RAN1 specifies for type-A devices to follow LTE SLSS, if available, in the context of coexistence between LTE and NR sidelinks. |
| Continental | Proposal 4: RAN1 should consider both scenarios with full synchronization and fixed misalignment between NR SL and LTE SL. |

# Collection of Agreements/Conclusions from Previous Meetings

## RAN1#110 (August 22nd – 26th, 2022)

**Working assumption**

Co-channel coexistence between LTE SL and NR SL is supported for device type A. Device type A contains both LTE SL and NR SL modules. For device type A, the NR SL module may use the sensing and resource reservation information shared by the LTE SL module.

**Conclusion**

For co-channel coexistence in Rel-18, RAN1 concludes that the TDM-based semi-static resource pool partitioning based on Rel-16/17 specifications is one possible solution to ensure co-channel coexistence between LTE-V UEs and NR-V UEs.

* + Note: The LTE and NR resource pools do not overlap in time with each other in the TDM-based semi-static resource pool partitioning.
  + Note 2: Rel-16 in-device coexistence framework can ensure alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe
  + FFS: potential enhancements for synchronization can be further investigated

**Agreement**

For co-channel coexistence in Rel-18, dynamic resource pool sharing is studied, with the following constraints:

* + NR SL resource pool is configured with 15 kHz SCS.
    - FFS support of NR SL resource pool configured with higher SCS, including other solutions to overcome the AGC issue caused by the differing SCSs between the NR SL and LTE SL resource pools
  + For NR PSFCH (if configured), at least the following alternatives are studied:
    - Alt 1: Avoid PSFCH transmission in time slots that overlap with subframes used for LTE SL transmissions.
      * FFS: Avoiding PSFCH transmissions can be performed by the UE transmitting PSFCH and/or the UE transmitting PSSCH.
    - Alt 2: NR SL UEs use a periodically repeating set of PSFCH slots.
      * FFS: periodicities of the set.

## RAN1#109-e (May 9th – 20th, 2022)

**Agreement:**

For co-channel coexistence in Rel-18, no changes in the LTE SL specifications are allowed.

**Agreement:**

For co-channel coexistence in Rel-18, Rel-16/17 simulation assumptions are reused for evaluation of solutions, except for the UE dropping model.

* FFS: UE dropping model

**Agreement:**

For the study of co-channel coexistence solutions in Rel-18, the combination of operational modes Mode 2 NR SL with Mode 4 LTE SL (Combination A) is considered with high priority.

* FFS: Whether/how to support Mode 1 NR SL + Mode 4 LTE SL (Combination B) and/or Mode 2 NR SL + Mode 3 LTE SL (Combination C).

**Agreement:**

For evaluation of co-channel coexistence solutions in Rel-18, support the inclusion of dual module devices with NR+LTE modules using the following UE dropping models:

* UE Dropping Model A: The distance between 1 LTE SL module and 1 NR SL module are maintained as zero to model a co-located dual module device. The inter-device distance between any two adjacent devices in the same lane, which may be either a single module or a dual module device, is modified by doubling the time in the upper limit, resulting in max{2 meter, an exponential random variable with the average of the speed \* 4sec}.
* UE Dropping Model B: The distance between 1 LTE SL module and 1 NR SL module are maintained as zero to model a co-located dual module device. The inter-device distance between any two adjacent devices in the same lane, which may be either a single module or a dual module device, is maintained the same as current assumptions, i.e., max{2 meter, an exponential random variable with the average of the speed \* 2sec}.

Companies should mention the UE dropping model and the distribution of each device type (single/dual module) used in their simulation assumptions.

**Agreement:**

Feasibility of semi-static resource pool partitioning and dynamic resource sharing as possible solutions for co-channel coexistence are to be studied.

**Agreement:**

For studying the feasibility of dynamic resource sharing as a possible solution for co-channel coexistence,

* For device type A, the NR SL module uses the sensing and resource reservation information shared by the LTE SL module.
  + FFS details on how the NR SL module uses this information.
  + FFS details on how the LTE SL module shares the information to the NR SL module, exact information shared, timeline etc.
* FFS: Whether/how to define other method(s) for device type A to be aware of resources being occupied by LTE SL.
* FFS: Whether/how device type B should be supported.

# References

1. R1-2208358 On Co-channel Coexistence for LTE Sidelink and NR Sidelink Nokia, Nokia Shanghai Bell
2. R1-2208450 Co-channel coexistence for LTE sidelink and NR sidelink Huawei, HiSilicon
3. R1-2208556 Discussion on Co-channel coexistence for LTE sidelink and NR sidelink Spreadtrum Communications
4. R1-2208645 Co-channel coexistence for LTE sidelink and NR sidelink vivo
5. R1-2208724 Study on co-channel coexistence for LTE sidelink and NR sidelink ZTE, Sanechips
6. R1-2208765 Discussion on Sidelink Co-channel Coexistence Panasonic
7. R1-2208824 Discussion on dynamic resource sharing in co-channel coexistence of LTE and NR SL OPPO
8. R1-2208978 Discussion on co-channel coexistence for LTE sidelink and NR sidelink CATT, GOHIGH
9. R1-2209056 Considerations for LTE Sidelink and NR Sidelink Co-channel Coexistence Intel Corporation
10. R1-2209103 Discussion on co-channel coexistence for LTE sidelink Sony
11. R1-2209150 Co-existence between LTE and NR sidelink NEC
12. R1-2209169 Discussion of co-channel coexistence for LTE sidelink and NR sidelink Transsion Holdings
13. R1-2209237 Considerations on co-channel coexistence for LTE SL and NR SL CAICT
14. R1-2209288 Discussion on co-channel coexistence for LTE and NR sidelink xiaomi
15. R1-2209303 Discussion on co-channel coexistence for LTE sidelink and NR sidelink Lenovo
16. R1-2209340 Discussion on co-channel coexistence for LTE sidelink and NR sidelink CMCC
17. R1-2209406 Discussion on co-channel coexistence for LTE sidelink and NR sidelink ETRI
18. R1-2209419 Discussion on Co-Channel Coexistence for LTE and NR Sidelink Fraunhofer HHI, Fraunhofer IIS
19. R1-2209480 Discussion on co-channel coexistence for LTE sidelink and NR sidelink LG Electronics
20. R1-2209520 Co-channel coexistence for NR sidelink and LTE sidelink MediaTek Inc.
21. R1-2209587 Discussion on Co-channel Coexistence for LTE Sidelink and NR Sidelink Apple
22. R1-2209611 On sidelink co-channel coexistence issues Mitsubishi Electric RCE
23. R1-2209632 Discussion on dynamic co-channel coexistence for LTE sidelink and NR sidelink TOYOTA Info Technology Center
24. R1-2209637 Co-channel coexistence for LTE sidelink and NR sidelink InterDigital, Inc.
25. R1-2209733 On co-channel coexistence for LTE sidelink and NR sidelink Samsung
26. R1-2209777 Discussion on co-channel coexistence for LTE sidelink and NR sidelink Sharp
27. R1-2209906 Discussion on co-channel coexistence of LTE-SL and NR-SL NTT DOCOMO, INC.
28. R1-2209987 Co-channel Coexistence Between LTE SL and NR SL Qualcomm Incorporated
29. R1-2210080 Views on LTE and NR sidelink co-channel coexistence ROBERT BOSCH GmbH
30. R1-2210131 Co-channel coexistence between LTE sidelink and NR sidelink Ericsson
31. R1-2210141 Discussion on co-channel coexistence for LTE sidelink and NR sidelink WILUS Inc.
32. R1-2210187 Discussion on Co-channel coexistence for LTE sidelink and NR sidelink Continental Automotive GmbH

# Appendix A: Contact Information

In this section, delegates responding to this email discussion can enter their details, in order to be informed about who is handling each topic. If a company has several delegates handling the same sub-agenda, all delegates can provide their information (and add their topics in bracket).

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