**3GPP TSG RAN WG1 Meeting #110 R1-2207636**

**Toulouse, France, August 22nd – 26th, 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#96, 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

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

[110-R18-SL] To be used for sharing updates on online/offline schedule, details on what is to be discussed in online/offline sessions, tdoc number of the moderator summary for online session, etc – Kevin (OPPO)

# Collection of Agreements/Conclusions in RAN1#110

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

TBD

# Device Types and Operational Modes

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. In the previous meeting, 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

Two aspects regarding the device types were discussed – one was which of the device types have to support co‑channel coexistence, covered in Sections 4.1, 4.2 and 4.3, and the other aspect was regarding which device types these supported devices have to co‑exist with, covered in Section 4.4.

The last version of the proposal that was discussed via email discussions in the previous meeting is as follows:

|  |
| --- |
| **Proposal 1-1 (V)**   * **For the study of co-channel coexistence solutions in Rel-18, ~~at least~~ device type A and type B are ~~is~~ considered.**   + **~~FFS: Whether type B devices are considered.~~** * **For the study of co-channel coexistence solutions in Rel-18, the ~~supported~~ considered device type(s) coexist with type C devices in the same channel~~, type D and type E devices~~.**   + **Note: The considered device type(s) are backward compatible with Rel-16/17 devices and coexist when they operate over the same resource pool.** * **Note:**   + **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~~** |

## [*ACTIVE*] Issue 1-1: Type A Devices

### Summary of Company Views from TDocs

Based on the inputs from the contributions, it is clear that majority of the companies (22) support type A devices. As per the WID, the in-device coexistence framework has to be reused as much as possible, which would mean that the type A devices should contain both the LTE SL and NR SL module.

However, the exact definition of type A devices needs to be revisited since contributions from [3], [6] and [28] pointed out that the presence of both the LTE SL and NR SL modules alone do not define the device type, but rather it should be based on the capability of the LTE SL module to share sensing information with the NR SL module within the device, and on the capability of the NR SL module to include this sensing information in its sensing and resource selection procedure. Hence, we can define type A devices as follows:

* Type A devices are devices with the following characteristics:
  + Contains both NR SL and LTE SL modules.
  + LTE SL module is capable of sharing sensing information with the NR SL module.
  + NR SL module is capable of considering this information in its own sensing and resource selection procedure.

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

|  |
| --- |
| **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. |

Hence, in this meeting, the FL proposes to define type A devices that have both an LTE SL module and an NR SL module, and the LTE SL module uses the Rel-16 in-device framework to share sensing and resource reservation information to the NR SL module. Based on this definition, companies can then decide whether type A devices can be supported for Rel-18 co-existence solutions.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Observation 2: The in-device coexistence framework can be used for co-channel coexistence but with expected resource use efficiency degradation for both LTE and NR.  Proposal 7: RAN1 to make an assumption on the latency associated with the exchange of LTE SL sensing information from the LTE SL to the NR SL module.  Observation 3: 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 4: A NR SL Type A device will have to be an NR module based on Rel-18 as NR SL specification changes would be needed.  Proposal 9: Support Type A devices with Rel-18 NR modules for LTE and NR SL co-channel coexistence. |
| LG | Proposal 4: The following combination of UE types should be considered as the baseline in the study of co-channel coexistence for LTE SL and NR SL:   Type A: Devices that contain both LTE SL and NR SL modules   Type C: Devices that contain only LTE SL module |
| Huawei, HiSilicon | Proposal 1: For co-channel coexistence in Rel-18, devices containing NR sidelink module shall be also able to decode LTE sidelink transmissions by its in-device LTE sidelink module.  Proposal 2: For NR-V and LTE-V co-channel co-existence in Rel-18,  • RAN1 only discusses enhancements related to Type A1 device.  • RAN1 assumes Type A2 device already works in semi-static resource pool partitioning solution. Type A2 device in dynamic resource sharing solution is not supported.  • Type B device is not supported.  • Note:  o A Type A1 device contains both LTE SL and NR SL modules, and use both modules for co-channel coexistence purpose.  o A Type A2 device contains both LTE SL and NR SL modules, and use only NR SL module for co-channel coexistence purpose.  o A Type B device contains only NR SL module. |
| Spreadtrum | Proposal 1: Devices type A and type B should be supported in the scope of the study of co- channel coexistence solutions in Rel-18, and could coexist with type C devices. |
| Toyota | Proposal 2: The following device types are considered for the study of co-channel coexistence solutions:  • Type A devices are Rel-18 devices that contain both LTE SL and NR SL modules with the availability of sensing and resource reservation information from the LTE SL module  • Type B devices are Rel-18 devices that contain a NR SL module without the availability of sensing and resource reservation information from a colocalized LTE SL module (if any)  • Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| ZTE, Sanechips | Proposal 3: To evaluate and support dynamic co-channel coexistence for LTE sidelink and NR sidelink, Type A device should be studied in high priority. |
| OPPO | Proposal 2: For co-channel coexistence in Rel-18, Type A devices with dual modules are considered as baseline. |
| Fraunhofer | Proposal 1: For co-channel coexistence between NR SL and LTE V2X, we propose that at least type A devices are supported, where the device contains both an NR SL modem and an LTE V2X modem. |
| 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). |
| Intel | Proposal 2:  • RAN1 should only consider co-existence mechanisms targeted for devices of type A, while these may transparently mitigate co-existence issues also for devices of type B. |
| Xiaomi | Proposal 1: Both type A and type B devices can be considered for studying the feasibility of semi-static resource pool partition based solutions.  Proposal 2: For studying the feasibility of dynamic resource sharing, only device type A is considered. |
| Panasonic | Proposal 3: 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).  Proposal 4: Type A devices should be capable to receive both LTE SL and NR SL simultaneously  Proposal 5: For SL UEs capable to perform simultaneous TX of LTE and NR SLs, some optimization on dynamic power sharing may also be considered |
| Transsion | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, at least device type A and device type C should be considered. |
| China Telecom | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, at least Type A devices that contain both LTE SL and NR SL modules are supported.  o Further study and specify the necessity and feasibility of Type B devices that contain only NR SL modules. |
| Samsung | Proposal 2: For studying the feasibility of dynamic resource sharing as a possible solution for co-channel coexistence, in addition to device Type A, support device Type B, where   * No in-device LTE sensing and resource reservation information is shared with NR module. |
| CMCC | Proposal 1: For the study of co-channel coexistence for LTE sidelink and NR sidelink:   Type A devices are studied for both semi-static partitioning solutions and dynamic resource sharing solutions;   Type B devices can only be studied for semi-static partitioning solutions.   Other types of devices are not considered in Rel-18. |
| ETRI | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, at least device type A is considered.   FFS: Whether type B devices are considered. |
| Mitsubishi | Observation 1: Agreements from previous meeting refer to undefined device types A/B.  Proposal 3: The following device types are defined for the purpose of the study:  1. Type A devices are dual-module LTE/ NR SL Rel.18 devices where the LTE sidelink module shares information with the colocalized NR sidelink module  2. Type B devices contain a Rel.18 NR SL module not assuming the availability of information from a colocalized LTE SL module  3. Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| Qualcomm | Observation 1: For the gradual transition from LTE SL to NR SL, it is necessary for NR SL UE-s to have collocated LTE SL modules which can communicate with legacy LTE SL UE-s operating the shared resource pool.  Proposal 1: RAN 1 should restrict the study of NR SL and LTE SL cochannel coexistence to a system with a mix of Type A and Type C devices only. |
| Sharp | Observation 1: Type A devices that contain both NR SL module and LTE SL module has been agreed to be considered in RAN1#109-e meeting.  Observation 2: There is no need to mention the release of a device in the definition of a device type. |
| Apple | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, the following three types of devices are considered:  • Type A devices are the devices with NR sidelink module which shares sensing and resource reservation information from in-device LTE sidelink module  • Type B devices are the devices with NR sidelink module which does not share sensing and resource reservation information from in-device LTE sidelink module  • Type C devices are the devices with only LTE sidelink module. |
| Bosch | Observation 2: Device Type A requires sharing between the LTE and NR sidelink co-located modules instantaneous resource sensing information, which is beyond Rel-16 in-device coexistence mechanism.  Proposal 2: For Type A device, study the level of cooperation needed between LTE/NR SL co-located modules for dynamic LTE/NR SL co-channel coexistence. |

### Company Views for 1st Round of Discussions

Would the following proposals be acceptable to the companies?

**Proposal 1-1a:**

* **For co-channel coexistence solutions in Rel-18, device type A contains both LTE SL and NR SL modules.**
  + **LTE SL module uses the Rel-16 in-device coexistence framework for sharing sensing and resource reservation information.**

**Proposal 1-1b:**

* **Support device type A for co-channel coexistence between LTE SL and NR SL.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | Yes | We agree with the proposal. While solutions defined in this AI could eventually mitigate co-existence for type B and type C devices, RAN1 should only consider co-existence mechanisms targeted for devices of type A, which are the only one that may be able to have and retrieve insightful information regarding SL NR and SL LTE devices and make appropriate action in this regards. |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## [*ACTIVE*] Issue 1-2: Type B Devices

### Summary of Company Views from TDocs

The following is a brief summary of the inputs from company contributions regarding type B devices:

* 13 companies support the use of type B devices,
* 2 companies [3] and [27] do not support type B devices,
* 2 companies [2] and [7] want to deprioritize type B devices,
* 2 companies [21] and [30] wants to restrict its use to only semi-static resource pool partitioning solutions.

An aspect that was clarified by multiple companies is that the type B devices can also contain an LTE SL module, but the LTE SL module does not share sensing information with the co-located NR SL module using the Rel-16 in-device coexistence framework. This would allow the device to be capable of transmitting and receiving basic V2X messages using the LTE SL module to other legacy LTE UEs. It was also brought up that it is not reasonable to expect all future releases of NR SL devices to continue support of LTE SL using a separate co-located module. Hence it is the FL’s view that it is beneficial to first define type B devices and the decide whether to support them or not.

It is up to the NR SL module to determine the LTE SL resource allocation information to avoid resource collisions. It can do so in one of the following ways:

* Use IUC messages from other type A UEs. [1], [29], [32]
  + It was pointed out that using IUC messages makes it dependent on other type A UEs, and thereby might not be a very reliable source of LTE sensing information. [1], [3], [15].
* The NR SL module can detect LTE SL transmissions by decoding LTE SCIs. [1]
* The NR SL module can perform energy-based sensing of LTE SL transmissions. [1], [30], [31]

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 10: For Type B devices, only NR Rel-18 onwards should be considered.  Proposal 11: A Type B device should support at least one of the following LTE detection or sensing capabilities:  • Capability B: NR SL device capability to detect LTE transmissions  • Capability A1: NR SL device capability to conduct energy-based sensing of LTE transmissions  • Capability A2: NR SL device can receive LTE PSCCH (incl SCI) signals  Proposal 12: A Type B device should be able to discover when a Type A device capable of providing IUC support is nearby.  Proposal 13: Both IUC Scheme 1 and Scheme 2 should be supported for NR SL Type B devices to enable co-channel coexistence. |
| Huawei, HiSilicon | Proposal 2: For NR-V and LTE-V co-channel co-existence in Rel-18,  • RAN1 only discusses enhancements related to Type A1 device.  • RAN1 assumes Type A2 device already works in semi-static resource pool partitioning solution. Type A2 device in dynamic resource sharing solution is not supported.  • Type B device is not supported.  • Note:  o A Type A1 device contains both LTE SL and NR SL modules, and use both modules for co-channel coexistence purpose.  o A Type A2 device contains both LTE SL and NR SL modules, and use only NR SL module for co-channel coexistence purpose.  o A Type B device contains only NR SL module. |
| Spreadtrum | Proposal 1: Devices type A and type B should be supported in the scope of the study of co- channel coexistence solutions in Rel-18, and could coexist with type C devices. |
| Toyota | Proposal 2: The following device types are considered for the study of co-channel coexistence solutions:  • Type A devices are Rel-18 devices that contain both LTE SL and NR SL modules with the availability of sensing and resource reservation information from the LTE SL module  • Type B devices are Rel-18 devices that contain a NR SL module without the availability of sensing and resource reservation information from a colocalized LTE SL module (if any)  • Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| Fraunhofer | Proposal 2: Study how type B devices containing only an NR SL modem can be used for co-channel coexistence with LTE V2X. |
| Lenovo | Proposal 1: Support to study co-channel coexistence for device type B with only 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). |
| Samsung | Proposal 2: For studying the feasibility of dynamic resource sharing as a possible solution for co-channel coexistence, in addition to device Type A, support device Type B, where   * No in-device LTE sensing and resource reservation information is shared with NR module.   Observation 1: Type-B devices can include Rel-16/17 NR SL devices that don’t share sensing and resource reservation information with the on device NR SL module.  Observation 2: The benefit of having Rel-18 NR SL devices without LTE SL modules that co-exist with LTE SL should be further justified. |
| CMCC | Proposal 1: For the study of co-channel coexistence for LTE sidelink and NR sidelink:   Type A devices are studied for both semi-static partitioning solutions and dynamic resource sharing solutions;   Type B devices can only be studied for semi-static partitioning solutions.   Other types of devices are not considered in Rel-18. |
| Mitsubishi | Observation 1: Agreements from previous meeting refer to undefined device types A/B.  Proposal 3: The following device types are defined for the purpose of the study:  1. Type A devices are dual-module LTE/ NR SL Rel.18 devices where the LTE sidelink module shares information with the colocalized NR sidelink module  2. Type B devices contain a Rel.18 NR SL module not assuming the availability of information from a colocalized LTE SL module  3. Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| Qualcomm | Observation 2: Type B devices may be able to coexist with legacy LTE SL devices but their inability to communicate and coordinate with Type C devices can potentially hamper the gradual adaption of NR SL. |
| Sharp | Proposal 1 (for conclusion): From RAN1 perspective, no specification work is envisioned for Type B devices (that contain only NR SL module, or the NR SL module does not assume any information shared by a co-located LTE SL module). |
| Apple | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, the following three types of devices are considered:  • Type A devices are the devices with NR sidelink module which shares sensing and resource reservation information from in-device LTE sidelink module  • Type B devices are the devices with NR sidelink module which does not share sensing and resource reservation information from in-device LTE sidelink module  • Type C devices are the devices with only LTE sidelink module. |
| NTT DOCOMO | Proposal 4:  • Support device type B with the same priority as device type A.  Proposal 5:  • If device type B is considered in Rel-18 co-channel coex, study how to obtain LTE-SL reservation information, including the following option.  o Inter-UE coordination based on LTE-SL sensing results |
| Bosch | Observation 3: Type B device, as a solution for co-channel coexistence, assumes no access to instantaneous physical layer measurements from another LTE V2X modules (if co-located, e.g., for safety requirements).  Observation 4: Type B device can be redefined to be: “UEs can only with NR SL modules indirectly detect LTE transmissions without utilizing co-located LTE SL modules (if existing).”  Proposal 3: Consider Type B device at least for quasi-dynamic LTE/NR SL co-channel coexistence.  - FFS: indirect LTE sidelink transmission detection mechanisms, i.e., without decoding LTE SCI |
| Ericsson | Proposal 2 In the study of LTE-NR coexistence, device Type B are considered as the baseline and then optimizations can be considered for device Type A. |
| WILUS | Proposal 1: To accommodate co-channel coexistence for type B device and LTE SL, the inter-UE coordination scheme between type A device and type B device should be studied.   Method for making a difference between the existing IUC message and the IUC message used for co-channel coexistence   Method to request/provide IUC message of LTE SL resource information   Method for exchanging sensing and resource reservation information of LTE SL UE(s) |

### Company Views for 1st Round of Discussions

Would the following proposals be acceptable to the companies?

**Proposal 1-2a:**

* **For co-channel coexistence solutions in Rel-18, device type B contains at least an NR SL module** 
  + **LTE SL modules, if present, do not use Rel-16 in-device coexistence framework for sharing sensing and resource reservation information.**
  + **FFS how the NR SL module determines resources occupied by LTE SL UEs.**

**Proposal 1-2b:**

* **Support device type B for co-channel coexistence between LTE SL and NR SL.**

**Proposal 1-2c:**

* **For device type B, the following options are studied for NR SL module to determine the LTE sensing information (other options are not precluded)**
  + **Option 1: Use IUC messages from other type A UEs.**
  + **Option 2: The NR SL module detects LTE SL transmissions by decoding LTE SCIs.**
  + **Option 3: The NR SL module performs energy-based sensing of LTE SL transmissions.**

#### Comments for Proposal 1-2a

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | No | From prior meeting definition, the type B devices are those NR devices which do not contain the LTE SL module, therefore, we do not understand why the proposal contains “at least”.  We are OK to consider the type B devices as part of the problem, but we do not think that solutions should be targeted for and defined using these types of devices. Therefore, if the interpretation of the proposal is that type B are considered in the study as source of co-existence issue, then we are OK with the proposal. But if the proposal intends to include the type B devices as a target for solution development, we are NOT. |
|  |  |  |
|  |  |  |
|  |  |  |

#### Comments for Proposal 1-2b

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | No | See reply above |
|  |  |  |
|  |  |  |
|  |  |  |

#### Comments for Proposal 1-2c

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | Yes | We are OK to pursue, and study Option 1, but we do not agree with option 2 and 3.  Specifically, for option 2, wouldn’t this imply that type B contains an LTE module? In this case, wouldn’t this type B be classified as type A device?  For option 3, how would a type B device identify the priority of an LTE SL transmission, and would this option mean that LTE transmissions would be always prioritized over NR transmissions? So in this case, wouldn’t the semi-static resource partitioning solution be sufficient? |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## [*ACTIVE*] Issue 1-3: Device Type Coexistence

### Summary of Company Views from TDocs

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.

Majority of the companies (14 companies) support the coexistence of type A and type B devices (if supported), with type C devices. This is as per the WID’s justification. Apart from this, [7], [10] and [31] suggest that the supported device types should also coexist with type D and E devices in the same resource pool.

According to the FL, it is obvious that device types A and/or B, depending on whether they are supported, have to coexist with LTE devices or type C devices. RAN1 will not pursue any further enhancements for other device types apart from type A and/or B, since no specification change to types C, D and E devices is possible within the scope of the WID.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 8: A study of what information should be exchanged in a Type A device should be evaluated against the impact it has on both Type B and Type C devices. |
| LG | Proposal 4: The following combination of UE types should be considered as the baseline in the study of co-channel coexistence for LTE SL and NR SL:   Type A: Devices that contain both LTE SL and NR SL modules   Type C: Devices that contain only LTE SL module |
| Spreadtrum | Proposal 1: Devices type A and type B should be supported in the scope of the study of co- channel coexistence solutions in Rel-18, and could coexist with type C devices. |
| Toyota | Proposal 2: The following device types are considered for the study of co-channel coexistence solutions:  • Type A devices are Rel-18 devices that contain both LTE SL and NR SL modules with the availability of sensing and resource reservation information from the LTE SL module  • Type B devices are Rel-18 devices that contain a NR SL module without the availability of sensing and resource reservation information from a colocalized LTE SL module (if any)  • Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| ZTE, Sanechips | Proposal 1: Considering the deployment scenarios, in addition to Rel-18 devices, Type C,D,E devices should be considered together.  Proposal 2: To evaluate and support semi-static co-channel coexistence for LTE sidelink and NR sidelink, Type C/D/E devices should be taken into account. |
| OPPO | Proposal 1: Co-channel coexistence should focus on the coexistence between Rel-18 devices and LTE devices. |
| CATT, GOHIGH | Proposal 2: Feasibility of the co-channel coexistence solutions need to be evaluated with Type D/E devices. |
| NEC | Proposal 5: 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). |
| Panasonic | Proposal 3: 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). |
| Transsion | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, at least device type A and device type C should be considered. |
| Mitsubishi | Observation 1: Agreements from previous meeting refer to undefined device types A/B.  Proposal 3: The following device types are defined for the purpose of the study:  1. Type A devices are dual-module LTE/ NR SL Rel.18 devices where the LTE sidelink module shares information with the colocalized NR sidelink module  2. Type B devices contain a Rel.18 NR SL module not assuming the availability of information from a colocalized LTE SL module  3. Type C devices are Rel-14/Rel-15 devices that contain only LTE SL modules |
| Qualcomm | Proposal 1: RAN 1 should restrict the study of NR SL and LTE SL co-channel coexistence to a system with a mix of Type A and Type C devices only. |
| Apple | Proposal 1: For the study of co-channel coexistence solutions in Rel-18, the following three types of devices are considered:  • Type A devices are the devices with NR sidelink module which shares sensing and resource reservation information from in-device LTE sidelink module  • Type B devices are the devices with NR sidelink module which does not share sensing and resource reservation information from in-device LTE sidelink module  • Type C devices are the devices with only LTE sidelink module. |
| Ericsson | Observation 7 Coexistence solutions for both Type C and Type E are required. A common design is preferable.  Observation 8 Coexistence with type D UEs is not the focus of this work, but it must be guaranteed too. |
| Continental | Proposal 1: The study of co-channel coexistence, while focusing on NR SL Rel. 18, should be functional and compatible with the presence of Type A, B, and C devices. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 1-3:**

* **For co-channel coexistence solutions in Rel-18, the supported device types (type A and/or type B) has to at least coexist with LTE SL devices.**
  + **RAN1 does not pursue any further enhancements for device type other than A and/or B.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | No | As explained above, we think that the type B devices should be considered as part of the problem, but we do not think that solutions should be targeted for these types of devices |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

# 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 were semi-static and dynamic co-channel coexistence. In the previous meeting, the following agreement was made where both these solutions were agreed to be studied for their feasibility.

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

Based on the inputs from the contributions, 2 flavors of semi-static co-channel coexistence were expressed by companies, while dynamic co-channel coexistence was also discussed.

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.

Hence the following solutions were discussed:

* TDM based Semi-static Resource Pool Partitioning (SRPP) - Solution A

Separate resource pools for LTE SL and NR SL in the same channel or band, configured over different time slots.

* + Supporting companies (11) – [1], [3], [7], [9], [10] (baseline), [15], [19], [21], [23], [25], [28]
* FDM based Semi-static Resource Pool Partitioning (SRPP) – Solution B

Separate resource pools for LTE SL and NR SL in the same time slots, configured over different channels or bands.

* + Supporting companies (11) – [4], [7], [9], [11], [13], [15], [16], [19], [27], [28], [30]
  + Non-supporting companies (3) – [1], [3], [10],
* Semi-static Resource Pool Partitioning (SRPP).
  + Supporting companies (9) – [2], [5], [9], [14], [17] (low priority), [19], [20] (baseline), [29], [31],
  + Non-supporting companies (2) [6], [26]
* Dynamic Resource Pool Sharing (DRPS) – Solution C

Same resource pool for LTE SL and NR SL, sharing resources across time and frequency, overlapping fully or partially.

* + Supporting companies (17) – [1], [2], [3], [6], [9], [10], [11], [12], [16], [18], [21] (low priority), [22], [25], [26], [29], [30], [33]

## [*ACTIVE*] Issue 2-1: TDM-based Semi-static Resource Pool Partitioning

### Summary of Company Views from TDocs

Regarding the use of TDM-based SRPP, 11 companies had voiced their support for this solution. Some of the aspects and highlights of this solution were discussed by companies, which included the following:

* It can easily be configured with minimal or no specification work since both the LTE SL and NR SL resource pools can be configured to be discontinuous over time. [1], [3], [4], [5], [14], [15], [21], [28], [29]
* No restrictions needed on the different SCSs that can be used for the NR SL resource pool. [3], [30]
* The slot boundaries between the NR SL and the LTE SL resource pools have to be aligned. [7], [14]
  + This could be achieved by using the same synchronization source. [14]
* While the solution performs well if the proportion of NR SL to LTE SL traffic load is known, small deviations in this proportion can cause performance degradation. [26], [30]
* Does not cause any AGC issues to the LTE SL UEs since the resource pools are TDMed. [7]

Regarding the point where the slot boundaries between the NR SL and the LTE SL requiring to be aligned, under the in-device coexistence framework, it was already specified in 38.213, in Section 16.7, that the subframe boundaries of the NR SL and LTE SL transmission have to be aligned. This can be reused for Rel-18, and discussed further in Section 5.2.

On the other hand, a few companies had expressed the following concerns:

* LTE SL resource pools cannot be updated in a timely and flexible manner. [5], [26]
* The solution could potentially cause latency delays, as pointed out by some companies. [2], [9], [14], [28]
* It would not be able to adapt to the changes in the network due to a hard split in the spectrum. [5], [6], [9], [14], [26]

In the FL’s understanding, TDM-based semi-static resource partitioning is already possible using the Rel-16/17 specifications through configuration. Hence, it can be concluded that this can be used as a solution for coexistence between LTE SL and NR SL.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Observation 1: Semi-static co-channel coexistence approaches (FDM and TDM) prevent transition/re-farming of LTE SL spectrum resources to NR SL due to the inability to update a V2X pre-configuration once it has been established.  Proposal 1: If a semi-static approach is to be supported, RAN1 should prioritize a TDM co-channel co-existence approach over a FDM approach since FDM gives no additional benefit over TDM while introducing AGC issues. Note that no specification changes are needed for TDM co-channel coexistence. |
| Huawei, HiSilicon | Observation 1: Current RAN1 and RAN2 specification allows resource pool partitioning between LTE sidelink and NR sidelink, which is a simple and effective way to support co-channel co-existence of the two RATs.  Proposal 4: For semi-static resource pool partitioning as a solution for co-channel coexistence:  • Support TDM-based resource pool partitioning when the NR SL BWP is configured with 15 kHz, 30 kHz, or higher SCS.  • Not support FDM-based resource pool partitioning. |
| Vivo | Proposal 1: The co-channel coexistence study should focus on limited scenarios, e.g., same numerology, same sub-channel configurations, etc. between LTE SL and NR SL.  Observation 1: Semi-static resource pool separation can be easily implemented through network configuration, but may be infeasible in regions deployed with LTE V2X devices not capable of configuration updating.  Observation 2: For LTE-NR V2X coexistence, dynamic resource pool sharing causes both performance loss to LTE devices and NR devices compared with semi-static separate pool separation in some cases.  Proposal 2: Semi-static resource pool separation is applicable for co-channel coexistence for LTE sidelink and NR sidelink. |
| Toyota | Observation 1: Semi-static resource pool sharing may cause under-utilization or over-utilization of spectrum (i.e., channel congestion) of spectrum due to the mismatch between the numbers of LTE SL radios and NR SL radios in a given time and location, and the amount of allocated resource pool for each RAT. |
| ZTE, Sanechips | Observation 2: TDM based co-channel coexistence solutions can support all of Rel-16/17/18 NR sidelink coexistence with LTE sidelink and allows flexible subcarrier spacing configuration without causing interference and AGC issues to LTEor NR sidelink.  Proposal 7: To achieve complete orthogonality of NR and LTE SL resource pools in time domain, at least the following conditions need to be met for NR and LTE SL: the same time position and number of S-SSBs and synchronization signals, the same number of reserved slots, and aligned slot boundary. |
| OPPO | Proposal 4: Both semi-static resource pool partitioning and dynamic resource sharing between LTE SL and NR SL should be supported. |
| CATT, GOHIGH | Proposal 4: TDM based resource pool partition should be the baseline for co-channel coexistence mechanism between LTE sidelink and NR sidelink. |
| Intel | Observation 1:  • Semi-static resource partitioning for co-channel co-existence between LTE SL and NR SL can be already supported without specification changes. |
| Xiaomi | Proposal 3: TDM-based semi-static resource pool partitioning between NR and LTE sidelink can be supported using the existing R16/17 mechanism. |
| Transsion | Proposal 4: The solution of Semi-static resource pool partitioning should be considered as a low priority. |
| China Telecom | Proposal 3: For semi-static configured resource allocation in co-channel coexistence for LTE sidelink and NR sidelink,  o Reuse in-device coexistence operation in Rel-16 as much as possible.  o TDM-ed and/or FDM-ed resource pools can be supported for LTE and NR sidelink.  o FFS: Other necessary clarification and modification if any. |
| Samsung | Proposal 1: Semi-static resource sharing is baseline for co-existence between LTE SL and NR SL. |
| CMCC | Observation 1: The method of semi-static resource pool partitioning has less specification impact and more benefits for reducing the workload of RAN1, but it may have a lack of resource efficiency.  Proposal 3: Semi-static resource pool partitioning (Alt 1 - TDM) should be studied with a first priority in Rel-18.   Dynamic resource sharing (Alt 2) can be studied with a second priority and needs more evaluations for studying the feasibility with the consideration of the complexity and RAN1 workload. |
| MediaTek | Observation 1: Separating LTE SL and NR SL resource pools in time domain (based on Rel-16 NR V2X long-term TDM) is a promising semi-static solution as a baseline approach for coexistence.  Proposal 2: Semi-static resource pool separation approach in time-domain (based on Rel-16 NR V2X long-term TDM) is supported in Rel-18 for co-channel coexistence as a baseline solution. |
| Mitsubishi | Proposal 1: Support co-channel coexistence with resource pool separation between LTE-V2X and NR-V2X. Further investigate which specification work or enhancements are needed beyond the Rel.16 framework. |
| Qualcomm | Observation 3: Semi-static TDM RP partitioning will require the network or device/vehicle manufacturer to update the RP pool partition as the sidelink system changes and evolves.  Observation 6: Given that an accurate proportion of NR SL to LTE SL traffic load is known, a semi-static RP partition can be configured to provide an optimal balance of performance between NR and LTE.  Observation 7: For a semi-static RP partition to provide a good balance between NR SL and LTE SL performance, the RP partition needs to be updated when the proportion of NR SL to LTE SL traffic in the network changes.  Observation 8: Small deviations in the network/traffic configuration will require the reconfiguration of the semi-static RP partition otherwise, the performance of NR SL or LTE SL is degraded.  Observation 9: A mismatch in the (pre-)configuration of the (semi-)static RP partition between UE-s in the network may arise when some UE-s have an updated RP configuration while others are using an outdated one, which may happen due to a staggered roll out of device updates, an inability to update based on RRC signalling, etc.  Observation 10: Mismatch of the (pre-)configured (semi-)static RP partition across devices degrades both NR and LTE performance.  Proposal 5: Specify mechanism for dynamic resource sharing between NR SL and LTE SL co-channel coexistence. |
| Apple | Proposal 3: The TDM-based semi-static resource pool partitioning is feasible for co-channel coexistence, where no specification impact is expected. |
| NTT DOCOMO | Observation 3:  • Rel-16 in-device coexistence was discussed and specified for semi-static resource pool partitioning.  Proposal 3:  • Conclude that ‘semi-static resource pool partitioning’ has already been supported in Rel-16. |
| Bosch | Observation 5: For Idle/in-active UEs, semi-Static resource pool partitioning need to be optimized to consider the variable LTE vs. NR penetration rate, the required load for each RAT, etc.  Observation 6: TDM resource pool partitioning can allow co-channel coexistence of LTE V2X and NR SL with different sub-carrier spacing (e.g., 30 and 60 kHz). |
| Ericsson | Observation 9 For LTE SL and NR SL co-channel coexistence, SCS is limited to 15 kHz.  Proposal 4 For semi-static co-channel coexistence with LTE SL, NR SL supports:  • Configuring two different classes of resources within a resource pool  • Selecting resources from both classes if LTE SL transmissions are not detected  • Restricting selection of resources to a fixed class if LTE SL transmissions are detected |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Conclusion 2-1:**

* **For co-channel coexistence in Rel-18, TDM-based semi-static resource pool partitioning can be used based on Rel-16/17 specifications.**
  + **FFS if any specification changes are required.**

|  |  |  |
| --- | --- | --- |
| **Company** |  | **Comments** |
| Intel | No | While we acknowledge that the semi-static resource pool partitioning may have several issues, we do not think that any specification change is required to enable semi-static resource pool partitioning per se, and this could be handled by proper network configuration. Therefore, the FFS should be removed and explicitly indicated that no specification change is needed. |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## [*ACTIVE*] Issue 2-2: FDM-based Semi-static Resource Pool Partitioning

### Summary of Company Views from TDocs

In the previous meeting, FDM-based SRPP was discussed and the last version of the proposal that was discussed via email discussions is as follows:

|  |
| --- |
| **Proposal 2-3(IV):**   * **For studying the feasibility of FDM-based semi-static resource pool partitioning as a possible solution for co-channel coexistence, the SL BWP configured with NR SL resource pools ~~for NR SL is limited to~~ with a SCS of 15 kHz is considered~~, which is the same SCS as LTE SL~~.**   + **~~FFS: Whether/how to consider other SCSs~~** |

Based on the contributions from companies, 11 companies support the use of FDM-based SRPP, while 3 companies do not support it.

The following were the concerns expressed by companies regarding FDM-based SRPP:

* LTE SL resource pools cannot be updated in a timely and flexible manner, would not be able to adapt to the changes in the network due to a hard split in the spectrum. [1], [5], [9], [14]. [26]
* Configuration of different SCSs for the NR SL resource pool other than the 15 kHz SCS used for the LTE SL resource pool, would cause AGC setting issues for the LTE SL UEs. [1], [3], [7]
* Gap in frequency domain is required to avoid performance degradation due to the IBE effect. [2], [16], [23], [28],
  + A guard band between the LTE SL and NR SL carrier might not be sufficient without proper configuration, which does not result in any specification impact. [14]
* The presence of PSFCH in the NR SL resource pools would cause AGC setting issues for the LTE SL UEs. [1], [26]
* Half-duplex problem could occur if the NR SL and LTE SL transmissions take place in the same time. [2]

In order to address the AGC issue caused due to differing SCSs in the NR SL and LTE SL resource pools, the following solutions were proposed:

* Fix the SCS for the NR SL resource pool to 15 kHz SCS. [4], [9], [11], [13], [14], [15], [16], [17], [28]
* Rel-18 NR SL UEs should occupy all symbols within a 15 kHz subframe. [7], [13], [14]
* Multi slot aggregation can be considered where same or different TBs can be transmitted in each slot. [7]

In order to address the AGC issue caused due to PSFCH being configured in NR SL resource pools, the following solutions were proposed:

* No transmission/reception of PSFCH in resources overlapping with LTE SL subframes. [4], [7], [14], [15], [16], [28]
* Use long PSFCH with same number of symbols as PSCCH/PSSCH. [7]
* PSFCH is not supported in FDM-based SRPP. [13]
* Use different SCSs. [16]

In the FL’s understanding, FDM-based semi-static resource partitioning is already possible using the Rel-16/17 specifications through configuration. However, there have to be certain restrictions in place for the configuration of the NR SL resource pools due to the AGC issues caused by differing SCSs between the NR SL and LTE SL resource pools, as well as due to PSFCH being configured in NR SL resource pools.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Observation 1: Semi-static co-channel coexistence approaches (FDM and TDM) prevent transition/re-farming of LTE SL spectrum resources to NR SL due to the inability to update a V2X pre-configuration once it has been established.  Proposal 1: If a semi-static approach is to be supported, RAN1 should prioritize a TDM co-channel co-existence approach over a FDM approach since FDM gives no additional benefit over TDM while introducing AGC issues. Note that no specification changes are needed for TDM co-channel coexistence. |
| LG | Proposal 2: The following two types of operations need to be investigated for the coexistence between LTE SL and NR SL in the same frequency channel:   Semi-static resource partitioning between LTE SL and NR SL in the same frequency channel   Dynamic resource sharing between LTE SL and NR SL in the same frequency channel |
| Huawei, HiSilicon | Proposal 4: For semi-static resource pool partitioning as a solution for co-channel coexistence:  • Support TDM-based resource pool partitioning when the NR SL BWP is configured with 15 kHz, 30 kHz, or higher SCS.  • Not support FDM-based resource pool partitioning. |
| Spreadtrum | Proposal 2: To avoid the AGC issue, the SCS configured for SL BWP with NR SL resource pools is limited to 15kHz only.  Proposal 3: The slot(s) with PSFCH symbols of NR resource pool should be excluded from the LTE resource pool, if HARQ-ACK feedback is supported in FDM solution. |
| Vivo | Proposal 1: The co-channel coexistence study should focus on limited scenarios, e.g., same numerology, same sub-channel configurations, etc. between LTE SL and NR SL.  Observation 1: Semi-static resource pool separation can be easily implemented through network configuration, but may be infeasible in regions deployed with LTE V2X devices not capable of configuration updating.  Observation 2: For LTE-NR V2X coexistence, dynamic resource pool sharing causes both performance loss to LTE devices and NR devices compared with semi-static separate pool separation in some cases.  Proposal 2: Semi-static resource pool separation is applicable for co-channel coexistence for LTE sidelink and NR sidelink. |
| ZTE, Sanechips | Observation 3: FDM based co-channel coexistence solutions can support all of Rel-16/17/18 NR sidelink coexistence with LTE sidelink, and some specification changes on NR sidelink are expected.  Observation 5: FDM based co-channel coexistence and dynamic co-channel coexistence may have AGC issues due to different SCS adopted by NR SL and LTE SL, or PSFCH of NR SL.  Proposal 8: To avoid the AGC issues caused by different SCS, restriction should be applied to NR SL in Rel-18 that PSSCH/PSCCH shall occupy all symbols in a slot with 15kHz SCS, or multi-slot aggregation can be considered.  Proposal 9: To avoid the AGC issue caused by PSFCH, one of the following options can be considered:  • Option 1: 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.  • Option 2: Introducing a long PSFCH format with the same number of symbols as PSCCH/PSSCH.  • Option 3: HARQ is not supported in case of dynamic co-channel coexistence. |
| OPPO | Proposal 4: Both semi-static resource pool partitioning and dynamic resource sharing between LTE SL and NR SL should be supported.  Proposal 5: For FDM-based semi-static resource pool partitioning, the SL BWP configured with NR SL resource pools is limited with a SCS of 15 kHz. |
| CATT, GOHIGH | Proposal 5: 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. |
| Fraunhofer | Proposal 3: 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. |
| NEC | Proposal 2: For 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:  − 15kHz;  − all symbols in a slot used as sidelink symbols;  − PSFCH is not supported; |
| Intel | Observation 1:  • Semi-static resource partitioning for co-channel co-existence between LTE SL and NR SL can be already supported without specification changes. |
| Xiaomi | Proposal 4: For FDM based resource pool partitioning, only 15KHz SCS is supported for NR SL.  Proposal 5: 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 6: 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. |
| Panasonic | Proposal 2: 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) |
| Transsion | Proposal 4: The solution of Semi-static resource pool partitioning should be considered as a low priority.  Proposal 5: For studying the feasibility of FDM-based semi-static resource pool partitioning as a possible solution for co-channel coexistence, the sidelink BWP configured with resource pools for NR sidelink is limited to a SCS of 15 kHz, which is the same SCS as LTE sidelink.  Proposal 6: For studying the feasibility of FDM-based semi-static resource pool partitioning as a possible solution for co-channel coexistence, it should be investigated whether PSFCH can be configured in NR sidelink resource pool. |
| China Telecom | Proposal 3: For semi-static configured resource allocation in co-channel coexistence for LTE sidelink and NR sidelink,  o Reuse in-device coexistence operation in Rel-16 as much as possible.  o TDM-ed and/or FDM-ed resource pools can be supported for LTE and NR sidelink.  o FFS: Other necessary clarification and modification if any. |
| Samsung | Proposal 1: Semi-static resource sharing is baseline for co-existence between LTE SL and NR SL. |
| MediaTek | Observation 2: FDM-based semi-static approach can be feasible; however, resource efficiency may be sub-optimal due to guard band requirement. |
| Sharp | Proposal 2 (for conclusion): From RAN1 perspective, for co-channel coexistence of LTE sidelink and NR sidelink, FDM-based semi-static resource pool partitioning with a same SCS (of 15 kHz) for NR SL and LTE SL is feasible and has no specification impact. |
| Apple | Proposal 4: To support FDM-based semi-static resource pool partitioning for co-channel coexistence, consider the following two solutions for AGC issue due to different SCS between NR sidelink and LTE sidelink:  • Guard band is introduced between LTE sidelink resource pool and NR sidelink resource pool  • The numerology of NR sidelink is always 15 kHz.  Proposal 5: To support FDM-based semi-static resource pool partitioning for co-channel coexistence, study the solutions for AGC issue due to PSFCH in NR sidelink, e.g., guard band is introduced between LTE sidelink resource pool and NR sidelink resource pool. |
| NTT DOCOMO | Observation 3:  • Rel-16 in-device coexistence was discussed and specified for semi-static resource pool partitioning.  Proposal 3:  • Conclude that ‘semi-static resource pool partitioning’ has already been supported in Rel-16. |
| Bosch | Proposal 4: Confirm the following proposal for semi-static resource pool partitioning:  For studying the feasibility of FDM-based semi-static resource pool partitioning as a possible solution for co-channel coexistence, the following aspects are to be investigated:  • Handling of numerologies other than 15kHz  • Configuration of overlapping time resources for LTE SL and NR SL including in slots where NR PSFCH may be transmitted, taking into account the handling of AGC.  • Mechanisms to avoid dropping of NR SL transmissions impacted by LTE SL transmissions.  • FFS: Other aspects. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 2-2:**

* **For co-channel coexistence in Rel-18, FDM-based semi-static resource pool partitioning can be used based on Rel-16/17 specifications, 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 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.**

|  |  |  |
| --- | --- | --- |
| **Company** |  | **Comments** |
| Intel | Comments | We agree with the proposal in principle, and with the list of constrains, but once again we do thing that these constraints could be simply achieved by a proper network configuration, and RAN1 may need to hardcode and explicitly indicate them in the spec. |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## [*ACTIVE*] Issue 2-3: Dynamic Resource Pool Sharing – SCS and PSFCH

### Summary of Company Views on SCS from TDocs

Based on the contributions from companies, 17 companies support the use of DRPS. Although it has a few advantages, the AGC issues faced by the FDM-based SRPS is also present in the DRPS.

The primary concern expressed by companies regarding DRPS regarding the SCS is that configuration of different SCSs for the NR SL resource pool, other than the 15 kHz SCS used for the LTE SL resource pool, would cause AGC setting issues for the LTE SL UEs. [2], [3], [6], [7], [12]

In order to address the AGC issue caused due to differing SCSs in the NR SL and LTE SL resource pools, the following solutions were proposed:

* Fix the SCS for the NR SL resource pool to 15 kHz SCS. [2], [6], [7], [31], [11], [12], [13], [16], [31]
  + Companies also argued that the NR SL resource pool should support higher SCS than 15 kHz, and not limit it. [1], [3], [6], [16], [22], [30], [33]
* Rel-18 NR SL UEs should occupy all symbols within a 15 kHz subframe. [1], [7], [13],
* NR SL UEs select resources in consecutive time slots depending on the SCS (2 time slots for 30 kHz). [1]
* LTE SL UEs will not use time slots where NR SL UEs are transmitting. [3]
* Multi-slot aggregation can be considered where same or different TBs can be transmitted in each slot. [7]
* LTE SL PSCCH subchannel is configured non-adjacently to the corresponding LTE SL PSSCH such that the NR SL subchannel overlaps with only the LTE SL PSSCH. [18]

In the FL’s understanding, the AGC issue caused due to differing SCSs between the resource pools can be resolved by fixing the SCS of the NR SL resource pool to 15 kHz, however, companies have also expressed strong views against limiting the NR SL resource pool to only 15 kHz SCS. It is also to be noted that there was a discussion in Rel-15 on how to support different TTI values in the same resource pool, and RAN1 had then concluded that it was not possible. Hence as a starting point, DRPS can be studied by restricting the NR SL resource pool to an SCS of 15 kHz, while other solutions can also be evaluated.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 2: RAN1 to focus the feasibility study on mechanisms that enable dynamic co-channel coexistence.  Proposal 3: NR SL should support higher SCS than 15 kHz for co-channel coexistence.  Proposal 5: Resource selection should allow selection of consecutive NR slots that overlaps an LTE SL subframe (in time) to avoid LTE Rx AGC issues caused by a NR SL transmission when NR use a higher SCS than 15kHz SCS. |
| LG | Proposal 2: The following two types of operations need to be investigated for the coexistence between LTE SL and NR SL in the same frequency channel:   Semi-static resource partitioning between LTE SL and NR SL in the same frequency channel   Dynamic resource sharing between LTE SL and NR SL in the same frequency channel  Proposal 3: When considering the dynamic resource sharing between LTE SL and NR SL in the same frequency channel, at least the following aspects need to be studied:   Condition(s) under which NR SL transmission can be allowed in the co-channel where LTE SL exists   Type/numerology of NR SL channel/signal that can be transmitted in the co-channel where LTE SL exists   Whether/how to allow Mode 1 based NR SL transmission in the co-channel where LTE SL exists |
| Huawei, HiSilicon | Proposal 5: For Rel-18 co-channel co-existence via dynamic resource sharing, one dedicated resource pool which consists of shared resources is used for co-channel co-existence with LTE-V.  Observation 2: 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.  Observation 3: For Alt2 (dynamic resource sharing), different SCS used for NR-V and LTE-V lead to AGC issue on LTE-V reception and cause decoding failure for LTE-V.  Proposal 6: For NR-V and LTE-V co-channel co-existence via dynamic resource sharing,  • Support at least 15 kHz SCS for NR-V.  • RAN1 further studies whether/how to support other SCS for NR-V subject to the following principles:  o Principle 1: LTE-V’s performance is not impacted by NR-V.  o Principle 2: RAN1 strives to have simple and unified design for different SCS to minimize the specification impact. |
| Toyota | Observation 2: Dynamic resource sharing enables efficient use of spectrum because time-frequency resources are used by LTE SL and NR SL as needed, thereby reducing wasted resources.  Proposal 1: Dynamic resource sharing is supported.  Proposal 5: RAN1 to study solutions to support higher SCSs (> 15 kHz) for NR SL and mitigate associated technical issues (e.g., AGC issue). |
| ZTE, Sanechips | Observation 4: Dynamic co-channel coexistence can be support by only Rel-18 NR sidelink coexisting coexistence with LTE sidelink only.  Observation 5: FDM based co-channel coexistence and dynamic co-channel coexistence may have AGC issues due to different SCS adopted by NR SL and LTE SL, or PSFCH of NR SL.  Proposal 8: To avoid the AGC issues caused by different SCS, restriction should be applied to NR SL in Rel-18 that PSSCH/PSCCH shall occupy all symbols in a slot with 15kHz SCS, or multi-slot aggregation can be considered. |
| CATT, GOHIGH | Observation 1: There is limited performance degradation of LTE SL for dynamic resource pool sharing solution comparing with TDM-based semi-static resource pool partition solution.  Observation 2: 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 6: Dynamic resource sharing solution for co-channel coexistence for LTE sidelink and NR sidelink can be considered in Rel-18. |
| Fraunhofer | Proposal 4: For dynamic resource pool sharing, we propose to restrict the SCS for NR SL resource pools to 15 kHz. |
| 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. |
| 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.  Proposal 2: For 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:  − 15kHz;  − all symbols in a slot used as sidelink symbols;  − PSFCH is not supported; |
| Panasonic | Proposal 6: 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 13: 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 |
| 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.  Proposal1: 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. |
| CMCC | Observation 2: The method of dynamic resource sharing may provide more efficiency and flexibility for resource allocation but have a risk of introducing more issues, e.g., issues caused by PSFCH and variable SCS additionally supported in NR sidelink.  Proposal 3: Semi-static resource pool partitioning (Alt 1) should be studied with a first priority in Rel-18.   Dynamic resource sharing (Alt 2) can be studied with a second priority and needs more evaluations for studying the feasibility with the consideration of the complexity and RAN1 workload. |
| ETRI | Proposal 3: It is proposed to study the following aspects to support dynamic resource sharing using overlapping resource pools between two RATs:   Resource configuration (aligned resource grids between two RATs)  • Not limit to the same SCS i.e., 15kHz between LTE sidelink and NR sidelink   Resource (re-)selection procedure taking LTE sensing results into account including timeline to pass the sensing results from LTE module to NR module, and so on.   Utilization of Rel-17 ICU schemes |
| Mitsubishi | Proposal 2: Support co-channel coexistence with dynamic sharing and resource pool overlapping between LTE-V2X and NR-V2X. |
| Qualcomm | Proposal 5: Specify mechanism for dynamic resource sharing between NR SL and LTE SL co-channel coexistence. |
| Bosch | Proposal 5: Confirm the following proposal for dynamic resource sharing (at least for FDMed situations):  For studying the feasibility of dynamic resource sharing as a possible solution for co-channel coexistence (at least for FDMed situation), the following aspects are to be investigated:  • Handling of numerologies other than 15kHz  • Configuration of overlapping time resources for LTE SL and NR SL including in slots where NR PSFCH may be transmitted, taking into account the handling of AGC.  • Mechanisms to avoid dropping of NR SL transmissions impacted by LTE SL transmissions.  • FFS: Other aspects. |
| Ericsson | Observation 9 For LTE SL and NR SL co-channel coexistence, SCS is limited to 15 kHz. |
| Continental | Proposal 3: The study of co-channel co-existence should prioritize schemes allowing dynamic resource sharing between LTE SL and NR SL.  Proposal 4: RAN1 to study and clearly identify the pros, cons, and tradeoffs of:  • LTE SL and NR SL synchronization,  • usage of multiple numerologies in NR,  • PSFCH handling,  • possibility of new explicit signalling to make aware NR SL about LTE resource reservation,  • intra-device optimizations and information exchange: timing, format, types. |

### Summary of Company Views on PSFCH from TDocs

Another concern expressed by companies regarding DRPS is the presence of PSFCH in the NR SL resource pools causing AGC setting issues for the LTE SL UEs. [1], [3], [4], [5], [12], [18], [19], [25], [27], [30]

In order to address the AGC issue caused due to PSFCH being configured in NR SL resource pools, the following solutions were proposed:

* No transmission/reception of PSFCH in resources overlapping with LTE SL subframes, with NR UEs avoiding subframes used for LTE SL transmissions. [2], [3], [5], [7], [10], [12]
* HARQ feedback is not supported in NR SL resource pools with DRPS. [7], [13], [16]
* Use long PSFCH with same number of symbols as PSCCH/PSSCH. [1], [7],
* NR SL UE sends LTE SCI to reserve the candidate slot containing a PSFCH occasion so that the LTE SL UE would exclude the reserved resources slot based on sensing. [5]
* Use only 60 kHz SCS and have PSFCH only in every 4th slot to make it align with the LTE guard symbol. [1]
* Use common AGC symbol – a new slot format with the NR SL resource pool restricted to 15 kHz and share a common AGC symbol in the beginning of the time slot. [1]
* Use IUC. [12]

According to the FL’s summary, the AGC issue caused due to PSFCH being configured in NR SL resource pools was discussed by 10 companies. Different solutions were suggested by companies, the most popular was for NR UEs avoiding the use of time slots with PSFCH that overlap with LTE SL subframes that are being used for LTE SL transmissions. Hence, as a starting point, this solution can be considered, while others can also be evaluated.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 6: NR should study mechanisms that allow the support of PSFCH in NR SL, while avoiding the occurrence of AGC issues at LTE SL Rx due to overlapping of LTE subframe with an NR slot containing PSFCH symbols. |
| LG | Proposal 3: When considering the dynamic resource sharing between LTE SL and NR SL in the same frequency channel, at least the following aspects need to be studied:   Condition(s) under which NR SL transmission can be allowed in the co-channel where LTE SL exists   Type/numerology of NR SL channel/signal that can be transmitted in the co-channel where LTE SL exists   Whether/how to allow Mode 1 based NR SL transmission in the co-channel where LTE SL exists |
| Huawei, HiSilicon | Observation 4: For Alt2 (dynamic resource sharing), collision may occur when LTE-V PSCCH/PSSCH and NR-V PSFCH are transmitted in the shared resource.  Proposal 7: 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.  • PSFCH can be transmitted only if the PSFCH resource is not overlapped with LTE-V’s reservation. |
| Spreadtrum | Proposal 8: Sidelink HARQ feedback enhancement should be studied for dynamic resource sharing. |
| Vivo | Observation 7: PSFCH of NR devices will be disturbed by the data transmission in the corresponding resource of LTE devices and vice versa.  Proposal 4：If dynamic resource sharing is supported, the sharing mechanism solution should be able to resolve the collision between PSFCH and LTE transmission. |
| ZTE, Sanechips | Proposal 9: To avoid the AGC issue caused by PSFCH, one of the following options can be considered:  • Option 1: 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.  • Option 2: Introducing a long PSFCH format with the same number of symbols as PSCCH/PSSCH.  • Option 3: HARQ is not supported in case of dynamic co-channel coexistence. |
| Lenovo | Proposal 4: Study the mechanism to avoid the AGC issue of LTE sidelink due to different frame structures, e.g., PSFCH is configured for NR sidelink.  Proposal 5: On the configuration of overlapping time resources for LTE sidelink and NR sidelink including in the slots where NR PSFCH may be transmitted, we propose to study following aspects:   The impact of congestion control of NR sidelink (e.g., CBR measurement and CR evaluation) when the slots with PSFCH are not allowed to be configured for dynamic resource sharing   How to avoid the AGC issue of LTE sidelink in the slot with PSFCH when slots with PSFCH could be configured for dynamic resource sharing, e.g.,   If the NR sidelink module is aware of the reservation of LTE sidelink in the slot with PSFCH, it could exclude the resources in that slot and/or the resources with associated PSFCH resource in that slot during the resource selection procedure |
| NEC | Proposal 2: For 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:  − 15kHz;  − all symbols in a slot used as sidelink symbols;  − PSFCH is not supported; |
| Panasonic | Proposal 14: 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. Otherwise, if no solutions to reserve the resource for PSFCH, not to have PSFCH in the resource pool with dynamic resource sharing should be supported. |
| CAICT | Observation2: For LTE SL transmitter, it cannot avoid the interferences on PSFCH resources/slots from NR SL through channel sensing. To avoid the collision issue, it only relies on channel sensing from R18 NR SL.  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.  Proposal2: FFS the mechanism of collision avoidance on the PSFCH resources/slots for dynamic co-channel co-existence between LTE SL Mode4 and NR SL Mode2. |
| China Telecom | Proposal 4: For dynamic resource allocation in co-channel coexistence for LTE sidelink and NR sidelink,  o Specify the benefit, necessity, and potential specification impact if any.  o How to enable PSFCH in LTE and NR sidelink coexistence.  o How to conduct sensing mechanism for LTE and NR sidelink.  • FFS: whether/how to support sensing information exchange between LTE and NR sidelink module.  o FFS: Other necessary clarification and modification if any. |
| Mitsubishi | Proposal 5: 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 |
| Qualcomm | Proposal 3: NR SL UE-s are (pre-)configured with a basic set of available resources for transmissions which contain one or more PSFCH occasions.  Proposal 4: The NR SL UE, based on the estimation of NR SL traffic ratio, adds resources to, or removes resources from the current set of available transmission resources. |
| Sharp | Proposal 3: For study of the dynamic resource sharing solution, PSFCH configured in a NR SL resource pool is considered. |
| Bosch | Proposal 5: Confirm the following proposal for dynamic resource sharing (at least for FDMed situations):  For studying the feasibility of dynamic resource sharing as a possible solution for co-channel coexistence (at least for FDMed situation), the following aspects are to be investigated:  • Handling of numerologies other than 15kHz  • Configuration of overlapping time resources for LTE SL and NR SL including in slots where NR PSFCH may be transmitted, taking into account the handling of AGC.  • Mechanisms to avoid dropping of NR SL transmissions impacted by LTE SL transmissions.  • FFS: Other aspects. |
| Ericsson | Observation 10 For LTE SL and NR SL co-channel coexistence, PSFCH periodicity should be 2 or 4.  Observation 13 LTE Resource exclusion based on RSSI averages may successfully exclude resources in subframes overlapping with NR slots configured with PSFCH.  Observation 14 For correct coexistence between NR and LTE sidelinks, NR UEs should prioritize transmitting PSCCH+PSSCH using slots with PSFCH resources.  Proposal 5 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. |
| WILUS | Proposal 4: RAN1 should study the PSFCH configuration method in case of dynamic resource sharing.  Proposal 5: Type A device can use the LTE SCI to avoid overlapping of PSFCH resource and LTE SL transmissions. |
| Continental | Proposal 3: The study of co-channel co-existence should prioritize schemes allowing dynamic resource sharing between LTE SL and NR SL.  Proposal 4: RAN1 to study and clearly identify the pros, cons, and tradeoffs of:  • LTE SL and NR SL synchronization,  • usage of multiple numerologies in NR,  • PSFCH handling,  • possibility of new explicit signalling to make aware NR SL about LTE resource reservation,  • intra-device optimizations and information exchange: timing, format, types. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 2-3:**

* **For co-channel coexistence in Rel-18, dynamic resource pool sharing is 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.**
  + **NR SL UEs avoid the transmission/reception of PSFCH in time slots that overlap with subframes used for LTE SL transmissions.**
    - **FFS other solutions to overcome the AGC issue caused due to PSFCH being configured in NR SL resource pools.**
  + **FFS other constraints.**

|  |  |  |
| --- | --- | --- |
| **Company** |  | **Comments** |
| Intel | Comments | Similarly, as previous proposal, we are in principle OK with it, and to define the assumptions under which RAN1 will be working on, but it should be also clearly indicated that these constraints will not be explicitly translated in the spec. |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## [*ACTIVE*] Issue 2-4: Dynamic Resource Pool Sharing – Use of LTE Sensing Information

### Summary of Company Views from TDocs

In the previous meeting, DRPS was discussed and agreement that was made is as follows:

|  |
| --- |
| **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. |

In this section, company views on the FFS points that were raised in the agreement have been discussed and summarized.

Regarding how the NR SL module utilizes this information in its own resource selection procedures, the following aspects were discussed:

* NR SL module excludes the reserved resource(s) of LTE sidelink in its resource (re-)selection. [1], [4], [5], [8], [9], [10], [11], [16], [20], [29]
* MAC layer takes into consideration the sensing results from the LTE V2X UE and takes an intersection to determine the available candidate resource set. [3], [28]
* NR module identifies and uses only LTE sensing-based idle resources delivered from LTE module to select/reserve NR SL transmission resources. [2]
* Use CBR value measured by LTE SL module on the co-channel and utilize the channel only when it is less than the (pre)configured threshold. [2]
* In type A devices, the NR SL module estimates the NR traffic proportion rate on a RP based on an LTE channel occupancy determined by inputs from the LTE SL module [26]
  + Using this NR traffic proportion rate, the UE determines a set of available resources by excluding resources being used by LTE traffic.

In terms of the information shared by the LTE SL module to the NR SL module, the following parameters were identified:

* Sensing results, or available candidate resources after resource exclusion. [8], [9], [11], [20], [24], [27], [29]
* Half-duplex subframes or non-monitored subframes, which are resource reservations not resulting from sensing, due to the LTE UE’s own transmission and reception of LTE PSSS/SSSS and PSSCH/PSCCH. [4], [15], [24], [27], [29]
* Resource reservation periods. [4], [28]
* SL RSRP and/or SL RSSI measurement results. [4], [9]
* Half-duplex subframe(s) of the LTE module. [4], [29]
* Priority of LTE transmission. [4]
* Time and frequency location of LTE sidelink reserved resources. [28]

With regards to how and when the LTE SL module shares the sensing and resource reservation information to the NR SL module, the following views were captured:

* Trigger-based, where the NR SL module triggers the LTE SL module to provide sensing and resource reservation information. [20], [24], [28]
* Condition-based, where the LTE module shares its sensing and resource selection information to the NR module when a certain condition is met. [20], [28]
* Rel-16 NR SL 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. [3]

Another aspect that was mentioned was for LTE modules within the Type A devices to transmit a LTE SCI indicating resources that are being used by NR SL transmissions, so that other LTE UEs avoid using these resources. [5], [16],

Apart from using the sensing information from the LTE SL module directly for its own resource selection procedure, a few companies had mentioned the use of IUC from a UE-A containing the LTE sensing information for UE-B to be aware of resources being used by LTE SL transmissions. [4], [8], [11], [12], [14], [16], [20], [22], [24], [28].

Based on the above views, the FL understands that the NR SL module uses the sensing and resource reservation information from the LTE SL module to exclude resources being used by the LTE SL UEs. A list of parameters that have to be shared by the LTE SL module has been identified by companies, including the time and frequency resource locations of the reserved resources and subframes that are not monitored by the LTE SL UE due to half-duplex constraints. The sharing can be trigger-based on condition-based, as described by a few companies. A significant number of companies also want to study the use of IUC for sharing LTE SL sensing information to other UEs.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 4: RAN1 to study how the resource exclusion step in the NR SL resource selection procedure can be updated in order to minimize impact to LTE SL. |
| LG | Proposal 3: When considering the dynamic resource sharing between LTE SL and NR SL in the same frequency channel, at least the following aspects need to be studied:   Condition(s) under which NR SL transmission can be allowed in the co-channel where LTE SL exists   Type/numerology of NR SL channel/signal that can be transmitted in the co-channel where LTE SL exists   Whether/how to allow Mode 1 based NR SL transmission in the co-channel where LTE SL exists |
| Huawei, HiSilicon | Observation 5: For Alt 2 (dynamic resource sharing), Rel-16 in-device coexistence framework shall be used to avoid large amount of specification workload in terms of re-designing NR-V.  Proposal 8: For Rel-18 co-channel co-existence via dynamic resource sharing,  • When NR-V numerology is 15 kHz,  o LTE-V module shares candidate resource set to NR-V module.  o NR-V module MAC layer takes intersection between LTE-V candidate resource set and NR-V candidate resource set to obtain the available candidate resource set.  o R16 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.  • FFS the case when other NR-V numerology is used. |
| Spreadtrum | Proposal 4: NR SL module takes the sensing and resource reservation information transmitted shared by LTE module into account for the procedure of resource allocation.  Proposal 5: LTE SL module could share the sensing and resource reservation information to NR SL module via the interface, including the priority of LTE transmission, RSRP measurement value, resource reservation periods, and half duplex subframe(s) of LTE module, etc.  Proposal 6: 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.  Proposal 7: The capability of devices Type B for sensing and transmitting LTE sidelink should be further studied, if devices type B are considered to be supported. |
| Vivo | Proposal 1: The co-channel coexistence study should focus on limited scenarios, e.g., same numerology, same sub-channel configurations, etc. between LTE SL and NR SL.  Observation 3: 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 4: 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 5: There is an obvious gain in Option 2 (the LTE SL modules of the SL 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) compared with Option 1 (NR SL UEs detect the resources reserved by LTE devices and then avoid the collision through resource (re-)selection, pre-evaluation and pre-emption).  Proposal 3：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.  Observation 6: The DMRS pattern in LTE is different from NR, thus, LTE SL UE can not maintain the accurate RSRP when detecting the resources reserved by NR modules/UEs. |
| Toyota | Observation 3: 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 3: 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 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.  Proposal 4: RAN1 to study solutions for Type B devices to obtain LTE SL sensing and/or LTE SL resource reservation information. |
| ZTE, Sanechips | Observation 4: Dynamic co-channel coexistence can be support by only Rel-18 NR sidelink coexisting coexistence with LTE sidelink only.  Proposal 10: Solution C should be supported in a way that a full set of NR SL functionality defined in Rel-16/17 is supported. |
| Sony | Proposal 1: Reuse inter-UE coordination scheme to exchange LTE/NR sidelink resource allocation information.  Observation1: Exchange information dynamically and periodically between UE’s LTE RAT and NR RAT is supported for co-channel coexistence.  Proposal 2: NR sidelink will use its dedicated resource pool at first and then (re-)select resource in LTE sidelink dedicated resource pool when collision happened.  Observation2: NR sidelink UE can get non-overlapping resource allocation information from its LTE RAT.  Proposal 3: NR Sidelink UE can inform coexistence issues to network and provide assistant information to network. |
| OPPO | Proposal 6: 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 and/or SL RSSI measurement result  Proposal 7: NR module ought to use the sensing and resource reservation information for initial selection, re-evaluation and pre-emption checking.  Proposal 8: 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. |
| Fraunhofer | Proposal 5: For dynamic resource pool sharing in type A devices, we propose that the NR SL module takes into account the sensing results from the LTE V2X module to exclude resources that are being used by LTE V2X transmissions.  Proposal 6: For dynamic resource pool sharing in type B devices, we propose to study the following:  • Perform basic LTE measurements to determine resources occupied by LTE V2X transmissions.  • Use IUCs from other type A devices that provide non-preferred resources that include resources occupied by LTE V2X transmissions.  • In the absence of LTE resource allocation information, use configuration-based solutions to decrease the probability of resource collisions between LTE V2X and NR SL transmissions. |
| Intel | Proposal 3:  • RAN1 should study mechanisms that enable dynamic co-channel coexistence between LTE SL and NR SL.  Proposal 4:  • When considering co-channel dynamic resource partitioning between LTE SL and NR SL, at the least the following aspects should be further studied:  o Information to be shared between LTE and NR module and any timeline impact  o Impact and enhancements to the NR SL sensing and resource selection procedure (e.g., exclusion rules, conditions under which NR SL transmission is not allowed)  o Impact and enhancements to Rel.17 inter-UE coordination schemes |
| Xiaomi | Proposal 9: Slots occupied by LTE SL synchronization resource shall be excluded when determining NR SL logic slots. |
| Panasonic | Proposal 7: 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%.  Proposal 8: 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.  Proposal 9: 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 10: 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 11: For in-coverage UEs, they can use gNB to relay the sensing information via UL and then DL to targeted UEs.  Proposal 12: 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. |
| China Telecom | Proposal 4: For dynamic resource allocation in co-channel coexistence for LTE sidelink and NR sidelink,  o Specify the benefit, necessity, and potential specification impact if any.  o How to enable PSFCH in LTE and NR sidelink coexistence.  o How to conduct sensing mechanism for LTE and NR sidelink.  • FFS: whether/how to support sensing information exchange between LTE and NR sidelink module.  o FFS: Other necessary clarification and modification if any. |
| Samsung | Proposal 5: 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 6: Further study content and timing of information from LTE SL module to NR SL module.  Proposal 7: 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 |
| ETRI | Proposal 3: It is proposed to study the following aspects to support dynamic resource sharing using overlapping resource pools between two RATs:   Resource configuration (aligned resource grids between two RATs)  • Not limit to the same SCS i.e., 15kHz between LTE sidelink and NR sidelink   Resource (re-)selection procedure taking LTE sensing results into account including timeline to pass the sensing results from LTE module to NR module, and so on.   Utilization of Rel-17 ICU schemes |
| MediaTek | Observation 3: Decoding SCI from other RAT (e.g., NR-SL UE decoding LTE-SCI) is a difficult problem to solve.  Observation 4: Dynamic type approach based on internally exchanging resource reservation information between LTE and NR modules could be feasible, although potential benefit is unclear. The performance benefit needs to be clearly justified versus its specification complexity.  Proposal 3: Further coexistence solutions (including dynamic based mechanisms) can be studied and evaluated for their potential benefits vs. complexities. |
| InterDigital | Proposal 1: LTE SL module shares results of sensing using parameters provided by NR SL module.  Proposal 2: Study shared LTE SL resource reservation information in addition to LTE SL sensing results.  Proposal 3: Study dynamic resource sharing mechanism for NR resource selection based on LTE SL sensing result, e.g. Set A.  Proposal 4: Study the latency aspect of the information exchange over the interface between NR SL and LTE SL module within a UE.  Proposal 5: Study NR SL IUC conflict indication based on overlapping LTE SL and NR SL resource reservation.  Proposal 6: Study Type A UE provides resource set based on dynamic NR and LTE SL resource sharing (if supported) to Type B UE. |
| Mitsubishi | Proposal 5: 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 |
| Qualcomm | Observation 4: The NR module of each Type A device can estimate a NR SL traffic proportion based on its own sensing results as well as resource occupancy information shared by the collocated LTE SL module.  Proposal 2: The NR SL UE-s determine the set of available resources based on the estimated NR SL traffic proportion and update this estimate at regular time intervals based on the current traffic load and/or system configuration.  Observation 5: Dynamic resource sharing between NR SL and LTE SL will not require any change to current LTE standards |
| Sharp | Proposal 4: For device type A, besides the resource reservation information obtained from the decoded SCI, the LTE SL module shares the resources corresponding to the “non-monitored” subframes. |
| Apple | Proposal 6: In dynamic resource 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 7: In dynamic resource 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  Proposal 8: In dynamic resource 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 where LTE sidelink sub-channel partially overlaps with NR sidelink sub-channel  Proposal 9: In dynamic resource sharing for co-channel coexistence, support that device type A (and device type B if applicable) receives LTE sidelink sensing and resource reservation information from inter-UE coordination. |
| NTT DOCOMO | Proposal 3:  • Conclude that ‘dynamic resource sharing’ is feasible and study the following aspects:  o Which information is shared  o Processing time on sharing  o Details of exclusion behavior  o Sync and async between LTE-SL and NR-SL  o S-SSB/PSFCH handling  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.  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. |
| Ericsson | Observation 15 Detection of LTE SL transmissions can be direct, indirect or by means of explicit signalling.  Proposal 6 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. |
| WILUS | Observation 1: Sensing and resource reservation information can be shared by LTE SL UE, and type A device can exclude the corresponding resources satisfying the RSRP condition, which allows spatial reuse. |
| Continental | Proposal 3: The study of co-channel co-existence should prioritize schemes allowing dynamic resource sharing between LTE SL and NR SL.  Proposal 4: RAN1 to study and clearly identify the pros, cons, and tradeoffs of:  • LTE SL and NR SL synchronization,  • usage of multiple numerologies in NR,  • PSFCH handling,  • possibility of new explicit signalling to make aware NR SL about LTE resource reservation,  • intra-device optimizations and information exchange: timing, format, types. |

### Company Views for 1st Round of Discussions

Would the following proposals be acceptable to the companies?

**Proposal 2-4a:**

* **For co-channel coexistence in Rel-18, the NR SL module in type A devices supports the use the LTE SL sensing and resource reservation information to exclude resources reserved by LTE SL UEs in its own resource selection procedures.**
  + **FFS details of resource exclusion by NR SL module.**

**Proposal 2-4b:**

* **For co-channel coexistence in Rel-18, the information shared by the LTE SL module to the NR SL module contains at least LTE sensing results and 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.**

**Proposal 2-4c:**

* **For co-channel coexistence in Rel-18, the LTE SL module shares the sensing and resource reservation information to the NR SL module using the following options: (possible down-selection):**
  + **Trigger-based, where the NR SL module triggers the LTE SL module to provide sensing and resource reservation information.**
  + **Condition-based, where the LTE module shares its sensing and resource selection information to the NR module when a certain condition(s) is met.** 
    - **FFS condition(s)**

**Proposal 2-4d:**

* **For co-channel coexistence in Rel-18, study the use of IUC for sharing LTE SL resource reservation information.**

#### Comments for Proposal 2-4a

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | Yes | We are Ok with the proposal |
|  |  |  |
|  |  |  |
|  |  |  |

#### Comments for Proposal 2-4b

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | Comments | We are generally Ok with the proposal, but just curious why this is decoupled from proposal 2-4a. In our view, the resource exclusion rules may also account for the half-duplex subframes which are not monitored by the LTE SL UE. |
|  |  |  |
|  |  |  |
|  |  |  |

#### Comments for Proposal 2-4c

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Intel | Comments | In our view this aspect could be also left up to implementation, while one aspect that may deserve further consideration may be the timeline of when this information is provided by the LTE module related to when this may need to be used by the NR module. |
|  |  |  |
|  |  |  |
|  |  |  |

#### Comments for Proposal 2-4d

|  |  |  |
| --- | --- | --- |
| **Company** |  | **Comments** |
| Intel | Yes | We are OK with the proposal |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

## Comparison of Solutions and Evaluation Results

### Company Views from TDocs

**Huawei, HiSilicon**

* Case1: FDMed resource pools for NR-V and LTE-V (Alt 1 with FDM configuration)
  + Assumption: RP configuration matches traffic density.
* Case 2: TDMed resource pools for NR-V and LTE-V (Alt 1 with TDM configuration)
  + Assumption: RP configuration matches traffic density
* Case 3: Mixed NR-V and LTE-V in a shared resource pool for NR-V and LTE-V (Alt 2)
* Alt 1: semi-static resource pool partitioning
* Alt 2: dynamic resource sharing

**Vivo**

* Semi-static resource pool sharing
  + Case 1: the ratio of LTE devices to NR devices is 1 (i.e. LTE: NR = 1:1)
  + Case 2: the number of NR devices is three times as many as LTE devices (i.e. LTE: NR = 1:3).
* Dynamic resource pool sharing
  + Option 1: NR SL UEs detect the resources reserved by LTE devices and then avoid the collision through resource (re-)selection, pre-evaluation and pre-emption.
  + Option 2: LTE SL modules of the SL 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.

**OPPO**

* Scenario 1：NR UE with periodic traffic + LTE UE with periodic traffic + Freeway layout
* Scenario 2：NR UE with aperiodic traffic + LTE UE with periodic traffic + Freeway layout
* Scenario 3：NR UE with periodic traffic + LTE UE with periodic traffic + Urban layout

**CATT, GOHIGH**

* Evaluation results for TDM-based semi-static resource pool partition solution in section 5.1 and dynamic resource pool sharing solution.
  + Highway scenario is considered

**Qualcomm**

* Three broad modes of operations for UE-s in the shared resource pool
  + Type A UE-s operating based on Rel-16 in-device coexistence mechanism, where, based on the priorities of the RATs, it drops NR SL or LTE SL transmissions and receptions. Type C UE-s operate based on Rel-14 mechanism with no change in LTE configurations.
  + UE-s operating over the shared resource pool are (pre-)configured with a NR SL resource pool and an LTE SL resource pool with the resources partitioned in a TDM manner.
  + Type A UE-s operate based on the dynamic resource pool sharing mechanism based on the resource information received from the collocated LTE SL module. Type C UE-s operate based on Rel-14 mechanism with no change in LTE configurations.
* Performed comparative study of the Rel-16 based in-device coexistence mechanism with the (semi-)static RP partitioning and dynamic resource sharing.

The above simulation details are based on proposals collected from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Huawei, HiSilicon | Observation 6: Based on simulation results, Alt 2 (dynamic resource sharing) has no obvious PRR performance gain compared with Alt 1 (semi-static resource pool partitioning). |
| Vivo | Observation 2: For LTE-NR V2X coexistence, dynamic resource pool sharing causes both performance loss to LTE devices and NR devices compared with semi-static separate pool separation in some cases.  Observation 5: There is an obvious gain in Option 2 compared with Option 1. |
| OPPO | Observation 1: There is no much difference for the PRR of LTE UE or NR UE when dynamic sharing and semi-static configuration are applied in freeway scenario.  Observation 2: It is hard to find a proper TDM ratio between NR and LTE resource pool in urban scenario. |
| CATT, GOHIGH | Observation 1: There is limited performance degradation of LTE SL for dynamic resource pool sharing solution comparing with TDM-based semi-static resource pool partition solution.  Observation 2: There is notable performance improvement of NR SL for dynamic resource pool sharing solution comparing with TDM-based semi-static resource pool partition solution. |
| Qualcomm | Observation 6: Given that an accurate proportion of NR SL to LTE SL traffic load is known, a semi-static RP partition can be configured to provide an optimal balance of performance between NR and LTE.  Observation 7: For a semi-static RP partition to provide a good balance between NR SL and LTE SL performance, the RP partition needs to be updated when the proportion of NR SL to LTE SL traffic in the network changes.  Observation 8: Small deviations in the network/traffic configuration will require the reconfiguration of the semi-static RP partition otherwise, the performance of NR SL or LTE SL is degraded.  Observation 9: A mismatch in the (pre-)configuration of the (semi-)static RP partition between UE-s in the network may arise when some UE-s have an updated RP configuration while others are using an outdated one, which may happen due to a staggered roll out of device updates, an inability to update based on RRC signalling, etc.  Observation 10: Mismatch of the (pre-)configured (semi-)static RP partition across devices degrades both NR and LTE performance.  Observation 11: Re-use of Rel. 16 in-device coexistence mechanism to implement cochannel coexistence leads to excessive performance degradation for the lower priority RAT. |

## Others

### Company Views from TDocs

Collection of proposals from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Spreadtrum | Proposal 9: Power control and in-device interference between LTE sidelink transmission and NR sidelink transmission should be further studied for dynamic resource sharing, if simultaneous transmission of LTE sidelink and NR sidelink is supported in a device. |
| Toyota | Observation 4: 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 5: 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 6: 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.  Proposal 6: RAN1 to study solutions that enable mutual detection of control signaling (at least resource reservation) between Rel-14/15/18 LTE SL UEs and Rel-18 NR SL UEs, without changing LTE SL specifications. |
| 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. |
| Intel | Proposal 4:  • When considering co-channel dynamic resource partitioning between LTE SL and NR SL, at the least the following aspects should be further studied:  o Information to be shared between LTE and NR module and any timeline impact  o Impact and enhancements to the NR SL sensing and resource selection procedure (e.g., exclusion rules, conditions under which NR SL transmission is not allowed)  o Impact and enhancements to Rel.17 inter-UE coordination schemes |
| Panasonic | Proposal 1: To clarify the last meeting agreements that the “semi-static resource pool partitioning” will only refer to the non-overlapped resource pools between LTE SL and NR SL. When the resources are overlapped, it should be discussed under Dynamic Resource Sharing including the case of partial overlapping between LTE and NR resource pools. |
| Samsung | Proposal 4: Further study conditions to enable or disable sharing of common resources between LTE SL transmissions and NR SL transmissions.  Proposal 8: Study solutions based on energy detection to assist in co-existence between LTE and NR. |
| InterDigital | Observation 1: R16 NR SL short-term TDM does not address collisions between LTE and NR SL transmissions in co-channel coexistence scenario.  Proposal 7: Study a semi-static mechanism to enable the use of overlapping resources in a NR SL resource pool based on an estimate of the LTE SL activities in those resources. |
| NTT DOCOMO | Observation 2:  • Definitions of ‘semi-static resource pool partitioning’ and ‘dynamic resource sharing’ are ambiguous.  Proposal 2:  • Confirm exact meaning of the following terminologies.  o Semi-static resource pool partitioning: Configured LTE-SL resource pool and NR-SL resource pool are within the same carrier but not overlapped in time and frequency.  o Dynamic resource sharing: Configured LTE-SL resource pool and NR-SL resource pool are within the same carrier and overlapped fully or partially in time and frequency. |
| Bosch | Objective 7: Quasi-dynamic adaptation of the resource pool separation needs optimization according to, e.g., the traffic load and the penetration rate of LTE-V2X devices.  Proposal 6: Study whether it is beneficial to use indirect detection of LTE-V2X transmissions to further adapt resource partitioning |
| Ericsson | Proposal 3 RAN1 discusses solutions for co-channel coexistence that meet the following principles:  • Changes to the configuration (e.g., pool configuration) are possible but should be minimized.  • The impact of having co-channel deployments to the different RATs should be as limited as possible.  Observation 11 Static split of resources for LTE and NR is not efficient in resource utilization.  Observation 12 “Detect-and-vacate” solution in channel or resource pool level is not efficient in terms of resource utilization. |

# Others

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

### Summary of Company Views from TDocs

In the previous meeting, 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 the previous meeting is as follows:

|  |
| --- |
| **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). |

The other combinations were left FFS, and have been discussed by company contributions.

* 10 companies prefer to support only combination A, and not B and C - [1], [3], [9], [13], [14], [20], [21], [22], [30], [31].
* 3 companies prefer to include combination B - [2], [23], [32].
* 2 companies prefer to include combination C - [17], [23] (low priority).
* 8 companies prefer to include combination B and C - [7], [10], [12], [19] (low priority), [25], [28], [29], [33].

Companies that prefer to support only combination A state that apart from reducing the work load, combinations B and C involve the gNB and eNB respectively, and hence the network can manage resources for such a shared system. Also, since Mode 1 and Mode 2 do not operate on the same resource pool, it can be assumed that Mode 1 does not share a resource pool with Mode 4 LTE UEs. Hence there is no need to discuss them.

On the other hand, companies supporting combination B state that the Mode 1 NR SL UE can report LTE sensing information to the gNB so that it is aware of the resources that are occupied by LTE transmissions before providing grants to the NR SL UEs. The same reporting scheme as used in Rel-15 in LTE can be reused.

Companies supporting combination C state that the same solutions used for combination A would work. [7], [29]

Due to the split set of support between the options, and in light of the agreement from the previous meeting, it is the FL’s view that the focus can remain on combination A, while combination B and C can be discussed after combination A has been specified.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Proposal 15: RAN1 to focus on LTE Mode 4 and NR Mode 2 for co-channel coexistence. |
| LG | Proposal 2: The following two types of operations need to be investigated for the coexistence between LTE SL and NR SL in the same frequency channel:   Semi-static resource partitioning between LTE SL and NR SL in the same frequency channel   Dynamic resource sharing between LTE SL and NR SL in the same frequency channel  Proposal 3: When considering the dynamic resource sharing between LTE SL and NR SL in the same frequency channel, at least the following aspects need to be studied:   Condition(s) under which NR SL transmission can be allowed in the co-channel where LTE SL exists   Type/numerology of NR SL channel/signal that can be transmitted in the co-channel where LTE SL exists   Whether/how to allow Mode 1 based NR SL transmission in the co-channel where LTE SL exists |
| Huawei, HiSilicon | Proposal 3: For NR-V and LTE-V co-channel co-existence, only Combination A (Mode 2 NR SL + Mode 4 LTE SL) is supported. |
| ZTE, Sanechips | Proposal 4: From deployment perspective, all of the four mode combinations should be supported,  • 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.  Observation 1: The solution of Combination A can be reused for Combination C because there is no essential difference for NR SL mode 2 between combination A and C.  Proposal 5: Combination C should has the same priority as Combination A.  Proposal 6: For combination B, the legacy mechanism in Rel-15 (sensing and reporting the sensing results to network) can be considered as starting point for NR SL mode 1 UE. |
| OPPO | Proposal 3: The combinations other than NR SL mode 2 + LTE SL mode 4 are not considered in Rel-18 co-channel coexistence. |
| CATT, GOHIGH | Proposal 3: 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. |
| Lenovo | Proposal 2: Support to study 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. |
| 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. |
| Intel | Proposal 1:  • Combination B and C are not considered, and any potential solution for co-channel co-existence between LTE V2X and NR V2X devices should be devoted to address combination A. |
| Transsion | Proposal 2: Combination C should be considered for co-channel coexistence scenarios.  Proposal 3: A common solution for combination A and combination C is favourable for co-channel coexistence scenario. |
| China Telecom | Proposal 2: Support Mode 1 NR SL + Mode 4 LTE SL (Combination B) and/or Mode 2 NR SL + Mode 3 LTE SL (Combination C) with lower priority. |
| Samsung | Proposal 9: 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” is the only combination considered. |
| CMCC | Proposal 2: For the study of co-channel coexistence solutions in Rel-18, only support the following combination of operational modes:   Mode 2 NR SL with Mode 4 LTE SL (Combination A);   Other combinations are not considered in Rel-18. |
| ETRI | Proposal 2: It is proposed to remove the FFS part in the previous agreement |
| MediaTek | Proposal 2: The following should be adopted for the combination of operation modes.  • Mode-1 NR sidelink + Mode-4 LTE sidelink is excluded from the coexistence study.  • Mode-2 NR sidelink + Mode-3 LTE sidelink is considered with low priority. |
| Mitsubishi | Proposal 4: For the study of co-channel coexistence solutions in Rel-18, combination of operational modes B and C are also considered. |
| Apple | Proposal 2: For the study of co-channel coexistence solutions in Rel-18, consider Mode 1 NR sidelink with Mode 4 LTE sidelink and Mode 2 NR sidelink with Mode 3 LTE sidelink with low priority. |
| NTT DOCOMO | Observation 1:  • From NR-SL module perspective, there is no difference between Combination A and Combination C.  Proposal 1:  • For the study of co-channel coexistence solutions in Rel-18, Combination B and Combination C are considered with the same priority as Combination A.  o For Combination A and Combination C, common mechanism is studied.  o For Combination B, information report to gNB is studied. |
| Bosch | Observation 1: Only combination A is of interest for LTE / NR SL co-channel coexistence.  Proposal 1: Confirm combination A (modes Mode 2 NR SL with Mode 4 LTE SL) to be the only combination considered in Rel-18 LTE / NR SL co-channel coexistence |
| 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 At least, for combinations B-D and possibly for combination A, it is possible to update the (pre-)configuration of SL UEs in a timely and efficient manner.  Observation 2 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 3 Information about the presence of LTE UEs allows for addressing Combination B by means of scheduling restrictions applied by the gNB.  Observation 4 Information about reservations by LTE UEs requires dynamic and costly reports from the NR UE.  Observation 5 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. |
| WILUS | Proposal 2: RAN1 should study the co-channel coexistence of NR SL Mode 1 + LTE SL Mode 4 with higher priority.  Proposal 3: Type A device may omit the configured transmission if configured resource is already reserved by LTE SCI, and reports NACK to gNB. |
| Continental | Proposal 2: The study of co-channel coexistence should also consider Combination B and Combination C. |

### Company Views for 1st Round of Discussions

Would the following conclusion be acceptable to the companies?

**Conclusion 3-1:**

* **For co-channel coexistence solutions in Rel-18, the combination of operational modes Mode 1 NR SL + Mode 4 LTE SL (Combination B) and Mode 2 NR SL + Mode 3 LTE SL (Combination C) can be revisited once Mode 2 NR SL with Mode 4 LTE SL (Combination A) has been specified.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

### Summary of 1st Round of Discussions

TBD

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

### Summary of Company Views from TDocs

Based on the contributions from companies [1], [7], [14], [20], [29] and [33], it is clear that the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe need to be aligned. Under the in-device coexistence framework, it was already specified in 38.213, in Section 16.7, that the subframe boundaries of the NR SL and LTE SL transmission have to be aligned. This can be reused for Rel-18.

This would mean that both the NR SL module and the LTE SL module select the same synchronization source [14], [15], [29]. Companies had suggested that the NR SL module can use the LTE SL synchronization procedure and sync source [5], [7], [15].

One company [5] had raised the concern of collisions between the synchronization signasl of one RAT and PSSCH transmissions of the other RAT, and suggested that synchronization signals in both LTE SL and NR SL could be configured FDMed in same time domain.

In the FL’s view, RAN1 can confirm to reuse the Rel-16 in-device framework that ensures alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe.

#### Company Proposals:

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

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| Nokia, Nokia Shanghai Bell | Observation 5: Any co-channel coexistence mode requires at least slot and subframe boundary alignment between LTE and NR SL. Semi-static TDM-based co-channel coexistence further requires DFN/SFN alignment.  Proposal 14: RAN1 should discuss whether to support NR SL synchronization based on LTE SLSS/PSBCH transmissions and/or NR SL being capable of transmitting LTE SLSS/PSBCH. |
| Vivo | Observation 8: 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 5: If dynamic resource sharing is supported, the collision between the synchronization signal and the resource pools of different RATs, 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 11: NR SL can use the same synchronization priority selection order as LTE SL via one of the following options:  • Option 1: For dual module device, only LTE SL module perform synchronization procedure, and NR SL module uses synchronization reference from co-located LTE module.  • Option 2: NR SL and LTE SL perform synchronization procedure according to the synchronization priority selection order of LTE SL on their respective synchronization resources. |
| Xiaomi | Proposal 5: 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 7: For dynamic resource sharing, the type A devices selects the same synchronization source for NR SL TX and LTE SL TX.  Proposal 8: For dynamic sharing, study further on solutions to unify the synchronization between LTE SL and NR SL. |
| Samsung | Observation 3: In case of LTE/NR SL co-existence, unsynchronized LTE/NR SL transmissions can suffer a greater performance loss.  Proposal 3: Further study how to achieve synchronization between NR and LTE SL transmissions when sharing common resources. |
| Mitsubishi | Proposal 5: 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 |
| NTT DOCOMO | Proposal 3:  • Conclude that ‘dynamic resource sharing’ is feasible and study the following aspects:  o Which information is shared  o Processing time on sharing  o Details of exclusion behavior  o Sync and async between LTE-SL and NR-SL  o S-SSB/PSFCH handling  Observation 4:  • In current synchronization procedure, NR-SL may be asynchronized to LTE-SL.  Proposal 8:  • For dynamic resource sharing, study how to ensure synchronization between LTE-SL and NR-SL. |
| Continental | Proposal 4: RAN1 to study and clearly identify the pros, cons, and tradeoffs of:  • LTE SL and NR SL synchronization,  • usage of multiple numerologies in NR,  • PSFCH handling,  • possibility of new explicit signalling to make aware NR SL about LTE resource reservation,  • intra-device optimizations and information exchange: timing, format, types. |

### Company Views for 1st Round of Discussions

Would the following proposal be acceptable to the companies?

**Proposal 3-2:**

* **For co-channel coexistence solutions in Rel-18, RAN1 will reuse the Rel-16 in-device framework that ensures alignment between the slot boundary of the NR SL time slot and the subframe boundary of the LTE SL subframe.**

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

### Summary of 1st Round of Discussions

TBD

## Operational Scenarios

### Company Views from TDocs

Collection of proposals from the contributions of different companies.

|  |  |
| --- | --- |
| **Company** | **Company proposal related to this issue** |
| LG | Proposal 1: RAN1 needs to firstly identify scenario(s) to be mainly considered for the co-channel coexistence between LTE SL and NR SL, e.g., at least the scenario that NR SL operates in both the frequency channel in which only NR SL exists and the frequency channel in which LTE SL and NR SL coexist can be considered. |
| CATT, GOHIGH | Proposal 1: Design principles of co-channel coexistence mechanism for LTE sidelink and NR sidelink should be considered as follows:  • Ensuring backward compatible of R14/R15 LTE sidelink and R16/R17 NR sidelink  • Reuse the in-device coexistence framework defined in Rel-16 as much as possible  • No or limited performance degradation of LTE sidelink |
| MediaTek | Proposal 1: Study for SL co-channel coexistence solutions should take into account the following aspects.  • Prioritize performance evaluations of existing Rel-16 design to assess the need for any enhanced solutions.  • Feasibility evaluations should be performed based on a common set of simulation scenarios and parameters. |

# Collection of Agreements/Conclusions from Previous Meetings

## 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. R1-2205841 On Co-channel Coexistence for LTE Sidelink and NR Sidelink Nokia, Nokia Shanghai Bell
2. R1-2205852 Discussion on co-channel coexistence for LTE sidelink and NR sidelink LG Electronics
3. R1-2205888 Co-channel coexistence for LTE sidelink and NR sidelink Huawei, HiSilicon
4. R1-2205993 Discussion on Co-channel coexistence for LTE sidelink and NR sidelink Spreadtrum Communications
5. R1-2206043 Co-channel coexistence for LTE sidelink and NR sidelink vivo
6. R1-2206065 Discussion on co-channel coexistence for LTE sidelink and NR sidelink TOYOTA Info Technology Center
7. R1-2206099 Study on co-channel coexistence for LTE sidelink and NR sidelink ZTE,Sanechips
8. R1-2206121 Discussion on co-channel coexistence for LTE sidelink Sony
9. R1-2206292 Discussion on co-channel coexistence for LTE and NR V2X OPPO
10. R1-2206402 Discussion on co-channel coexistence for LTE sidelink and NR sidelink CATT, GOHIGH
11. R1-2206440 Discussion on Co-Channel Coexistence for LTE and NR Sidelink Fraunhofer HHI, Fraunhofer IIS
12. R1-2206450 Discussion on co-channel coexistence for LTE sidelink and NR sidelink Lenovo
13. R1-2206471 Co-existence between LTE and NR sidelink NEC
14. R1-2206587 Considerations for LTE Sidelink and NR Sidelink Co-channel Coexistence Intel Corporation
15. R1-2206646 Discussion on co-channel coexistence for LTE and NR sidelink Xiaomi
16. R1-2206660 Discussion on Sidelink Co-channel Coexistence Panasonic
17. R1-2206671 Discussion of co-channel coexistence for LTE sidelink and NR sidelink Transsion Holdings
18. R1-2206681 Considerations on co-channel coexistence for LTE SL and NR SL CAICT
19. R1-2206692 Discussion on co-channel coexistence for LTE sidelink and NR sidelink China Telecom
20. R1-2206828 On co-channel coexistence for LTE sidelink and NR sidelink Samsung
21. R1-2206915 Discussion on co-channel coexistence for LTE sidelink and NR sidelink CMCC
22. R1-2206956 Discussion on co-channel coexistence for LTE sidelink and NR sidelink ETRI
23. R1-2207010 Co-channel coexistence for NR sidelink and LTE sidelink MediaTek Inc.
24. R1-2207147 Co-channel coexistence for LTE sidelink and NR sidelink InterDigital, Inc.
25. R1-2207154 On sidelink co-channel coexistence issues Mitsubishi Electric RCE
26. R1-2207235 Co-channel Coexistence Between LTE SL and NR SL Qualcomm Incorporated
27. R1-2207281 Discussion on co-channel coexistence for LTE sidelink and NR sidelink Sharp
28. R1-2207339 Co-channel Coexistence for LTE Sidelink and NR Sidelink Apple
29. R1-2207410 Discussion on co-channel coexistence of LTE-SL and NR-SL NTT DOCOMO, INC.
30. R1-2207509 Discussions on LTE and NR sidelink co-channel coexistence ROBERT BOSCH GmbH
31. R1-2207565 Co-channel coexistence between LTE sidelink and NR sidelink Ericsson
32. R1-2207601 Discussion on co-channel coexistence for LTE sidelink and NR sidelink WILUS Inc.
33. R1-2207625 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).

The following is a list of delegates handling this AI from the previous meeting.

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email Address** |
| Fraunhofer | Tom Wirth | thomas.wirth@hhi.fraunhofer.de |
| NTT DOCOMO | Shohei Yoshioka | shohei.yoshioka@docomo-lab.com |
| Apple | Chunxuan Ye | Chunxuan\_ye@apple.com |
| vivo | Siqi Liu | liusiqi@vivo.com |
| Intel | Kilian Roth  Salvatore Talarico | kilian.roth@intel.com  salvatore.talarico@intel.com |
| Qualcomm | Sourjya Dutta | sourdutt@qti.qualcomm.com |
| Lenovo | Zhennian Sun | [sunzn1@lenovo.com](mailto:sunzn1@lenovo.com) |
| Samsung | Emad Farag | e.farag@samsung.com |
| OPPO | Kevin Lin  Yi Ding | kevin.lin@oppo.com  yi.ding@oppo.com |
| ZTE,Sanechips | Yuzhou Hu | hu.yuzhou@zte.com.cn |
| Transsion | Xingya Shen | xingya.shen@transsion.com |
| InterDigital | Moon-il Lee | Moonil.lee@interdigital.com |
| Spreadtrum | Haowen Liu | haowen.liu@unisoc.com |
| Sharp | Luochao | chao.luo@cn.sharp-world.com |
| Xiaomi | Zhao Qun | zhaoqun1@xiaomi.com |
| NEC | Jin Yang | yangjin@labs.nec.cn |
| Ericsson | Ricardo Blasco | name.surname at company . com |
| Sony | Xiaoxue Wang | Xiaoxue.Wang@sony.com |
| HiSilicon | Fan Yang | james.yangfan@huawei.com |
| Huawei | Xiang Mi | shawn.mixiang@huawei.com |
| Nokia, NSB | Torsten Wildschek | torsten.wildschek@nokia.com |
| Mitsubishi Electric | Cristina Ciochina | c.ciochina at fr.merce.mee.com |
| CATT | ShupengLi | lsp@catt.cn |
| LGE | Seungmin Lee  Daesung Hwang | [edison.lee@lge.com](mailto:edison.lee@lge.com)  daesung.hwang@lge.com |
| Toyota ITC | Takayuki Shimizu | takayuki.shimizu@toyota.com |
| China Mobile | Pengyu JI | jipengyu@chinamobile.com |
| ETRI | Junghoon Lee | jh.lee@etri.re.kr |
| Panasonic | Yang KANG | yang.kang@sg.panasonic.com |
| China Telecom | Jing Guo | guojing6@chinatelecom.cn |
| MediaTek | Umut Ugurlu | umut.ugurlu@mediatek.com |
| Bosch | Khaled Hassan | khaled.hassan@bosch.com |
| WILUS | Youngjoon Yoon | eric.yoon@wilusgroup.com |
| CableLabs | Dorin Viorel | d.viorel@cablelabs.com |
| Continental Automotive GmbH | David Gonzalez | david.gonzalez.gonzalez@continental-corporation.com |