**3GPP TSG RAN WG1 #106-e R1-210xxxx**

**e-Meeting, August 16th – 27th , 2021**

**Source: Moderator (CATT)**

**Title:** **Summary for email discussion [106-e-NR-R17-Sidelink-05]**

**Agenda Item:** **8.11.2**

**Document for:** **Discussion and Decision**

# Introduction

This document provides the email discussion summary on Reply LS to R1-2106430.

[106-e-NR-R17-Sidelink-05] Reply LS to [R1-2106430](file:///D:\08_Rel-17\05_会议文稿\Docs\R1-2106430.zip) (LS on synchronous operation between Uu and SL in TDD band n79, RAN4) by August 20 – Rui (CATT)

# Summary of contributions

In the LS from RAN4, the synchronous operation between Uu and SL in TDD band n79 is raised, and provide two potential options:

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| **1. Overall Description:**  Partially used SL with Uu in TDD band, e.g. n79, irrespective of TDM or FDM is being discussed for Rel-17 SL enhancement in RAN4.  In Rel-16 NR V2X, SL transmission timing is aligned with DL timing of Uu based on RAN1 agreements. The same SL transmission timing if applied to Rel-17 SL in the scenario of partially used SL with Uu in TDD band may give rise to interference problem between SL and Uu.  There are two options under discussion in RAN4 as below.  Option 1: To follow the Rel-16 agreement to align SL transmission timing with DL timing.  Option 2: To reconsider SL transmission timing to align with UL timing to mitigate the interference between Uu and SL, i.e.   * For sidelink transmissions,   + SL transmission timing is aligned with Uplink timing when Uu and sidelink is TDMed/FDMed coexistence in the same band, including TDM coexistence within the same carrier or different carriers.   + Otherwise, SL transmission timing is aligned with Downlink timing.   RAN4 respectfully ask RAN1 to clarify that is it feasible that RAN4 consider option 2 from RAN1 perspective to define SL transmission timing to align with UL timing when SL is synchronized to a network?  **2. Actions:**  **To RAN WG1:**  RAN4 respectfully request RAN1 to clarify the above question regarding partially used SL with Uu in TDD band. |

Companies’ views are summarized as following:

* Samsung [2]: Option 1, the reason is that option 2 will lead to backward compatibility issues between UEs supporting option 1 (i.e. Rel-16) and UEs supporting option 2 in the same network.
* OPPO [3][9]: Option 1, the reason is as following:
* No timing advanced field in Rel-16 SCI, PSCCH and PSSCH are transmitted in same slot, the Rel-12 D2D mechanism cannot be reused.
* Only 1 reference timing is maintained by UE
* Option 2 will lead to timing misalignment between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs
* Qualcomm [4]: Option 1, the reason is as following:
* Option 2 will lead to timing misalignment between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs
* Interference between SL and Uu could exist even if option 2 is used.
* LG [5]: Option 1, the reason is as following:
  + No timing advanced field in Rel-16 SCI, PSCCH and PSSCH are transmitted in same slot, the Rel-12 D2D mechanism cannot be reused.
  + If option 2 is used, the maximum timing differences between different UEs(UEs with UL timing vs. UEs with DL timing) would be increased compared to Rel-16 NR-V2X, which has negative impacts on SL transmission/reception.
  + Insufficient remaining time of Rel-17 WI.
* Apple [6]: Provides clarification on the feasible or infeasible scenarios on option 2:
  + For a mode 1 UE in RRC idle or inactive state or a mode 2 UE, the uplink timing may not be maintained at the UE, and hence Option 2 is infeasible.
  + For a mode 1 UE in RRC connected state, the uplink timing is maintained at the UE, and hence Option 2 is feasible. In other words, Option 2 is feasible for mode 1 UE in RRC connected state.
* Xiaomi [7]: Option 1: the reason is as following:
  + TA is only available for RRC\_CONNECTED UEs, and not possible for RRC\_IDLE and RRC\_INACTIVE UEs
  + Option 2 will lead to timing misalignment between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs, the SL communication between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs may be broken due to the timing misalignment
* Vivo [8]: Option 1, the reason is as following:
  + TA is only available for RRC\_CONNECTED UEs, and not possible for RRC\_IDLE and RRC\_INACTIVE UEs
  + Option 2 will lead to timing misalignment between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs, the SL communication between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs may be broken due to the timing misalignment
  + Option 2 will lead to backward compatibility issue between Rel-16 and Rel-17 UEs in SL communication because different transmission timings are applied
* ZTE, Sanechips [10]: Option 1, the reason is as following:
  + Supporting SL communication between between RRC\_CONNECTED state and RRC\_IDLE/INACTIVE state UEs, and reduce the timing misalignment as much as possible.
  + The GAP symbol can address Tx/Rx switching/the misalignment of SL transmission timing and Uplink timing, etc.
  + Option 2 will seriously affect LTE and NR sidelink coexistence and mutual communication between Rel-17 UEs and Rel-14/15/16 UEs.
* Nokia, Nokia Shanghai Bell [11]: Option 2 at least when Uu and SL are in same carrier, the reason is as following:
  + If SL and Uu are in the same carrier, SL mode 1 operation can be assumed, while mode 2 would not be efficient usage of resources when all the UL transmissions are dynamically scheduled by the gNB.
  + Option 1 could create interference to the UL transmissions because in the time domain consecutive SL and Uu slots would overlap and in the frequency domain adjacent SL and UL subcarriers would not be fully orthogonal.
* Ericsson [12][13]: Provides clarification on both options
  + For option 1:
    - The use of DL timing allows for SL communication between nearby UEs in the same cell.
    - The use of DL timing for SL communication may require a tight OLPC using DL PL if the TX UE is close to the gNB.
    - With the Rel-16 requirement of tracking a single timing reference, SL communication across cell borders using DL timing may not be possible in general.
  + For option 2:
    - The use of UL timing for SL transmission requires that all SL active UEs (i.e., interested in TX or RX over SL) are RRC\_CONNECTED.
    - The use of UL timing (i.e., requiring UEs to be RRC\_CONNECTED to have a TA value, etc.) for SL transmission must be configurable and always complementary to using DL timing, not a standalone solution.
    - If the Rel-16 requirement of tracking a single timing reference is reused, SL communication across cell borders using UL timing may not be possible in general.
  + Coexistence is not possible in a scenario where some UEs use DL timing for SL transmission (Option 1) and other UEs use UL timing for SL transmission (Option 2) if the Rel-16 requirement of tracking a single timing reference is kept.
* Huawei, Hisilicon [14]: Option 2 when Uu and SL are in same carrier, the reason is as following:
  + Option 1 will lead to timing misalignment between UL and SL, in this situation, SL transmission will cause interference to UL reception, and UL transmission will cause interference to SL transmission or reception.
  + Band n79 is specified for Rel-17 UE only by now, and whether to support Rel-16 UE operating in this band is not clear yet.

# Round 1 discussion

Based on the summary of companies’ contributions, the observations are as following:

* For option 1(DL timing):
  + Allows sidelink communication between RRC\_CONNECTED and RRC\_IDLE/INACTIVE UEs
  + No backward compatible issues when R17 is coexisting with R14/R15/R16 SL UEs.
  + The UL interference due to SL transmission can only be mitigated by power control based on DL pathloss and gap symbol.
* For option 2(UL timing) at least when UL and SL are in same carrier.
  + The precondition for option 2 is that all the SL UEs should be RRC\_CONNECTED state, including Tx UEs and Rx UEs.
  + There is potential coexistence issue between R17 and R14/R15/R16 SL UEs.

Based on the above observations, I would like to collect companies’ views on the following questions firstly.

**Q1: From RAN1’s perspective, is it acceptable to mandate all the SL active UEs being RRC\_CONNECTED state when Uu and SL share same carrier?**

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| **Company** | **Answer** | **Comments** |
| OPPO | No | If it is mandatory that all SL UEs are in RRC\_CONNECTED state, one of the preconditions is that the network coverage should be everywhere and all UEs should be IC. However, the precondition is not realistic for all the releases by now.  Furthermore, Q1 precludes the SL UEs in RRC\_IDLE/INACTIVE working on the share carrier. |
| Xiaomi | No | From Rel-17 SL WID, three use cases have been considered for NR sidelink including V2x, public safety and commercial. At least for V2x and public safety services, it would be critical to support sidelink operation when UEs are in RRC\_idle state, or to support SL operation when UEs are in partial coverage or out of coverage. Even for commercial services, it would be much beneficial to enable sidelink operation among UEs in RRC\_idle state, and enable sidelink operation between UEs in RRC\_connected and UEs in RRC\_idle.  From our point of view, a solution can be considered as “acceptable” only if it can satisfy the targeted service requirement and application scenario. Therefore we do not think mandating all SL UEs are in RRC\_connected is “acceptable”. |
| Ericsson | It depends | If all UEs need to be in RRC\_CONNECTED state, depending on the number of UEs this could pose a management problem at the gNB. This is unacceptable for a mass UC such as V2X. On the other hand, for a UC with a handful of users such as PS, it may be possible and indeed preferrable over having larger interference to Uu. |
| NTT DOCOMO |  | Same view with Ericsson. It would be up to use case. |
| Apple |  | This may be up to use cases. |
| Qualcomm | No | Requiring UEs to be in RRC\_CONNECT to use sidelink is not backwards compatible with the existing design and runs counter to use cases that are listed in the WID.  The question from RAN4 is about the same band and it isn’t clear why Q1 is signaling out the same carrier case.  We prefer to focus the discussion directly on the question from RAN4. RAN4 did not ask RAN1’s view on whether all UEs could be required to be in the RRC\_CONNECTED state for example. |
| LG Electronics | No | We don’t understand why Q1 is related to the question (asked to RAN1) in RAN4 LS. In addition, the motivation of specifying such a restriction does not seem reasonable even from a technical point of view. |
| Lenovo/Motorola Mobility | No | We prefer legacy sidelink operating principle defined based on DL timings and even mandating all SL active UEs to be in RRC connected state will still create backward compatibility issues with R16 SL UEs. |
| vivo | Comment | This is not a decision 3GPP/RAN1 can make; it is a deployment issue.  On the other hand, even in Rel-16 (and actually also in LTE), it is already possible for the network to enforce that only connected mode UEs can use SL. |
| ZTE, Sanechips | No | Considering the scenarios for sidelink (InC, OoC, and partial coverage), and backward compatibility with Rel-14/15/16 sidelink UEs, it is not reasonable to mandate all the Rel-17 SL active UEs being RRC\_CONNECTED state. |
| Sharp | No | Agree with other companies that this is not backward compatible with legacy UEs. |
| Intel | Comments | We suggest aligning question with LS from RAN4, e.g.  Is it feasible from RAN1 perspective to define SL transmission timing to align with UL timing when SL is synchronized to a network? |
| Nokia, Nokia Shanghai Bell |  | We agree with Ericsson. In the shared carrier interference from SL to Uu need to be considered. We think that the option to only have SL between RRC\_CONNECTED UEs and the use UL timing for SL should be supported in the shared carrier. |
| Huawei, HiSilicon | No | This question was not asked by RAN4, neither clear about the relationship with RAN4 question in the LS, so we suggest to focus the discussion directly on the RAN4’s question. Considering from technical perspective, it is not reasonable either to mandate a UE always work in RRC\_CONNECTED state, especially for the UE using resource allocation mode-2. |
| Samsung | No | It is not clear how this question relates to the response RAN4 is seeking.  SL active UE’s can be in RRC Connected state, RRC INACTIVE or RRC IDLE. In partial coverage scenarios, it seems unreasonable to mandate that all SL active UE’s are RRC connected state as this requires all UEs to be in coverage, and even if all UEs are in coverage this will increase the load on the network. |
| Fraunhofer | No | We do not think that all SL active UEs have to be mandated to be in the RRC\_CONNECTED state, primarily because it would not be possible for a UE to be always in coverage with a gNB and has backward compatibility issues. Also, even if this were possible, it should be considered depending on the use case, as mentioned by Ericsson and others. |
| Convida Wireless | No | We don’t think that all SL active UEs should be mandated to be in the RRC\_CONNECTED state. |
| Futurewei | No | The question is not directly related to the question that RAN4 asked.  It may be possible and beneficial for some scenarios, but not reasonable to mandate all the SL active UEs being RRC\_CONNECTED state for all cases. |
| MediaTek | No | Unclear the relation to the RAN4 question. But such restriction may not be reasonable, especially if SL UE may not have the uu interface. |

**Q2: From RAN1’s perspective, whether the coexistence between R17 SL UEs and R14/R15/R16 SL UEs in shared carrier or dedicated carrier need to be supported?**

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| **Company** | **Answer** | **Comments** |
| OPPO | Yes | Backward compatibility issue should always be considered at least for those releases by now. Band n79 is defined specifically for Rel-17 SL only by now, however n79 is not a release-specific band. If it will not support other releases of SL UEs on band n79, this band must be useless by only supporting only one release SL features with a precondition that all UEs should be in RRC\_CONNECTED states. Therefore, the coexistence should be supported. |
| Xiaomi | Yes | In Rel 17 sidelink WID, it has clearly stated “Enhancements introduced in Rel-17 should be based on the functionalities specified in Rel-16, and Rel-17 sidelink should be able to coexist with Rel-16 sidelink in the same resource pool.” |
| Ericsson | Yes, but only for bands with Rel-16 UEs | In our view, it is important that backward compatibility is ensured. Clearly, mixing DL and UL timing in the same cell or area is not possible. However, for the new bands from Rel-17 a NW operator may choose to use a configuration that is not suitable for Rel-16 UEs. |
| NTT DOCOMO | Yes, at least with Rel-16 UE | Rel-16 UE may be configured with SL in the band. This possibility should be kept. |
| Apple | Yes | The coexistence of Rel-17 UE and Rel-16 UE needs to be supported. |
| Qualcomm | Yes | Our understanding of the WID is that ensuring coexistence between Rel-16 and Rel-17 is needed:  Enhancements introduced in Rel-17 should be based on the functionalities specified in Rel-16, and Rel-17 sidelink should be able to coexist with Rel-16 sidelink in the same resource pool. This does not preclude the possibility of operating Rel-17 sidelink in a dedicated resource pool  Similar to our comment on Q1, we prefer to focus the discussion directly on the question from RAN4. |
| LG Electronics | Comment | According to our understanding on the current RAN4 specification, Rel-16 SL operation on the band of “n79” is supported. This means that in this band, Rel-16 SL UE and Rel-17 SL UE can coexist (see Table 5.2E.2-1 in TS 38.101-1). We think that the coexistence between Rel-14/15 LTE SL UE and Rel-16/17 NR SL UE in the same band does not need to be discussed here. For your information, the following note is explicitly written in WID of Rel-17 SL enhancement (regardless of carrier type (e.g., shared licensed carrier, ITS dedicated carrier)).   * *Enhancements introduced in Rel-17 should be based on the functionalities specified in Rel-16, and Rel-17 sidelink should be able to coexist with Rel-16 sidelink in the same resource pool.* |
| Lenovo/Motorola Mobility | Yes | We share the same view as OPPO |
| vivo | Yes with comment | Backward coexistence should be supported from RAN1 specification perspective. However, it is not precluded that there may be some SL bands introduced in future release but not in a release independent way. |
| ZTE, Sanechips | Yes | Backward compatibility in system and multi-RAT(NR and LTE sidelink) coexistence in one device should be considered. |
| Sharp | Yes | Same view as Xiaomi. |
| Intel | Comments | Our understanding is that R14/R15 UEs are out of WID scope. Our answer is yes for R16 UEs only. |
| Nokia, Nokia Shanghai Bell | Yes, but only for bands with Rel-16 UEs | Our understanding is that the scenario discussed in the LS i.e. “SL and Uu in the same TDD band” is not supported in Rel-16 in RAN4, so there would not be coexistence problems if UL timing was used in this case. We think that if RAN1 specifies an option to use UL timing in the shared carrier case, it does not create coexistence problems. |
| Huawei, HiSilicon | LTE-V2X releases are not in-scope. | Similar as our comments in Q1, we suggest to discuss the question asked by RAN4 directly.  As per the coexistence for different releases’ UE, in the WID of Rel-17 SL enhancements, it supports the coexistence between Rel-16 and Rel-17 in the same resource pool, so based on our understanding, at least in ITS bands, Rel-16/Rel-17 UE can coexist.  For the coexistence among Rel-14/Rel-15 and Rel-16/Rel-17 UE, we think it is out of the scope of RAN1 discussion. We also share the views that does not need to be discussed here. |
| Samsung | Yes | Backward compatibility to release 16 for bands where Rel-17 and Rel-16 UEs can co-exist. |
| Fraunhofer | Yes | We agree that there should be co-existence between at least Rel-16 and Rel-17 UEs. |
| Convida Wireless | Yes | From RAN1’s perspective, we should support the coexistence between R17 SL UEs and R16 SL UEs in shared carrier or dedicated carrier. |
| Futurewei | comments | Coexistence among R14/R15 and R16/R17 UEs is not related to the question RAN4 asked. It is out of scope. The coexistence of R16 and R17 UEs in the same resource pool is supported based on R17 sidelink WID |
| MediaTek | comments | Rel’17 can co-exist with Rel’16 UEs but it doesn’t preclude that Rel’17 UE can have its own resource pool for operation.  Co-existence between Rel’14/15 UEs and Rel’16/17 UEs is another issue and no new mechanism is required for Rel’17 UE. |

# Round 2 discussion

Based on the Round 1 discussion, most of companies have concerns on mandating all the SL active UEs to be RRC\_CONNECTED state. In this situation, if some of SL UEs with RRC\_CONNECTED state are using UL timing(option 1), and some of SL UEs with RRC\_IDLE/INACTIVE state are using DL timing(Option 2), the SL communication between these two types of UEs may be broken. From RAN1’s perspective, we should avoid this issue.

As comment by some companies, whether mandating all the SL active UEs to be RRC\_CONNECTED state is up to use case. But other companies think it is not necessary mandate that all the SL active UE is RRC\_CONNECTED state or always work in RRC\_CONNECTED state. Based on this situation, it is moderator’s opinion that RAN1 has no consensus on that UE can always maintain the UL timing even when the UE is worked within network coverage.

Regarding the coexistence between R17 SL and R16 SL, as comment by most of companies, there is a clear note in R17 eSL WID that “Enhancements introduced in Rel-17 should be based on the functionalities specified in Rel-16, and Rel-17 sidelink should be able to coexist with Rel-16 sidelink in the same resource pool. This does not preclude the possibility of operating Rel-17 sidelink in a dedicated resource pool”. From WID’s perspective, even there is a potential room for defining new feature which is not backward compatible with R16 in a dedicated resource pool. However, according to R16 SL design, SL synchronization is designed in a system/cell-specific manner which will used for all the resource pool. If there is a R16 SL UE which is coexistence with R17 SL UE in same bandr, the SL synchronization operation in 17 should be backward compatible with R16 design aspects, otherwise, they cannot communicate with each other.

Regarding whether a new SL band is only defined for R17 or not, it is out of scope of RAN1 discussion.

Based on above summary/observation, the following proposals and questions are prepared.

***Draft Proposal 1: In case that R16 SL-UE is coexisting with R17 SL UE in same band, only option 1 is used in R17 SL synchronization, i.e. SL transmitting timing is aligned with DL timing when SL is synchronized to a network.***

**Q1: Do you agree draft proposal 1? Please feel free to revision the proposal in your feedback**

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| **Company** | **Answer** | **Comments** |
| Intel | Comments | We are supportive of the proposal intention, but we prefer to stick to the question/action in LS. In our view RAN1 can reply something along the following lines:  RAN1 has not studied feasibility of Option 2 for NR sidelink communication. Option 2 is not supported by NR specification and RAN1 is not considering support of Option 2 in R17, since it implies quite many challenges for sidelink communication (e.g. sidelink communication with RRC\_IDLE UEs) |
| Ericsson | Comments | What is the intention of this proposal? Capture it as a conclusion? In any case, the statement as such requires some changes  “In case that R16 SL-UE is coexisting with R17 SL UE in same band, of the options described in the LS by RAN4, only option 1 is suitable ~~used in R17 SL synchronization~~, i.e., SL transmitting timing is aligned with DL timing when SL is synchronized to a network.” |
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***Draft proposal 2: Reply LS to RAN4***

***From RAN1’s perspective, option 2 is not feasible in case that R16 SL-UE is coexisting with R17 SL UE in same band, otherwise they cannot communicate with each other.***

**Q2: If Q1 is Yes, do you agree draft proposal 2? Please feel free to revision the proposal in your feedback.**

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| **Company** | **Answer** | **Comments** |
| Intel | Comments | We are supportive of the proposal intention, but we prefer to stick to the question/action in LS. In our view RAN1 can reply something along the following lines:  RAN1 has not studied feasibility of Option 2 for NR sidelink communication. Option 2 is not supported by NR specification and RAN1 is not considering support of Option 2 in R17, since it implies quite many challenges for sidelink communication (e.g. sidelink communication with RRC\_IDLE UEs) |
| Ericsson | Comments | We think that the proposed reply needs a bit of clarification.  From RAN1’s perspective, option 2 is not feasible in case that R16 SL-UE is coexisting with R17 SL UE in the same band~~, otherwise~~ as they cannot communicate with each other. For operation without coexisting R16 SL UEs, option 2 is feasible but not supported by the current RAN1 specifications. |
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# References

1. [R1-2106430](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2106430.zip) LS on synchronous operation between Uu and SL in TDD band n79 RAN4, CATT
2. [R1-2106851](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2106851.zip) Draft reply LS on synchronous operation between Uu and SL in TDD band n79 Samsung
3. [R1-2107228](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107228.zip) Draft reply LS on synchronous operation between Uu and SL in TDD band OPPO
4. [R1-2107306](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107306.zip) Draft Reply to RAN4 LS on synchronous operation between Uu and SL in TDD band Qualcomm Incorporated
5. [R1-2107531](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107531.zip) Discussion on LS on synchronous operation between Uu and SL in TDD band n79 LG Electronics
6. [R1-2107701](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107701.zip) Draft Reply LS on Synchronous Operation between Uu and SL in TDD Band Apple
7. [R1-2107892](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107892.zip) [Draft] Reply LS on synchronous operation between Uu and SL in TDD band Xiaomi
8. [R1-2107956](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2107956.zip) Draft reply LS on synchronous operation between Uu and SL in TDD band vivo
9. [R1-2108059](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108059.zip) Discussion on synchronous operation between Uu and SL in TDD band OPPO
10. [R1-2108075](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108075.zip) Discussion on RAN4 LS on synchronous operation between Uu and SL in TDD band n79 ZTE, Sanechips
11. [R1-2108125](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108125.zip) Discussion on RAN4 LS on synchronous operation between Uu and SL Nokia, Nokia Shanghai Bell
12. [R1-2108129](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108129.zip) [Draft] Reply LS on synchronous operation between Uu and SL in TDD band Ericsson
13. [R1-2108134](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108134.zip) Discussion on RAN4 LS on synchronous operation between Uu and SL in TDD band Ericsson
14. [R1-2108187](file:///D:\02_3GPP\TSGR1_106-e\Docs\R1-2108187.zip) Discussion on RAN4 LS on synchronous operation between Uu and SL in TDD band Huawei, HiSilicon