**3GPP TSG-RAN WG4 Meeting # 97-e R4-2016968**

**Electronic Meeting, 2nd -13th Nov., 2020**

**Agenda item:** 10.23

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [97e][126] NR\_LTE\_V2X\_PC5\_combos

**Document for:** Information

# Introduction

In RAN#88e meeting, the WI, band combinations for con-current operation of NR/LTE Uu bands/band combinations and one NR/LTE V2X PC5 band, was approved. From the last meeting on, it is expected to bring request of specific band combinations and also to specify the UE RF requirements if required. This email discussion summary will further discuss some general issues of V2X con-current operation, associated TPs and CRs.

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

* 1st round
  + Companies to provide comments on the general issues of V2X con-current operation, associated TPs and CRs.
  + Assign the corresponding WF after the 1st round discussion if needed.
* 2nd round
  + Capture the agreements and open issues if any in WF and further discuss the WF.
  + Recommend the final status of the WF if any, associated TPs and CRs.

# Topic #1: General issues of con-current operation

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014421](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014421.zip) | CATT | Discussion on Rel-17 band combinations for Uu and V2X con-current operation  Proposal 1: Prioritize to use separate antenna architecture like LTE V2X band combinations. The shared antenna architecture can be used for the specific band combination where the bands are closely located.  Proposal 2: For band combinations between Uu and SL, it is preferred to put the relaxation of configured output power and reference sensitivity on Uu band instead of SL band. |
| [R4-2014425](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014425.zip) | CATT | Revised WID for V2X band combination |
| R4-2015561 | Huawei, HiSilicon | TP for TR 37.875: adding some UE RF study for NR V2X band combinations |
| [R4-2014422](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | CATT | TP on V2X\_n40A-n47A coexistence study |
| [R4-2014423](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | CATT | CR for TS 38.101-1, Introduce new band combination of V2X\_n39A-n47A and V2X\_n40A-n47A |
| [R4-2014424](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | CATT | CR for TS 38.101-3, Introduce new band combination of V2X\_39A-n47A, V2X\_n39A-47A,V2X\_40A-n47A and V2X\_n40A-47A |

## Open issues summary

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

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

* Proposals
  + Option 1: Capture the following RF architecture with separate antennas proposed in R4-2015561 in TR 37.875

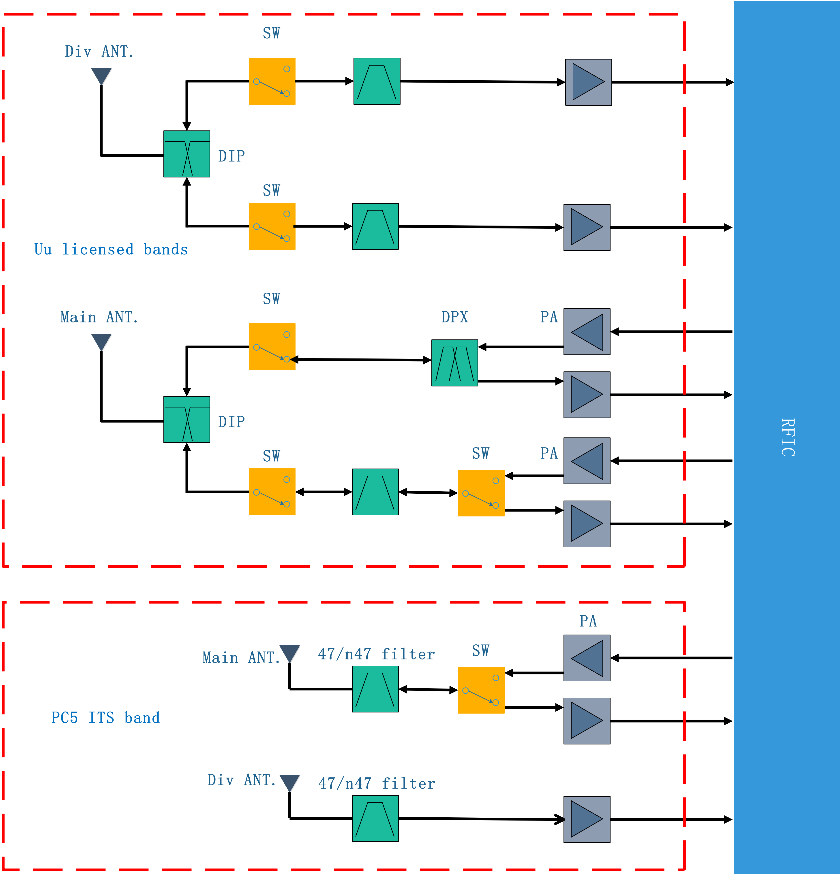


Figure 5.1.1-1 NR V2X band combinations RF architecture with separate antennas

* + Other options are not precluded.
* Recommended WF
  + Need more discussion.

**Issue 1-1-2: Shared antenna architecture or separate antenna architecture**

* Proposals
  + Option 1: Prioritize to use separate antenna architecture like LTE V2X band combinations. The shared antenna architecture can be used for the specific band combination where the bands are closely located.
  + Other options are not precluded.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-2: Filter performance

**Issue 1-2-1: Filter performance for band n47/47**

* Proposals
  + Option 1: Capture the following filter performance for band 47/n47 proposed in R4-2015561 in TR 37.875.

Table 5.1.1-1 Filter performance for band n47/47

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Filter | IL [dB] | | Min Attenuation [dB] @ | | |
| Nominal | Worst Case | 410-2690 MHz | 3300-4200 MHz | 4400-5000 MHz |
| n47/47 (5855-5925 MHz) | 1.2 | 2 | > 35 | > 32 | > 30 |

* + Other options are not precluded.
* Recommended WF
  + Need more discussion.

### Sub-topic 1-3: ΔTIB,c and ΔRIB,c

**Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**

* Proposals
  + Option 1: Adopt ΔTIB,c and ΔRIB,c on Uu band instead of SL band.
  + Other options are not precluded.
* Recommended WF
  + Need more discussion.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **LGE** | **Issue 1-1-1: UE RF architecture**  In LTE V2X and NR V2X, RAN4 generally consider separate ant. RF architecture.  It is means that consider separate RFIC and antenna between Uu and SL. The baseline RF architecture is 1Tx/2Rx for Uu operation or for ITS spectrum.  But do not add the candidate RF architecture in TR 37.785  **Issue 1-1-2: Shared antenna architecture or separate antenna architecture**  LGE think that shared antenna architecture is not condiered in previous V2X WI. Also there are different filter and PA characteristics in Uu operation and ITS (5.9GHz) spectrum.  **Issue 1-2-1: Filter performance for band n47/47**  I don’t understand for the intention to study the filter performance in n47. RAN4 only consider the additional ILs term by harmonic trap filer in Uu transmission. In ITS spectrum, RAN4 do not specify the additional IL term due to loose Noise figure. So do not need to study this filter performance.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  Prefer option1, just consider the additional ILs term by using of harmonic trap filter to reduce the self interference from Uu transmission. So It will be added in Uu band. |
| **Qualcomm** | **Issue 1-1-1 UE RF architecture**  There should be more discussion on the baseline RF architecture before capturing it in TR37.875. Discussion should be based on whether this is a general architecture that should be taken as guidance or one that should be strictly followed. Also, the number of TXs and RXs should be discussed. Should the number be the same as previous architectures or not. Given these unknowns we feel that it is a little premature to add this RF architecture into TR37.875.  Option 2 : Do not capture the RF architecture in R4-2015561 in TR37.875.  **Issue 1-1-2 Shared antenna architecture or separate antenna architecture**  Option 2 : No prioritization needs to be made. It should be decided on a case by case basis.  **Issue 1-2-1: Filter performance for band n47/47**  Option 2 : Do not capture filter characteristic in TR37.875. No need to capture the entire filter characteristic in TR37.875. It would suffice to capture the inband IL and the required attenuation for the given band combination.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  Option 2: Do not adopt ΔTIB,c and ΔRIB,c on Uu band instead of SL band. In the past the “share the pain approach was used”. Why would we deviate from that method. We believe that this needs further discussion. |
| **CATT** | **Issue 1-1-1: UE RF architecture**  For the proposed RF architecture, I think both Uu licensed band and ITS band are 1T2R. For the Uu licensed bands, I am wondering whether two Uu bands are involved in the figure. More clarifications are needed in the figure.  **Issue 1-1-2: Shared antenna architecture or separate antenna architecture**  Separate antenna is more applicable to the current band combinations with a large frequency separation between two bands. If other band combinations in which two bands are close will be introduced in future, it can be decided case by case.  **Issue 1-2-1: Filter performance for band n47/47**  The filter performance for band n47/47 will be used to calculate the MSD level when the band combination has interference. But it should be aligned with the values defined before.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  Share the same view as LGE. The additional IL caused by harmonic trap filter in Uu band should be added in Uu band. |
| **Huawei** | I have to mention that 3GPP is deriving by contributions. Companies can’t object the proposals without any technical analysis and input. Look at the TR 37.863-01-01. Similar studies and architectures are captured into this TR.  To LGE: I wonder why we don’t need to study the filter performance as we did at the beginning of Rel-15 for band n77 and n78. It’s just a reference when we need them to derive the requirements for the band combinations. When we derive the MSD for band combinaitons, we need to be aligned with each other about assumption of filter performance.  LGE: to HW, what is the con-current band combination as example? If you consider V2X\_nX-n47, then, we need to HTF performance when the Band nX’s x-order harmonic will be impact to n47 case.  But, the proposal is studied for filter performance in n47/B47. Please give more information why RAN4 need to study the B47/n47 filter performance. |
| **Xiaomi** | **Issue 1-1-1 UE RF architecture**  We also believe the architecture should be studied case by case considering more R17 combs might come up so it is premature to decide only one architecture at the beginning..  **Issue 1-1-2 Shared antenna architecture or separate antenna architecture**  Same comment as issue 1-1-1..  **Issue 1-2-1: Filter performance for band n47/47**  Agree to capture the filter performance.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  We prefer as do NOT adopt ΔTIB,c and ΔRIB,c on Uu band instead of SL band. As discussed in RAN1, there is no fix priority of NR or LTE link so there should be no prioritization to adopt the relaxation. |

### CRs/TPs comments collection

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

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2015561  (TP for TR 37.875: adding some UE RF study for NR V2X band combinations) | LGE :please see the LGE comment in 1.3.1 |
| Qualcomm: Cannot agree to placing 47/n47 filter characteristic table 5.1.1-1 inTR37.875 as we think that it requires further discussion. Cannot agree to placing RF architecture diagram in figure 5.1.1-1 in TR37.875 for the same reason as it needs group consensus. Do not approve this TR. |
| Huawei: To QC and LGE, please provide technical analysis and input before you object the proposals.  LGE: to HW, to HW, what is the con-current band combination as example? If you consider V2X\_nX-n47, then, we need to HTF performance when the Band nX’s x-order harmonic will be impact to n47 case.  But, the proposal is studied for filter performance in n47/B47. Please give more information why RAN4 need to study the B47/n47 filter performance. |
| [R4-2014422](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (TP on V2X\_n40A-n47A coexistence study) | LGE: no self interference problem in V2X\_40\_n47 UE, so do not need to define additional ILs term and MSD level. |
| CATT: The additional IL part will be removed. |
|  |
| [R4-2014423](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (CR for TS 38.101-1, Introduce new band combination of V2X\_n39A-n47A and V2X\_n40A-n47A) | LGE: Additional ILs Tables do not need to specify in TS38.101-1. Need for the check the REFSENS requirements. |
| Qualcomm: For the con-current V2X operation characteristics given in table 6.5e.3.1.1-1 for V2X\_n39A-n47A, n39 is a band operating in China so why is B26 (NAR) and B34 (EMEA) a band in the protected band list. For V2X\_n40A-n47A, n40 is a band operation in China so why is B26 (NAR) and N34 (EMEA) a band in the protected band list. We should clarify this before approving this CR.  In table 7.3E.3-1 the reference sensitivity for n47 for cases n39\_n47, n40\_n47 are incorrect for n47 as per the REFSENS numbers given for n47 in 38.101-1, v16.5.0 Table7.3E.2-1 |
| CATT: The additional IL tables will be removed for the band combinations that have no self-interference. The REFSENS requirements for n47 are not correctly captured in the CRs and will be modified based on the latest table for REFSENS.  To Qualcomm: We will further check the band B26 and n34 in the protected band list. |
|  |
| [R4-2014424](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (CR for TS 38.101-3, Introduce new band combination of V2X\_39A-n47A, V2X\_n39A-47A,V2X\_40A-n47A and V2X\_n40A-47A) | LGE: Additional ILs Tables do not need to specify in TS38.101-3. Need for the check the REFSENS requirements. |
| Qualcomm: For the con-current V2X operation characteristics given in table 6.5C..3.2.2-1 for V2X\_n39A-47A, V2X\_n39A-n47A , n39 is a band operating in China so why is B26 (NAR) and B34 (EMEA) a band in the protected band list. For V2X\_n40A-n47A, V2X\_n40A-47A, n40 is a band operation in China so why is B26 (NAR) and N34 (EMEA) a band in the protected band list. We should clarify this before approving this CR.  In table 7.3C.2.3-1 the reference sensitivity for n47\_39, n47\_40 for incorrect for n47 as per the REFSENS numbers given for n47 in 38.101-1, v16.5.0 Table7.3E.2-1 |
| CATT: The additional IL tables will be removed for the band combinations that have no self-interference. The REFSENS requirements for n47 are not correctly captured in the CRs and will be modified based on the latest table for REFSENS.  To Qualcomm: We will further check the band B26 and n34 in the protected band list. |

## Summary for 1st round

### Open issues

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

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Issue 1-1-1: UE RF architecture** | *Tentative agreements: None*  *Candidate options:*   * + Option 1: Capture the RF architecture with separate antennas proposed in R4-2015561 in TR 37.875.   + Option 2: Specify RF architecture based on consensus and capture it in TR 37.875.   + Option 3: No need to capture RF architecture in TR 37.875.   *Recommendations for 2nd round:*   * + Study the number of Tx and Rx for both Uu band and SL band and decide RF architecture based on consensus.   + The selection of an RF architecture does not preclude the introduction of other RF architectures in the future. |
| **Issue 1-1-2: Shared antenna architecture or separate antenna architecture** | *Tentative agreements: None*  *Candidate options:*   * + Option 1: Prioritize to use separate antenna architecture like LTE V2X band combinations. The shared antenna architecture can be used for the specific band combination where the bands are closely located.   + Option 2: Decide antenna architecture based on the specific band combination.   *Recommendations for 2nd round:*   * + Companies to share views whether to converge to Option 2. |
| **Issue 1-2-1: Filter performance for band n47/47** | *Tentative agreements: None*  *Candidate options:*   * + Option 1: Capture the filter performance for band 47/n47 proposed in R4-2015561 in TR 37.875.   + Option 2: No need to study the filter performance for band 47/n47.   + Option 3: Study the filter performance for band 47/n47 and capture it based on consensus in TR 37.875.   *Recommendations for 2nd round:*   * + Further discuss the filter performance for band 47/n47 based on technical analysis and companies’ input. |
| **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47** | *Tentative agreements: None*  *Candidate options:*   * + Option 1: Adopt ΔTIB,c and ΔRIB,c on Uu band instead of SL band.   + Option 2: Adopt shared pain approach for Uu band and SL band.   + Option 3: Adopt either option 1 or option 2 based on specific band combination   *Recommendations for 2nd round:*   * + Decide after RF architecture is clear. |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on band combinations for V2X con-current operation | CATT |

### CRs/TPs

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

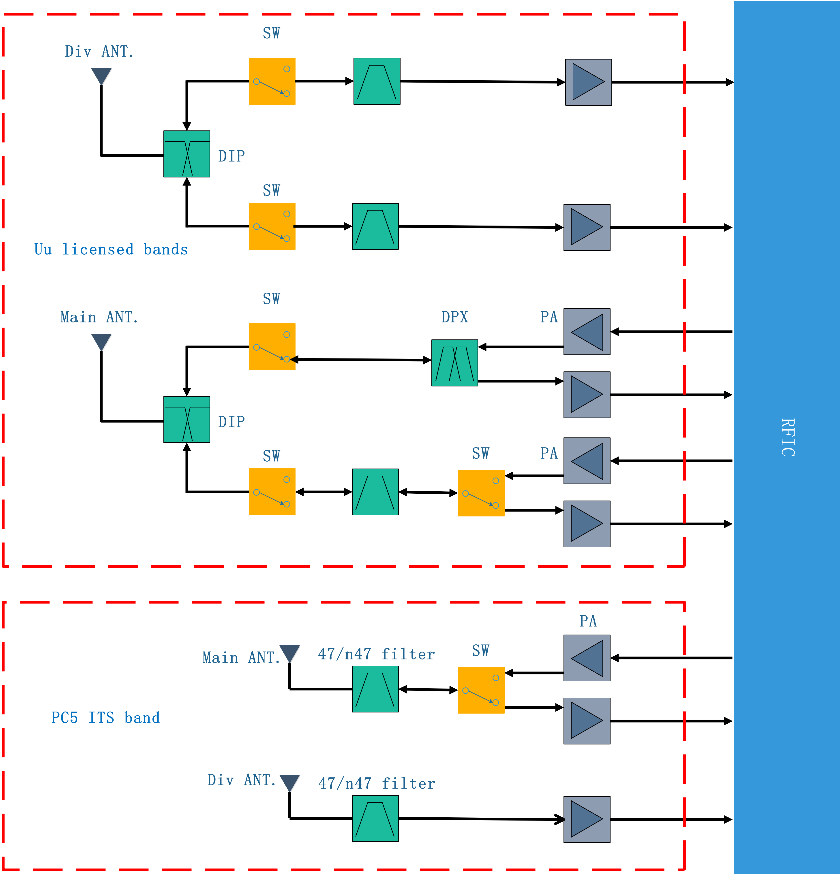
|  |  |
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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2015561 | To be revised |
| [R4-2014422](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | To be revised |
| [R4-2014423](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | To be revised |
| [R4-2014424](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip) | To be revised |

## Discussion on 2nd round (if applicable)

The open issues are listed below for the 2nd round discussion.

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

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

* Proposals
  + Option 1: Capture the RF architecture with separate antennas proposed in R4-2015561 in TR 37.875.
* 
* Figure 5.1.1-1 NR V2X band combinations RF architecture with separate antennas
  + Option 2: Specify RF architecture based on consensus and capture it in TR 37.875.
  + Option 3: No need to capture RF architecture in TR 37.875.
* Recommended WF
  + Study the number of Tx and Rx for both Uu band and SL band and decide RF architecture based on consensus.
  + The selection of an RF architecture does not preclude the introduction of other RF architectures in the future.

**Issue 1-1-2: Shared antenna architecture or separate antenna architecture**

* Proposals
  + Option 1: Prioritize to use separate antenna architecture like LTE V2X band combinations. The shared antenna architecture can be used for the specific band combination where the bands are closely located.
  + Option 2: Decide antenna architecture based on the specific band combination.
* Recommended WF
  + Companies to share views whether to converge to Option 2.

### Sub-topic 1-2: Filter performance

**Issue 1-2-1: Filter performance for band n47/47**

* Proposals
  + Option 1: Capture the filter performance for band 47/n47 proposed in R4-2015561 in TR 37.875.
* Table 5.1.1-1 Filter performance for band n47/47

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Filter | IL [dB] | | Min Attenuation [dB] @ | | |
| Nominal | Worst Case | 410-2690 MHz | 3300-4200 MHz | 4400-5000 MHz |
| n47/47 (5855-5925 MHz) | 1.2 | 2 | > 35 | > 32 | > 30 |

* + Option 2: No need to study the filter performance for band 47/n47.
  + Option 3: Study the filter performance for band 47/n47 and capture it based on consensus in TR 37.875.
* Recommended WF
  + Further discuss the filter performance for band 47/n47 based on technical analysis and companies’ input.

### Sub-topic 1-3: ΔTIB,c and ΔRIB,c

**Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**

* Proposals
  + Option 1: Adopt ΔTIB,c and ΔRIB,c on Uu band instead of SL band.
  + Option 2: Adopt shared pain approach for Uu band and SL band.
  + Option 3: Adopt either option 1 or option 2 based on specific band combination
* Recommended WF
  + Decide after RF architecture is clear.

## Companies views’ collection for 2st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Huawei | Issue 1-1-1: UE RF architecture  We support option 1. For V2X combination V2X\_nX-n47, the separated antenna architecture is assumed at least.  **Issue 1-2-1: Filter performance for band n47/47**  We support option 1. RAN4 need to make common assumption for filter performance when studying the IMD issue. For example, IMD2 of n78 and n47 may fall into band n1. Thus, there is no need to discuss the necessity for the filter assumption.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  Since the separated antenna architecture is assumed for V2X\_nX-n47, there is no need to specify the ΔTIB,c and ΔRIB,c for band 47/n47. |
| CATT | **Issue 1-1-1: UE RF architecture**  1T2R should be considered as a baseline for both Uu band and SL band, which is reflected in the proposed RF architecture. So we support Option 1 to capture the RF architecture as a baseline in the TR. Other RF architecture can be further discussed and is not precluded in the future.  **Issue 1-1-2: Shared antenna architecture or separate antenna architecture**  Option 1 is not contradictory with Option 2. Our intention to proposing Option 1 is that separate antenna is more applicable to the majority of current band combinations with a large frequency gap between two bands. We prefer to prioritize separate antenna and also to not preclude shared antenna.  **Issue 1-2-1: Filter performance for band n47/47**  The filter performance for band n47/47 should be considered to derive MSD. If the proposed filter performance has no difference with previous values, we prefer to not capture it in the TR as what we did in LTE V2X band WI. Indeed, the proposed filter values if agreed among companies can be considered as a baseline to calculate MSD level.  **Issue 1-3-1: ΔTIB,c and ΔRIB,c for band 47/n47**  We share the similar view with Huawei. If separate antenna is adopt, no additional IL will be specified for band 47/n47. On the other hand, additional IL should be added on Uu band if HTF is used to reduce the harmonic interference from Uu band. |
|  |  |

### CRs/TPs comments collection

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2016870  (TP for TR 37.875: adding some UE RF study for NR V2X band combinations) |  |
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| [R4-2016871](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (TP on V2X\_n40A-n47A coexistence study) |  |
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| [R4-2016872](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (CR for TS 38.101-1, Introduce new band combination of V2X\_n39A-n47A and V2X\_n40A-n47A) | To Qualcomm, the protected band list for V2X band combination is derived based on the intersection of such two single band protected band list. As we observed, band 26 and band ve concern on band 26 and nd band list.ived b the current band combination capture it in the TR. 34 are protected for both n39 and n47. If you have concern on this, we need to first discuss the protected band list for n39 and n40. |
| [R4-2016873](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_96_e/Docs/R4-2009834.zip)  (CR for TS 38.101-3, Introduce new band combination of V2X\_39A-n47A, V2X\_n39A-47A,V2X\_40A-n47A and V2X\_n40A-47A) | To Qualcomm, the protected band list for V2X band combination is derived based on the intersection of such two single band protected band lists. As we observed, band 26 and band ve concern on band 26 and nd band list.ived b the current band combination capture it in the TR. 34 are protected for both n39 and n47. If you have concern on this, we need to first discuss the protected band list for n39 and n40. |

## Summary on 2nd round (if applicable)

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

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