**3GPP TSG-RAN WG4 Meeting # 97-e R4-20xxxxx**

**Electronic Meeting, 2 – 13 Nov., 2020**

**Agenda item:** 7.3.7.1 & 7.3.7.2

**Source:** Moderator (LG Electronics)

**Title:** Email discussion summary for [97e][317] V2X\_Demod\_Part1

**Document for:** Information

# Introduction

This email discussion is for Rel-16 NR V2X demodulation performance for single link in Agenda 7.3.7.1 and 7.3.7.2. For the information, in this meeting, email discussion will focus on finalizing the simulation assumptions, so draft CRs will be treated with low priority.

List of candidate target of email discussion for 2nd round as follows:

* 1st round:
  + Topic#1 : Simulation assumption for performance requirements
    - Sub-topic 1-1: PSSCH demodulation
    - Sub-topic 1-2: PSCCH demodulation
    - Sub-topic 1-3: PSBCH demodulation
    - Sub-topic 1-4: PSFCH demodulation
    - Sub-topic 1-5: Resource pool configuration
  + Topic#2 : Draft CRs for demodulation test cases
    - Sub-topic 2-1: Draft CR handling
* 2nd round:
  + Topic#1 : Simulation assumption for performance requirements
    - Sub-topic 1-1: PSSCH demodulation
    - Sub-topic 1-2: PSCCH demodulation
    - Sub-topic 1-3: PSBCH demodulation
    - Sub-topic 1-4: PSFCH demodulation
    - Sub-topic 1-5: Resource pool configuration
  + Topic#2: Draft CRs for demodulation test cases
    - Continue to collect comments for draft CR/CR

# Topic #1: Simulation assumptions for performance requirements

This section will treat simulation assumption for single link performance requirements.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014417 | CATT | Observation 1: PSSCH DMRS position in time domain should not be overlapped with PSCCH when the sub-channel size is less than 20 PRB.  Observation 2: it is difficult to avoid the overlapping case between PSSCH DMRS and PSCCH when sub-channel size is less than 20 RB.  Proposal 1: Given that DMRS pattern is more likely to vary based on different SL UE velocities, it is proposed to increase the sub-channel size such that the sub-channel size is above 20 RB.  Observation 3: The number of RE for 2nd stage SCI excluding the REs used for the 1st symbol and 2nd symbol should be multiple of PRB.  Proposal 2: The number of RE for 2nd stage SCI in Option 1 should be configured as 246 where 2nd stage SCI occupies the total 13 PRB.  Proposal 3: To specify the number of DMRS symbol based on the specific SL UE speed.  Proposal 4: To introduce 1 S-SSB per SL period for PSBCH demodulation performance requirements (Option 1).  Proposal 5: To reduce and simplify the test case, it is proposed to introduce either Case 1 or Case 2 or both.  Proposal 6: It is proposed to reuse the TO and FO based on BS sync source in LTE V2X for NR V2X.  Proposal 7: Do not introduce 256QAM demodulation test case in Rel-16. |
| R4-2014538 | Intel Corporation | Proposal 1: Use the following simulation assumptions for Rel-16 V2X PSSCH demodulation requirements with GNSS based synchronization:   * PSFCH periodicity = 4 slots * Test 1   + MCS 4   + PSSCH DMRS Time Pattern = {2, 4} (2 is for slots with PSFCH, 4 for slots without PSFCH)   + Channel model: TDLA30 – 2700 * Test 2   + MCS 11   + PSSCH DMRS Time Pattern = {2, 4} (2 is for slots with PSFCH, 4 for slots without PSFCH)   + Channel model: TDLA30 – 1400   Proposal 2: Use the following simulation assumptions for Rel-16 V2X PSSCH demodulation requirements with gNB based synchronization:   * PSFCH periodicity = 4 slots * MCS 17 * PSSCH DMRS Time Pattern = 2 * Channel model: TDLA30 – 180 * Proposal 3: Use the following simulation assumptions for Rel-16 V2X PSCCH demodulation requirements: * SCI payload = 30 bits * Channel model: TDLA30-1400   Proposal 4: Use the following simulation assumptions for Rel-16 V2X PSBCH demodulation requirements:   * 1 S-SB per SL period * Channel model: TDLA30-180   Proposal 5: Use the following simulation assumptions for Rel-16 V2X PSFCH demodulation requirements:   * PSFCH periodicity 1 slot * Channel model: TDLA30-180 * Test metrics: Pr (DTX to ACK) ≤ 1% and Pr (ACK miss) ≤ 1%. |
| R4-2014637 | Qualcomm, Inc. | Proposal 1: Introduce two tests for PSSCH with 64QAM MCS table with low speed 30km/h and high speed 500km/h. For high speed tests, consider the following configurations (a) TDL\_C 300ns channel (b) More subchannel allocation (c) Not configuring PSFCH. (a)+(b) is preferred in our opinion.  Proposal 2: Configure 2 DMRS symbol for PSSCH low speed test.  Proposal 3: PSSCH tests MCS configuration: MCS 21 for low speed, and MCS 4 for high speed  Proposal 4: Define the requirement based on subchannel size of 10RB for all PSSCH tests except high speed.  Proposal 5: Define 256QAM PSSCH demod test with the same configuration as low speed PSSCH demod test configuration, only change the MCS to lowest one in 256QAM (MCS 20).  Proposal 6: Set beta = 2.25 for all PSSCH tests.  Proposal 7: Use relative speed of 260km/h and SCI 1 payload size = 28bits in PSCCH test.  Proposal 8: Use 30km/h relative speed and no repetition for PSBCH test.  Proposal 9: Consider 1 PSFCH in PSFCH detection performance test. Statistics to be collected:  Option 2 (ACK/NACK type): Pr(NACK to ACK) < 0.1%.  Option 1 (NACK only type): Pr(NACK miss) < 1%, or Pr(DTX to NACK)<1% (if we have DTX). |
| R4-2014652 | LG Electronics Inc. | Proposal 1: DMRS configuration for PSSCH demodulation should be considered depending on relative velocity as case 1 and case 3 in option 1.  Proposal 2: PSFCH transmission should be considered every 4 slots.  Proposal 3: QPSK and 64QAM modulation order should be considered for PSSCH demodulation requirements  Proposal 4: 256QAM modulation order should be verified with applicability rule.  Proposal 5: TDLA30-1350 should be used for PSCCH demodulation requirement.  Proposal 6: Only ACK/NACK feedback mode should be considered for PSFCH demodulation (single link) requirement.  Proposal 7: Use simulation assumptions Table 1~4 for single link tests |
| R4-2015640 | Huawei, HiSilicon | Proposal 1: Define the PSSCH performance requirements with first PSSCH DMRS FDMed with PSCCH.  Proposal 2: Allocate 20 RBs for PSSCH and 10 RBs for PSCCH.  Proposal 3: PSFCH is transmitted on every 4 slots for PSSCH test.  Proposal 4: At least 260km/h and 500km/h should be used as candidate velocity for PSSCH performance test.  Proposal 5: Use following receiver assumptions for PSSCH performance tests   * CFO estimation: Cross-DMRS symbol CFO estimation. * CE channel estimation:   + Frequency domain interpolation: MMSE interpolation   + Time domain interpolation: Linear interpolation * RX window: CP/2 from GNSS   Proposal 6: Use following DMRS pattern for PSSCH performance test:   * + Case 1: Max speed: 500km/h DMRS symbol: 4 for slots without PSFCH, 3 for slots with PSFCH.   + Case 2: Moderate speed: 260km/h DMRS symbol: 3 for slots without PSFCH, 2 for slots with PSFCH   Proposal 7: Use MCS 11 (16QAM, 378/1024) for 260 km/h and MCS 4 (QPSK, 308/1024) for 500km/h and not to define the 256 QAM performance requirements.  Proposal 8: For 2nd-stage SCI configuration:   * Set=5 and =3.5 from Table 9.3-2 of TS 38.213 to guarantee the performance of 2nd-stage SCI for SCH\_Test1 and SCH\_Test2 of respectively. * Use SCI format 2-A.   Proposal 9: Use 10% BLER as test metric.  Proposal 10: Not introduce the case for gNB based synchronization reference source  Proposal 11: Adopt simulation assumptions in Table 2.1.2 for PSSCH performance test.  Proposal 12: Use TDLA30-1350 as propagation conditions for performance requirements for PSCCH.  Proposal 13: Set payloads to 28 bits for performance requirements for PSCCH.  Proposal 14: Use TDLA30-180 as propagation condition for PSBCH demodulation performance  Proposal 15: Use 2 S-SSBs within one period (i.e.160ms) without combining for PSBCH test.  Proposal 16: Transmission of SLSS and PSBCH in the same slot during the test to keep consistent with core specification  Proposal 17: Use TDLA-30-180 as propagation conditions for PSFCH performance requirements.  Proposal 18: Only consider 1 CS pair for PSFCH performance requirement.  Proposal 19: Only consider NACK/ACK case for single-link PSFCH performance requirement. |
| R4-2014537 | Intel Corporation | Proposal 1: Define SDR requirements with active Sidelink in the scope of Rel-16 V2X.  Proposal 2: Define Rel-16 V2X demodulation requirements for different relative vehicle speeds: 30, 260 and 500 km/h.  Proposal 3: Define Rel-16 V2X demodulation requirements for scenarios with gNB based synchronisation, relative vehicle speed 30 km/h, TX/RX frequency offset ±1300 Hz and TX/RX time offset ±24Ts.  Proposal 4: Postpone the discussion on definition of 256QAM until simulation assumption for verification of basic V2X functionality will be stable.  Proposal 5: Use the following resource pool configuration for V2X demodulation requirements with CBW 20 MHz and SCS 30 kHz: sub-channel size = 10 PRBs, number of sub-channels = 5. |
| R4-2014779 | MediaTek inc. | Proposal 1: 40MHz CBW should be configured for PSCCH/PSSCH decoding capability test.  Proposal 2: The velocity configuration of NR V2X test case can reuse LTE V2X.  Proposal 3: PSFCH should be transmitted on every slot and 3DMRS symbols for PSSCH test cases.  Proposal 4: 1 S-SSB per SL period should be configured for 30kHz SCS.  Proposal 5: Not to define 256QAM demodulation test case.  Proposal 6: Not to define SDR with active sidelink test case. |
| R4-2014419 | CATT | Initial simulation results |
| R4-2014668 | LG Electronics Inc. | Initial simulation results |
| R4-2015641 | Huawei, HiSilicon | Initial simulation results |

## Open issues summary

### Sub-topic 1-1 : PSSCH demodulation

**Issue 1-1-1: Sub-channel size**

* Proposals
  + Option 1: 10 PRB sub-channel for low relative velocity and 20 sub-channel size for high relative velocity
  + Option 2: 15 PRB sub-channel (with 15 PRB PSCCH)
  + Option 3: 20 PRB sub-channel (with 10 PRB PSCCH)
  + Option 4: lager than 20 PRB sub-channel
* Recommended WF
  + Need further discussion.

**Issue 1-1-2: Modulation order (GNSS based sync)**

* Proposals: Introduce two test cases based on GNSS sync with
  + Test 1: QPSK for 500km/h
  + Test 2:
    - Option 1: 16QAM for 260km/h
    - Option 2: 64QAM for 30km/h
* Recommended WF
  + Need further discussion

**Issue 1-1-3: PSFCH periodicity**

* Proposals:
  + Option 1: 1 periodicity
  + Option 2: 4 periodicity
* Recommended WF
  + Need further discussion

**Issue 1-1-4: DMRS pattern**

* Proposals: Depending on decision of Issue 1-1-2,
  + For 500km/h
    - Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4
    - Option 2: {3,4} DMRS symbols when PSFCH periodicity is 4
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1
  + For 260km/h
    - Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4
    - Option 2: {2,3} DMRS symbols when PSFCH periodicity is 4
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1
  + For 30km/h
    - Option 1: {2,3} DMRS symbols when PSFCH periodicity is 4
    - Option 2: 2 DMRS symbols when PSFCH periodicity is 1 or 4
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1

Note: {a,b} DMRS means the number of DMRS (a) with PSFCH symbol and (b) without PSFCH symbol in a slot.

* Recommended WF
  + Need further discussion

**Issue 1-1-5: 2nd stage SCI allocation**

* Proposals:
  + Option 1: beta = 2.25 for all test cases
  + Option 2: beta = 5 for 16QAM test configuration and beta = 3.5 for QPSK test configuration
  + Option 3: beta = 1.75, 2.5, and 4 for QPSK, 64QAM, and 256QAM test configuration, respectively
* Recommended WF
  + Need further discussion

**Issue 1-1-6: gNB based sync test cases**

* Proposals:
  + Option 1: Define performance requirement with 1300Hz FO and ±24Ts TO
  + Option 2: Do not define performance requirement
* Recommended WF
  + Need further discussion

**Issue 1-1-7: 256QAM test cases**

* Proposals:
  + Option 1: Define performance requirement
  + Option 2: Do not define performance requirement
* Recommended WF
  + Need further discussion

**Issue 1-1-8: Propagation condition for high relative velocity**

* Proposals:
  + Option 1: consider TDLC300ns
* Recommended WF
  + Need further discussion

**Issue 1-1-9: Receiver assumption**

* Proposals:
  + Option 1:
    - CFO estimation: Cross-DMRS symbol CFO estimation.
    - CE channel estimation:
      * Frequency domain interpolation: MMSE interpolation
      * Time domain interpolation: Linear interpolation
    - RX window: CP/2 from GNSS
* Recommended WF
  + Need further discussion

### Sub-topic 1-2 : PSCCH demodulation

**Issue 1-2-1: Payload size**

* Proposals
  + Option 1: 28 bit
  + Option 2: 30bit
  + Option 3: 24 bits
* Recommended WF
  + Need further discussion.

**Issue 1-2-2: Relative velocity**

* Proposals
  + Option 1: 260km/h
* Recommended WF
  + Use 260km/h relative velocity (TDLA30-1400)

### Sub-topic 1-3 : PSBCH demodulation

**Issue 1-3-1: The number of S-SSB per one period**

* Proposals
  + Option 1: 1 S-SSB
  + Option 2: 2 S-SSBs
* Recommended WF
  + Need further discussion.

**Issue 1-3-2: Relative velocity**

* Proposals
  + Option 1: 30km/h
* Recommended WF
  + Use 30km/h relative velocity (TDLA30-180)

### Sub-topic 1-4 : PSFCH demodulation

**Issue 1-4-1: Test metric**

* Proposals
  + Option 1: Pr(DTX to ACK)<1% and Pr(ACK miss)<1%
  + Option 2: Pr(DTX to ACK)<1% , Pr(ACK miss)<1% , and Pr(NACK to ACK) < 0.1%
  + Option 3: Statistics to be collected:
    - ACK/NACK type: Pr(NACK to ACK) < 0.1%.
    - NACK only type: Pr(NACK miss) < 1%.
* Recommended WF
  + Need further discussion.

**Issue 1-4-2: PSFCH periodicity**

* Proposals
  + Option 1: 1 periodicity
  + Option 2: 4 periodicity
* Recommended WF
  + Need further discussion

**Issue 1-4-3: Number of Cyclic shift pairs**

* Proposals
  + Option 1: 1
* Recommended WF
  + Use 1 cyclic shift pair

**Issue 1-4-4: Relative velocity**

* Proposals
  + Option 1: 30km/h
* Recommended WF
  + Use 30km/h relative velocity (TDLA30-180)

### Sub-topic 1-5 : Resource pool configuration

**Issue 1-5-1: Resource pool configuration**

* Proposals
  + Option 1: for V2X demodulation requirements with CBW 20 MHz and SCS 30 kHz: sub-channel size = 10 PRBs, number of sub-channels = 5
* Recommended WF
  + Need further discussion.

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1: PSSCH demodulation**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | **Issue 1-1-1: Sub-channel size**  According to RAN1’s agreements for DMRS pattern limitation, to support high relative speed (500km/h), more than 3 DRMS symbols pattern should be considered, so 20 PRB sub-channel size is reasonable. For other tests, 10 or 20 PRB sub-channel size is fine for us. We support option 1 or option 3.  **Issue 1-1-2: Modulation order (GNSS based sync)**  We support option 2. Supporting 64QAM modulation for NR V2X is mandatory feature. So we need to consider 64QAM modulation order. And similar to LTE V2X test cases, low and high relative velocity can be considered for PSSCH test.  **Issue 1-1-3: PSFCH periodicity**  We prefer option 2  **Issue 1-1-4: DMRS pattern**  For 500km/h, we prefer option 2. For 30km/h, we prefer option 1.  **Issue 1-1-5: 2nd stage SCI allocation**  We don’t have strong view on these. However, it should be not affect the PSSCH coding rate due to the high beta value.  **Issue 1-1-6: gNB based sync test cases**  We don’t have strong view.  **Issue 1-1-7: 256QAM test cases**  We support option 1. This feature was first introduced in NR V2X to support high data rate and RAN4 agreed 256QAM modulation as optional feature. So, if the UE supporting 256QAM modulation should be tested. To reduce test cases, applicability rule can be considered to test 256QAM instead of 64QAM (if agreed).  **Issue 1-1-8: Propagation condition for high relative velocity**  We can check performance with TDLC300, but if more than 3 DMRS symbols are considered, current propagation model is available.  **Issue 1-1-9: Receiver assumption** |
| QC | **Issue 1-1-1: Sub-channel size**  We propose option one, since in a V2X network, in order to maximize system capacity to accommodate more SL UEs and transmissions, subchannel size of 10RB is the most common choice, especially in low speed scenario, in which usually with crowded cars. Moreover, since less RBs are allocated, less RSREs are available for channel estimation and this becomes the bottleneck scenario and need to be tested.  **Issue 1-1-2: Modulation order (GNSS based sync)**  For test 2, we support option 2. Since high speed is covered by 500km/h QPSK test, and highest modulation order supported needs to be tested, therefore, low speed test with 64QAM should be introduced. Otherwise 64QAM is out of test coverage.  **Issue 1-1-3: PSFCH periodicity**  Both options are fine for us.  **Issue 1-1-4: DMRS pattern**  500km/h: option 2 or option 3  260km/h: option 2 and option 3 if being introduced as a test  30km/h: option 2, our simulation shows that 2 DMRS performs better than 3 DMRS.  **Issue 1-1-5: 2nd stage SCI allocation**  We proposed option 1, but can compromise to option 2, given that better performance is shown.  **Issue 1-1-6: gNB based sync test cases**  We support option 2.  **Issue 1-1-7: 256QAM test cases**  We support option 1, since (1) optional feature still requires to be tested if UE declare support (2) if workload is an issue, this test can directly copy the 30km/h configuration, with MCS replaced by 20 in 256QAM table, the smallest MCS with 256QAM.  **Issue 1-1-8: Propagation condition for high relative velocity**  We propose this option, since larger delay spread can help CFO estimation in high speed scenario. But we are open to discuss other options.  **Issue 1-1-9: Receiver assumption**  Option 1 is good for us. |
| CATT | **Issue 1-1-1: Sub-channel size**  Prefer option 3. We share the same view as LGE. Based on current DMRS patterns, it is difficult to avoid the overlapping case between PSSCH DMRS symbol and PSCCH symbol when sub-channel size is less than 20RB, especially for 3 and 4 DMRS pattern. For PSSCH test case, we prefer 20RB as sub-channel size.  **Issue 1-1-2: Modulation order (GNSS based sync)**  Prefer option 2. From the perspective of testing, the upper limit and lower limit are usually preferred to increase the test coverage. If 256QAM is not considered, 64QAM is expected to be tested.  **Issue 1-1-3: PSFCH periodicity**  Prefer Option 1. Option 2 is also acceptable.  **Issue 1-1-4: DMRS pattern**  If the periodicity of PSFCH is defined as 4, our preference of DMRS pattern is as follows:   * For 500km/h: Option 2 * For 260km/h: Option 2 * For 30km/h: Option 2.   **Issue 1-1-5: 2nd stage SCI allocation**  We don’t have strong view.  **Issue 1-1-6: gNB based sync test cases**  Option 1. The principle of LTE V2X can be reused.  **Issue 1-1-7: 256QAM test cases**  Prefer Option 2. 256QAM reception was agreed as an optional UE capability. Compared to 64QAM, 256QAM demodulation requires much higher SNR level that is difficult to be achieved in time-varying channel with different velocities.  **Issue 1-1-8: Propagation condition for high relative velocity**  No strong view.  **Issue 1-1-9: Receiver assumption**  Support Option 1. |
| Intel | **Issue 1-1-1: Sub-channel size**  Our preference is to have 10 PRB sub-channel size for all tests with 20 MHz and 30 kHz, because such configuration allow to have efficient spectrum utilization. Same time, we are open to further discuss how many sub-channels will be allocated for PSSCH transmission. At current stage, our results show that performance with one sub-channel allocation is fine for different scenarios.  **Issue 1-1-2: Modulation order (GNSS based sync)**  We are fine to define test 2 with 16QAM or 64QAM. Same time, we suggest to have one PSSCH test with 260 km/h relative speed to show performance for medium speed conditions. Probably we can check 64QAM performance for 260 km/h scenario.  **Issue 1-1-3: PSFCH periodicity**  For PSSCH requirements, we prefer to consider PFSCH periodicity 4 to reduce overhead and verify correct UE processing of slots with and without PSFCH. PSFCH periodicity 1 can be considered for other tests.  **Issue 1-1-4: DMRS pattern**  For high and medium speed, probably further discussion is needed depending on discussion on Issues 1-1-1 and 1-1-4.  For low speed, we think that 2 DMRS configuration is sufficient. (i.e. Option 2)  **Issue 1-1-5: 2nd stage SCI allocation**  Don’t have strong preference at current stage, we think that 2nd stage SCI configuration should be selected to balance between overhead and impact on PSSCH performance. Probably we can list several options for further analysis and decide in the next meeting.  **Issue 1-1-6: gNB based sync test cases**  As we showed in our General paper, FO and TO configuration will be worser in comparison to scenario with GNSS sync source. Usually, RAN4 define minimum requirements for the worst scenarios. Therefore, we think that it will be rather important to verify UE which support concurrent operation. If there is concern about number of tests, then we can further discuss the definition of applicability rule (e.g. UE can skip one test with GNSS sync source in case it passed test with gNB sync source).  **Issue 1-1-7: 256QAM test cases**  We prefer to keep this open or not define in Rel-16 time frame. Based on our understanding, due to this feature is optional for Tx and Rx, this feature is only applicable to unicast operation. Therefore, we suggest to focus on discussion of requirements for basic V2X features verification.  **Issue 1-1-8: Propagation condition for high relative velocity**  At current stage, we prefer to have same propagation conditions for scenarios with different speeds and keep agreement from previous meeting. Same time, we can further investigate if there are any issues with existing model and whether scenario with high delay spread is typical for high speed conditions.  **Issue 1-1-9: Receiver assumption**  We are fine to consider Option 1 for minimum requirements definition. Same time, we should not preclude any other UE implementation in case it allows to meet requirements. |
| Huawei: | **Issue 1-1-1: Sub-channel size**  We support option 3.  To Intel: According to the agreements of RAN 1 #102-3 meeting:   |  | | --- | | Agreements:   * When a subchannel size is less than 20 PRBs and the size of PSCCH is less than the subchannel size, a TX UE is not expected to choose a PSSCH DMRS pattern to be transmitted in the same OFDM symbol with PSCCH. |   Even if we use 10 PRBs subchannel size with more than one sub-channels are allocated, only 2 DMRS symbols can be selected, it is difficult to guarantee the performance under the scenario with medium speed and high speed  For Option1, 10 RBs sub-channel allocation will cause that PSSCH is TDM with PSCCH which has been verified in Rel-15. Meanwhile, our purpose is to verify the single link demodulation performance, so spectrum utilization is not the key factors to be considered for PSCCH test. While for multi-link test such as PSCCH/PSSCH decoding capability and power imbalance test, 10 RBs sub-channel allocation can be considered.  **Issue 1-1-2: Modulation order (GNSS based sync)**  The suitable modulation order depends on speed. We think that at least 260km/h and 500km/h should be included, considering that 260km/h is very typical velocity for NR V2X for scenarios of vehicles platooning and advanced Driving as figured out in TS 22.186, at the same time according to our simulation results shown in R4-2015641, MCS 11 for 260km/h is feasible. If companies have strong views on 30km/h with 64QAM, we are also fine to include it.  **Issue 1-1-3: PSFCH periodicity**  We support option 2. We should configure PSFCH periodicity to 4 to reduce overhead.  **Issue 1-1-4: DMRS pattern**  According to our simulation results, we support option 2 for 500km/h and option 2 for 260km/h and option 1 or 2 for 30km/h (If agreed).  To Intel, for 260km/h, according to our simulation results, we think 3 DMRS symbol is enough to guarantee the performance for slots without PSFCH. There is no need to set maximum 4 DMRS symbols.  **Issue 1-1-5: 2nd stage SCI allocation**  We support option 2, the principle to derive it is that the performance of 2nd stage SCI allocation should be guaranteed when the SNR satisfying 10% BLER for PSSCH is achieved. According to our simulation results in R4-2015640, 2nd stage SCI configuration in option 2 is reasonable.  However, the 2nd stage SCI allocation not only depends on Beta-offset but also depends on MCS, DMRS pattern and sub-channel size. We propose to further discuss this issue after parameters such as MCS, DMRS pattern and sub-channel size have been determined.  For how to select Beta-offset, we propose the following principle: the BLER of 2nd stage SCI should be lower than [1%] when SNR satisfying 10% BLER of PSSCH is achieved.  **Issue 1-1-6: gNB based sync test cases**  We prefer Option 2.  **Issue 1-1-7:256 QAM test cases**  We support option 2, 256QAM is not commonly used in group cast and broadcast scenarios. What’s more, the SNR @ 10% of BLER is very high (more than 20dB) for 256QAM and it is not possible to achieve such high in practical scenario. We prefer not define the performance requirements for 256 QAM.  **Issue1-1-8: Propagation condition for high relative velocity**  High speed is most used for scenarios with less obstacles, time delay shouldn’t be set such high as 300ns. From our simulation results, it is feasible to use TDLA-30, but we can further check TDL-C 300  **Issue 1-1-9: Receiver assumption**  Support option 1. |
| MTK | **Issue 1-1-1: Sub-channel size**  Support option 3.  We have the same view with CATT/HW.  **Issue 1-1-2: Modulation order (GNSS based sync)**  We are ok with test 1.  For test 2, we prefer option 2.  According to RAN1’s discussion, 64QAM modulation is mandatory for NR V2X, we suggest defining 64QAM test case. For speed configuration, we have similar view with LG.  **Issue 1-1-3: PSFCH periodicity**  Support option 1.  If the PSFCH periodicity is 4 slots, DMRS pattern for PSSCH will be 4-symbol for most of slots. DMRS pattern for PSSCH will be always 3-symbol when PSFCH periodicity is 1 slot. To test UE’s performance in worst scenario, we suggest defining the test case with PSFCH transmission on every slot.  **Issue 1-1-4: DMRS pattern**  The DMRS pattern is related to velocity configuration. About PSSCH velocity configuration, we suggest reusing LTE V2X configuration, e.g., high speed (500km/h) and low speed (30km/h). Besides, as mentioned in issue 1-1-3, we think PSFCH should be configured within every slot. 3 DMRS symbols with PSFCH configuration also have the same DMRS symbol interval (3 symbols) with LTE V2X. Thus, we shall configure DMRS pattern as follows:   * + For 500km/h     - Option 3: 3 DMRS symbols and PSFCH periodicity is 1   + For 30km/h     - Option 3: 3 DMRS symbols and PSFCH periodicity is 1   **Issue 1-1-5: 2nd stage SCI allocation**  The beta offset of the 2nd stage SCI should guarantee 2nd SCI have enough performance, which will not impact the PSSCH performance. From HW’s simulation results, it can be seen that beta = 3.5 for QPSK test is enough. We can further evaluate the specific beta offset value for 64QAM modulation.  **Issue 1-1-6: gNB based sync test cases**  Support option 2.  The only difference between GNSS and gNB is timing offset, which can be guaranteed by RRM test. Besides, gNB is an optional feature. Thus, we suggest not to introduce this test.  **Issue 1-1-7: 256QAM test cases**  Support option 2.  256QAM may need a high SNR, and it isn’t a practical NR V2X application scenarios. Especially, 256QAM performance mainly depends on RF front end and AGC other than baseband demodulation performance. Since V2X UE may use different hardware design with Uu link, it may be hard for RAN4 to discuss how to consider the additional RF margin for 256QAM.  **Issue 1-1-8: Propagation condition for high relative velocity**  We think that TDL-C 300ns is not a practical scenario in high speed. We have noticed QC’s concern about the PSSCH performance. we suggest to evaluate the PSSCH performance with more RBs firstly in RAN4.  **Issue 1-1-9: Receiver assumption**  We are Ok with the proposal. |
| QC | **Issue 1-1-8: Propagation condition for high relative velocity**  We see some concerns from above comments on TDL\_C 300ns, here are a few alternatives to avoid the error floor we observed, for second round discussion:   1. Lower MCS 2. Instead of TDL\_C 300ns, TDL\_B 100ns is another option, which is closer to traditional EVA channel 3. Set CCH symbol to 3: this reduce number of SCH symbols, can help performance when Doppler spread is large |

**Issue 1-2: PSCCH demodulation**

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| **Company** | **Comments** |
| LG | **Issue 1-2-1: Payload size**We support option 1  **Issue 1-2-2: Relative velocity**  We support option 1 |
| QC | **Issue 1-2-1: Payload size**  We support option 1  **Issue 1-2-2: Relative velocity**  We support option 1 |
| CATT | **Issue 1-2-1: Payload size**  We support option 1.  **Issue 1-2-2: Relative velocity**  We support option 1. |
| Intel | **Issue 1-2-1: Payload size**  At current stage, our calculation shows that PSCCH with 30 bits payload reflects the typical scenario. Same time, we are open to further discuss both options. Please find below the details of calculations from our side:   * Priority – 3 bits * Frequency resource assignment – 4 bits * Time resource assignment – 5 bits * Resource reservation period – 4 bits * DMRS pattern – 1 bit * 2nd-stage SCI format – 2 bits * Beta\_offset indicator – 2 bits * Number of DMRS port – 1 bits * Modulation and coding scheme – 5 bits * Additional MCS table indicator – 0 bits * PSFCH overhead indication – 1 bits * Reserved – 2 bits   **Issue 1-2-2: Relative velocity**  Support Option 1 |
| Huawei | **Issue 1-2-1: Payload size**  Our proposal for payload size setting:   * Priority: 3 * Frequency resource assignment: 2 * Time resource assignment: 5 * Resource reservation period: 0 * DMRS pattern: 1 * 2nd-stage SCI format: 2 * Beta\_offset indicator: 2 * Number of DMRS port: 1 * Modulation and coding scheme: 5 * Additional MCS table indicator: 0 * PSFCH overhead indication: 1 * Reserved: 2   Total payload should be 24bits.  To intel:  We propose to set sub-channel size to 20RBs, so the number of sub-channels should be 2, the number of bits indicating frequency resource assignment should be 2.  We don’t think resource reservation period is necessary since for PSSCH testing, repetition is not configured.  To Qualcomm:  In contribution R4-2014637, you propose to set number of sub-channel to 10, in that case, for 20MHz bandwidth, the subchannel size is 5RBs, which is not suitable.  **Issue 1-2-2: Relative velocity**  Support Option 1 |
| MTK | **Issue 1-2-1: Payload size**  Support option 1.  **Issue 1-2-2: Relative velocity**  Support option 1. |

**Issue 1-3: PSBCH demodulation**

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| **Company** | **Comments** |
| LG | **Issue 1-3-1: The number of S-SSB per one period**  We support option 1. We think that 2 S-SSBs configuration does not affect PSBCH demodulation performance requirement.  **Issue 1-3-2: Relative velocity**  We support option 1. |
| QC | **Issue 1-3-1: The number of S-SSB per one period**  We prefer option 1 for simplicity, but open to discuss option 2.  **Issue 1-3-2: Relative velocity**  We support option 1. |
| CATT | **Issue 1-3-1: The number of S-SSB per one period**  Prefer Option 1.  1 S-SSB transmission per SL period brings about smaller transmission time delay and smaller overhead. In our understanding, Option 1 and Option 2 seem to have the similar performance except the simulation time. So 1 S-SSB per SL slot is preferred.  **Issue 1-3-2: Relative velocity**  Support Option 1 which is also aligned with LTE V2X. |
| Intel | **Issue 1-3-1: The number of S-SSB per one period**  Support Option 1, because impact of 2 S-SSB on demodulation requirements is not clear taking into account that SSB combining is not considered.  **Issue 1-3-2: Relative velocity**  Support Option 1. |
| Huawei | **Issue 1-3-1: The number of S-SSB per one period**  Prefer Option 2 considering the similar performance requirements as 1-SSB and short test time.  To CATT: Could you share clarification about “1 S-SSB transmission per SL period brings about smaller transmission time delay and smaller overhead”? Based on our understanding, transmission 2-SSB without combing per SL period will bring smaller transmission delay and achieve similar performance. We cannot understand the relationship with smaller overhead.  To Intel: Transmission 1 S-SSB or 2 S-SSB with suitable gap between 2 S-SSB within one SL period of 160ms, no any demodulation difference, how to understand the impact of 2 S-SSB on demodulation requirement?  **Issue 1-3-2: Relative velocity**  Support Option 1. |
| MTK | **Issue 1-3-1: The number of S-SSB per one period**  Support option 1.  **Issue 1-3-2: Relative velocity**  Support option 1. |

**Issue 1-4: PSFCH demodulation**

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| **Company** | **Comments** |
| LG | **Issue 1-4-1: Test metric**  We prefer option 2. For clarification, final test metric for PSFCH is only Pr(ACK miss) < 1% with Pr(DTX to ACK)<1% and Pr(NACK to ACK)<0.1% being satisfied if option 2 is used. Is it the same understanding?  **Issue 1-4-2: PSFCH periodicity**  We don’t have strong view. If no any technical concern, we prefer option 2.  **Issue 1-4-3: Number of Cyclic shift pairs**  We support option 1.  **Issue 1-4-4: Relative velocity**  We support option 1. |
| QC | **Issue 1-4-1: Test metric**  Since this test is option 2 ACK/NACK test, we support option 2, with the clarification that DTX corresponding to nothing is transmitted from SL Tx.  **Issue 1-4-2: PSFCH periodicity**We support option 1.  **Issue 1-4-3: Number of Cyclic shift pairs**  We support option 1  **Issue 1-4-4: Relative velocity**  We support option 1 |
| CATT | **Issue 1-4-1: Test metric**  Prefer Option 2.  **Issue 1-4-2: PSFCH periodicity**  Prefer Option 1.  **Issue 1-4-3: Number of Cyclic shift pairs**  Prefer Option 1.  **Issue 1-4-4: Relative velocity**  Prefer Option 1 |
| Intel | **Issue 1-4-1: Test metric**  Prefer Option 1. Based on our understanding, PSFCH is same as PUCCH format 0. For PUCCH format 0, Pr(DTX to ACK) and Pr(ACK miss) are used for requirements definition. We think that this set of metrics is sufficient from testing point of view and it is not required to verify Pr(NACK to ACK) separately.  **Issue 1-4-2: PSFCH periodicity**  If PSFCH periodicity 4 will be used for PSSCH test then we prefer to consider periodicity 1 for PSFCH requirements to have sufficient test coverage.  **Issue 1-4-3: Number of Cyclic shift pairs**  Support Option 1.  **Issue 1-4-4: Relative velocity**  Support Option 1. |
| Huawei | **Issue 1-4-1: Test metric**  Support option 1. Based our evaluation, SNR@ Pr(NACK to ACK) = 0.1% is much lower than SNR@ Pr(ACK miss) = 1%. Therefore if we check SNR@ Pr(ACK miss) = 1%, the Pr(NACK to ACK) = 0.1% can be met at the same time, but Pr(DTX to ACK)<1% needs to be checked separately, so Option 1 is enough.  Company is welcome to check this observation based on your simulations. Before RAN4 derived these two test metrics of Pr(DTX to ACK)<1% and Pr(ACK miss) = 1% for PUCCH format 0 based on evaluations.  **Issue 1-4-2: PSFCH periodicity**  We prefer option 1, for PSFCH performance testing, shorter PSFCH period can reduce test time and is more suitable.  **Issue 1-4-3: Number of Cyclic shift pairs**  Support option 1  **Issue 1-4-4: Relative velocity**  Support Option 1 |
| MTK | **Issue 1-4-1: Test metric**  Support option 2. We’re also fine with option 1.  **Issue 1-4-2: PSFCH periodicity**  Support option 1.  To have sufficient test coverage as mentioned by Intel’s paper and align with PSFCH periodicity configuration in PSSCH Demod configuration, we can consider 1 slot PSFCH periodicity for PSFCH demodulation requirements.  **Issue 1-4-3: Number of Cyclic shift pairs**  Support option 1.  **Issue 1-4-4: Relative velocity**  Support option 1. |

**Issue 1-5: Resource pool configuration**

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| **Company** | **Comments** |
| LG | It is better to discuss after sub-channel size is decided. |
| Intel | This topic is coupled with Issue 1-1-1. Based on our understanding, the only option from Issue 1-1-1, which contradicts with Option 1 from Issue 1-5-1, is Option 3. The other options can be replaced with multiple sub-channels allocation of size 10 PRBs.  Based on our discussion from General paper, the following sub-channel sizes can be considered to ensure more efficient spectrum utilization for 20 MHz and 30 kHz: 10, 25 and 50. Same time, 10 PRBs sub-channel allows to have more flexibility in resource allocation. Therefore, we proposed to use this option for all scenarios with 20 MHz and 30 kHz scenario. |
| Huawei | As discussed in Issue 1-1-1. For PSSCH testing, we propose to use 20RBs sub-channel size. For other tests, 10RBs sub-channel size is OK for us. |
| MTK | We have the same comment with LG. |
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### 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## 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#1-1: PSSCH** | **Issue 1-1-1: Sub-channel size**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 10 PRB sub-channel for low relative velocity and 20 PRB sub-channel for high relative velocity (LG, Qualcomm)* * *Option 2: 10 PRB sub-channel size for all cases and number of allocated sub-channels is FFS (Intel)* * *Option 3: 20 PRB sub-channel for all cases (LG, CATT, Huawei, MediaTek)*   *Recommendations for 2nd round: Select one option in 2nd round. As moderator point of view, one compromise option is option 1*  **Issue 1-1-2: Modulation order (GNSS based sync)**  *Tentative agreements: Introduce test for QPSK with 500km/h, and additional test will be discussed in 2nd round*  *Candidate options:*   * *Option 1: 16QAM for 260km/h (Intel, Huawei)* * *Option 2: 64QAM for 30km/h (LG, Qualcomm, CATT, MediaTek, Huawei(additionally))* * *Option 3: Introduce tests both option 1 and option 2 (compromised option from moderator)*   *Recommendations for 2nd round: Select one option in 2nd round.*  **Issue 1-1-3: PSFCH periodicity**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 1 periodicity (Qualcomm, CATT, MediaTek)* * *Option 2: 4 periodicity (LG, Qualcomm, CATT, Intel, Huawei)*   *Recommendations for 2nd round: Select one option in 2nd round.*  **Issue 1-1-4: DMRS pattern**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *For 500km/h*    + *Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4*   + *Option 2: {3,4} DMRS symbols when PSFCH periodicity is 4 (LG, Qualcomm, CATT, Huawei)*   + *Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)* * *For 260km/h*   + *Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4*   + *Option 2: {2,3} DMRS symbols when PSFCH periodicity is 4 (Qualcomm, CATT, Huawei)*   + *Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)* * *For 30km/h*   + *Option 1: {2,3} DMRS symbols when PSFCH periodicity is 4 (LG, Huawei)*   + *Option 2: 2 DMRS symbols when PSFCH periodicity is 1 or 4 (Qualcomm, CATT, Huawei)*   + *Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)*   *Recommendations for 2nd round: Select one option for each relative velocity in 2nd round. This issue is related Issue 1-1-1, Issue 1-1-2, and Issue 1-1-3.*  **Issue 1-1-5: 2nd stage SCI allocation**  *Tentative agreements: Depending on final decision of test cases, beta value will be used by 5 for 16QAM test configuration and beta = 3.5 for QPSK test configuration.*  *Candidate options:*  *Recommendations for 2nd round: Companies are encouraged to provide beta value for 64QAM modulation order if 640QAM is introduced.*  **Issue 1-1-6: gNB based sync test cases**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: Define performance requirement with 1300Hz FO and ±24Ts TO (CATT, Intel)* * *Option 2: Do not define performance requirement (Qualcomm, Huawei, MediaTek)*   *Recommendations for 2nd round: Select one option in 2nd round.*  **Issue 1-1-7: 256QAM test cases**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: Define performance requirement (LG, Qualcomm)* * *Option 2: Do not define performance requirement (CATT, Intel, Huawei, MediaTek)*   *Recommendations for 2nd round: Select one option in 2nd round.*  **Issue 1-1-8: Propagation condition for high relative velocity**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: TDLA30* * *Option 2: other conditions as following*   + *Lower MCS*   + *TDLB100*   + *Set PSCCH symbol to 3*   *Recommendations for 2nd round: Select one option in 2nd round. As moderator point of view, majority companies support option 1 and can further check other propagation condition in the next meeting,*  **Issue 1-1-9: Receiver assumption**  *Tentative agreements: Agree option 1*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#1-2: PSCCH** | **Issue 1-2-1: Payload size**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 28bits (LG, Qualcomm, CATT, MediaTek)* * *Option 2: 30bit (Intel)* * *Option 3: 24 bits (Huawei)*   *Recommendations for 2nd round: Select one option in 2nd round, and companies supporting option 1 are encouraged to re-check 28bit payload size considering Huawei comments for ‘Frequency resource assignment’ bit.*  **Issue 1-2-2: Relative velocity**  *Tentative agreements: Use 260km/h relative velocity (TDLA30-1400)*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#1-3: PSBCH** | **Issue 1-3-1: The number of S-SSB per one period**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 1 S-SSB (LG, Qualcomm, CATT, Intel, MediaTek)* * *Option 2: 2 S-SSBs (Huawei)*   *Recommendations for 2nd round: Select one option in 2nd round, but majority view is option 1.*  **Issue 1-3-2: Relative velocity**  *Tentative agreements: Use 30km/h relative velocity (TDLA30-180)*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#1-4: PSFCH** | **Issue 1-4-1: Test metric**  *Tentative agreements: Use ACK/NACK feedback mode and Pr(DTX to ACK)<1% and Pr(ACK miss)<1% for test metric. RAN4 will discuss whether or not to consider Pr(NACK to ACK) < 0.1% for test metric*  *Candidate options:*  *Introduce additional test metric as Pr(NACK to ACK) < 0.1%*   * *Option 1: Yes (LG, Qualcomm, CATT, MediaTek)* * *Option 2: No (Intel, Huawei, MediaTek)*   *Recommendations for 2nd round: Select one option in 2nd round.*  **Issue 1-4-2: PSFCH periodicity**  *Tentative agreements: Use 1 periodicity*  *Candidate options:*  *Recommendations for 2nd round:*  **Issue 1-4-3: Number of Cyclic shift pairs**  *Tentative agreements: Use 1 cyclic shift pair*  *Candidate options:*  *Recommendations for 2nd round:*  **Issue 1-4-4: Relative velocity**  *Tentative agreements: Use 30km/h relative velocity (TDLA30-180)*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#1-5: Resource pool** | *Tentative agreements: Need further discussion*  *Candidate options:*  *Recommendations for 2nd round: Depending on decision of sub-channel size for Sub-topic 1-1, RAN4 will continue to discuss this issue.* |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on single link tests for NR V2X demodulation performance | LG Electronics |
| #2 | Simulation assumptions for NR V2X single link test case | Huawei |

### 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”* |

## Discussion on 2nd round (if applicable)

### Sub-topic 1-1 : PSSCH demodulation

**Issue 1-1-1: Sub-channel size**

* Proposals
  + Option 1: 10 PRB sub-channel for low relative velocity and 20 PRB sub-channel for high relative velocity (LG, Qualcomm)
  + Option 2: 10 PRB sub-channel size for all cases and number of allocated sub-channels is FFS (Intel)
  + Option 3: 20 PRB sub-channel for all cases (LG, CATT, Huawei, MediaTek)
* Recommended WF
  + Need further discussion, but as moderator point of view, option 1 is suggested to compromise solution.

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| **Company** | **Comments** |
| LG | Support option 1.  For option 2, I don’ know why multiple sub-channels are allocated for 20 PRB test configuration. We can use simply single sub-channel size, and multiple sub-channel will be used for multiple link tests. |
| QC | For low speed test, 2 DMRS is enough, performance limitation argued by proponents of option 3 is not a concern. As we explained, 10RB is performance bottleneck (but 10% BLER still achievable within reasonable SNR) and is more practical for low (even mid) speed, since the scenario might have crowded UEs (cars). |
| Intel | Support option 2. We suggest to have unified resource pool configuration for all tests and using of subchannel size of 10, 25 or 50 PRBs for scenario with 20 MHz and 30 kHz is more beneficial from spectrum utilization point of view. Therefore, in case we are going to consider 20 PRBs PSSCH allocation for test we can just use 2 sub-channel allocation.  As for comments from HW in first round, such mapping rule is applicable for scenario with “subchannel size is less than 20 PRBs and the size of PSCCH is less than the subchannel size”. Same time, in our proposal subchannel size is same as size of PSCCH. Therefore, this agreement is not applicable to suggested scenario and in case 3 DMRS is configured, 2 DMRSs will be mapped in the first subchannel (with PSCCH) and 3 DMRSs will be mapped in the second sub-channel (without PSCCH). So, signal structure will be same for scenario with 2 subchannels of 10 PRBs and scenario with 1 subchannel of 20 PRBs. |
| Huawei | To Intel: Thank for your clarification. Meanwhile considering the performance for high and medium velocity, it is more suitable to use 20RBs corresponding to 2 sub-channels for medium and high velocity (260km/h and 500km/h) and 10 RBs corresponding to 1 sub-channel can be used for 30km/h if agreed to define. |
| CATT | Support option 3 to use unified sub-channel size for PSSCH performance requirements. |
| MTK | Support option 3.  To Intel,  We don’t agree with your comments about the DMRS configuration, e.g., “2 DMRSs will be mapped in the first subchannel (with PSCCH) and 3 DMRSs will be mapped in the second sub-channel (without PSCCH)”. The completed PSSCH DMRS configurations is described as follows in Ts 38.214 (V16.3.0):   |  | | --- | | If PSSCH DMRS and PSCCH are mapped to the same OFDM symbol, then this mapping within a single sub-channel is **only supported if higher layer parameter *sl-SubchannelSize* >= 20**, i.e. the sub-channel size is at least 20 PRBs.  When a sub-channel size is less than 20 PRBs and the size of PSCCH is less than the sub-channel size, a UE is not expected to choose a PSSCH DMRS pattern to be transmitted in the same OFDM symbol with PSCCH. |   From our understanding, if the subchannel size is less than 20 PRBs, it doesn’t support PSSCH DMRS and PSCCH are mapped to the same OFDM symbol as illustrated in following picture. |

**Issue 1-1-2: Modulation order (GNSS based sync)**

* Test 1 : QPSK for 500km/h
* Proposals for Test 2:
  + Option 1: 16QAM for 260km/h (Intel, Huawei)
  + Option 2: 64QAM for 30km/h (LG, Qualcomm, CATT, MediaTek, Huawei(additionally))
  + Option 3: Introduce tests both option 1 and option 2 (compromised option from moderator)
* Recommended WF
  + Need further discussion.

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| **Company** | **Comments** |
| LG | Support option2.  64QAM for NR V2X is mandatory feature, so option 2 should be considered. If companies want to include 16QAM, we are fine to option 3. |
| QC | Support option 2.  Peak MCS test is needed, since it is the performance bottleneck for LLR calculation and decoder. High/mid speed test mainly affect channel estimation performance, without low speed high MCS test, LLR calculation and decoder performance can’t be guaranteed.  Since high speed test is agreed, it’s not clear to us why 260km/h is needed, LLR calculation/decoding performance is (and should) tested by 64QAM test, channel estimation is tested in high speed test, what additional block performance needs to be tested in 260km/h? |
| Intel | We think that is can be rather beneficial to verify performance for scenario with medium relative speed and medium modulation order. Same time, to move forward, Option 2 is fine for us. |
| Huawei | We think that at least 260km/h and 500km/h should be included, considering that 260km/h is very typical velocity for NR V2X for scenarios of vehicles platooning and advanced Driving as figured out in TS 22.186, at the same time according to our simulation results shown in R4-2015641, MCS 11 for 260km/h is feasible. Option 2 can be additionally introduced if most companies have strong views, i.e. we can compromise to Option 3.  To Qualcomm: Our purpose is to verify the comprehensive demodulation performance under the typical scenarios other than the separate algorithm under extreme scenarios. 260km/h is typical scenario and should be verified. |
| CATT | Support option 2. Considering the introduction of 256QAM is pending, 64QAM test case should be introduced to verify the performance of higher order modulation. We are also Ok with Option 3 proposed by moderator. |
| MTK | Support option 2  We suggest the NR V2X velocity configuration can reuse LTE V2X, where data channel only focus on higher velocity with lower MCS and lower velocity with higher MCS. Besides, 64QAM is maximum mandatory modulation for NR V2X. So, we prefer option 2. |

**Issue 1-1-3: PSFCH periodicity**

* Proposals
  + Option 1: 1 periodicity (Qualcomm, CATT, MediaTek)
  + Option 2: 4 periodicity (LG, Qualcomm, CATT, Intel, Huawei)
* Recommended WF
  + Need further discussion.

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| **Company** | **Comments** |
| LG | Support option 2  If 1 periodicity is configured for all tests, other DMRS patterns cannot be verified. We prefer to use 4 periodicity at least one test case. |
| Intel | Support Option 2.  Option 2 allows to verify that UE has correct PSSCH processing for different slots structures in one test. |
| Huawei | Option 2.  Longer PSFCH periodicity can reduce the overhead and more DMRS patterns can be verified. |
| CATT | Both option 1 and option 2 are Ok with us. Option 1 seems one simpler way to test PSSCH performance. Option 2 is much more consistent with the real scenario where initial transmission and retransmission might have different TBS. |
| MTK | We still prefer option 1. |

**Issue 1-1-4: DMRS pattern**

* Proposals
  + For 500km/h
    - Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4
    - Option 2: {3,4} DMRS symbols when PSFCH periodicity is 4 (LG, Qualcomm, CATT, Huawei)
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)
  + For 260km/h
    - Option 1: {2,4} DMRS symbols when PSFCH periodicity is 4
    - Option 2: {2,3} DMRS symbols when PSFCH periodicity is 4 (Qualcomm, CATT, Huawei)
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)
  + For 30km/h
    - Option 1: {2,3} DMRS symbols when PSFCH periodicity is 4 (LG, Huawei)
    - Option 2: 2 DMRS symbols when PSFCH periodicity is 1 or 4 (Qualcomm, CATT, Huawei)
    - Option 3: 3 DMRS symbols when PSFCH periodicity is 1 (MediaTek)
* Recommended WF
  + Need further discussion.

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| **Company** | **Comments** |
| LG | Depending on sub-channel size and PSFCH periodicity, DMRS pattern will be decided. Our preference is the same as 1st round, and option 2 is preferred if 260km/h is considered. |
| QC | 500km/h and 260km/h option 2 and 3 are essentially the same.  For 30km/h, we support option 2.  As we showed in our contribution, 2 DMRS has better performance than 3 DMRS in low speed, therefore, 2 DMRS should be used. |
| Intel | 500 km/h: Our analysis showed that Option 1 for scenarios with 1 sub-channel of size 10 PRBs. Same time we can Option 1 or Option 2 if PSSCH allocation will increased from 10 PRBs to 20 PRBs.  260 km/h: Option 1 or 2 for scenario with 1 sub-channel of size 10 PRBs.  30 km/h: Support Option 2. Based on our analysis, it is enough number of DMRS for low speed scenario |
| Huawei | Considering the balance of DMRS overhead and performance, our preference is same as 1st round discussion. We support option 2 for 500km/h, option 2 for 260km/h and either option 1 and option 2 for 30km/h (if agreed). According to our simulation results in our contribution, these configurations are feasible. |
| CATT | PSFCH periodicity should be decide first.  For 500km/h, we support option 2 and option 3.  For 260km/h, we support option 2 and option 3  For 30km/h, our simulation results indicate 2 DMRS is sufficient to trace the frequency shift. |
| MTK | As commented in Issue 1-1-2: Modulation order (GNSS based sync), we don’t support to define 260km/h case.  For 500km/h and 30km/h case, we still prefer option 3. |

**Issue 1-1-5: 2nd stage SCI allocation**

* beta = 3.5 for QPSK and beta = 5 for 16QAM depending on final decision of test cases
* Proposals
  + Companies are encouraged to provide beta value for 64QAM (if 64QAM modulation is introduced)

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| **Company** | **Comments** |
| LG | We suggest 5 for beta value of 64QAM. If beta value is high, it might be impact on PSSCH coding rate. |
| QC | OK for LG proposal for 64QAM |
| Intel | We can take suggested values as baseline and if technical issue (i.e. impact of PSSCH performance) will be observed in the next meeting then these values can be revised. |
| Huawei | Beta=3.5 for QPSK, beta=5 for 16QAM and 5 for 64QAM can be used as baseline. But the overall performance depends on RB allocation, DMRS pattern and other parameters, those suggested Beta values are derived based on our simulation with certain assumptions of RB allocation, DMRS pattern and other parameters. We propose companies to further check by using the following metric and the newly agreed simulation assumptions, as Intel suggested, if technical issue will be observed, we can revise the related beta values in next meeting:  The smallest beta value should ensure that BLER of 2nd stage SCI is lower than [1%] when SNR satisfying 10% BLER of PSSCH is achieved. |
| CATT | OK with LG proposal as baseline. |
| MTK | We have the same view with Intel. |

**Issue 1-1-6: gNB based sync test cases**

* Proposals
  + Option 1: Define performance requirement with 1300Hz FO and ±24Ts TO (CATT, Intel)
  + Option 2: Do not define performance requirement (Qualcomm, Huawei, MediaTek)
* Recommended WF
  + Need further discussion.

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| **Company** | **Comments** |
| LG | No strong view. |
| Intel | Support Option 1. Con-current operation is one of the typical scenarios for V2X operation and gNB based synchronization is mandatory for such scenario. Therefore, we think that it is very important to verify performance for such scenario where CFO and TO is higher than for scenario with GNSS based sync source.  @MTK: It is not clear which RRM test allows to verify performance in such conditions. Based on our understanding, timing test in RRM is for AWGN conditions and without CFO. |
| LG | To clarify the RRM test, in our understanding, there were no any RRM test cases to verify TO/FO based on gNB based sync as mentioned by Intel. |
| Huawei | Option 1. Since it is optional for UE on band n47, currently we do not observe any practical use case for such scenario. Only difference is larger CFO and CTO, no need to consider this test. |
| CATT | Prefer option 1. In LTE V2X, eNB based sync test cases were introduced in addition to GNSS based sync test. When it comes to NR V2X, there is no any scenario difference observed and thus the same principle should apply. In our understanding, gNB based sync test is different from GNSS based sync test except FO and TO. It is not expected to have implicit test passing for these two test cases. |
| MTK | Support option 2.  To Intel,  From our understanding, the only difference between GNSS and gNB is timing offset, but it can be guaranteed by RRM test as illustrated in **R4-2012104**. The FO can be evaluated by GNSS based sync source (0.2ppm). Besides, gNB is an optional feature. Thus, we suggest not to introduce this test. |

**Issue 1-1-7: 256QAM test cases**

* Proposals
  + Option 1: Define performance requirement (LG, Qualcomm)
  + Option 2: Do not define performance requirement (CATT, Intel, Huawei, MediaTek)
* Recommended WF
  + Need further discussion.

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| **Company** | **Comments** |
| LG | Support option 1  Since unicast will be typical scenario for NR V2X., high SNR for 256QAM can be achieved. So, even this feature is optional, this feature should be verified. |
| QC | We want to address companies comments in first round for concerns on 256QAM test:  (1) 3GPP has defined many test cases for SNR > 20dB (2) Only low speed will be defined, and reuse 64QAM low speed test configurations, no work load increases |
| Intel | Support Option 2 and we can keep it open and come back once simulation assumption for other, already agreed, scenarios will be stable. It is optional feature for unicast transition which requires that it is supported by Tx UE and Rx UE, because separate UE capabilities are defined. |
| Huawei | Still support option 2.  RAN4 had lots of discussions in last meeting about the Rx 256QAM mandatory or not, almost all companies including the proponent of Option 1 agree to set it to optional, we would like to know the motivation to set it to optional but define performance requirements for it at the same time.  3GPP already agreed to set both Tx and Rx 256QAM are optional, it means limited support and use case that is only for group and broadcast for 256QAM in the real network, we don’t think it is necessary to define the requirements. |
| CATT | Support option 1. |
| MTK | We still think it is unnecessary to define 256QAM test case for NR V2X as commented in 1st round. Based on 2nd round comments in Issue 1-2-1: Payload size (PSCCH), we think at least QC/LG/Intel agree with that the “Additional MCS table indicator” filed is 0 bit, which also means that the maximum modulation is 64QAM.  Could LG or QC explain why you want to define 256QAM since you have agreed that 0 bit “Additional MCS table indicator” is enough? |
| LG | To MTK,  For PSCCH test, we think that we don’t need to configure PSSCH with 256QAM. |

**Issue 1-1-8: Propagation condition for high relative velocity**

* Proposals
  + Option 1: TDLA30
  + Option 2: other conditions as following
    - Lower MCS
    - TDLB100
    - Set PSCCH symbol to 3
* Recommended WF
  + Need further discussion. As moderator point of view, majority companies support option 1 and can further check other propagation condition in the next meeting.

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| **Company** | **Comments** |
| LG | Support option 1. And we can check with one of option 2 in the next meeting. |
| QC | We suggest to keep this open, the come back next meeting with simulation results to decide that under which condition 10% BLER is achievable, meaning, has enough margin from error floor. Our initial investigation shows that TDLB 100 and set PSCCH symbol to 3 helps more than lower MCS, other companies can chime in if some study has been done. |
| Intel | Prefer Option 1. Same time, we are open to analyze other conditions from Option 2 in the next meeting. |
| Huawei | Support option 1.  Based on our simulation results, option 1 is feasible. |
| CATT | Prefer option 1. We are also open to come back in the next meeting. |
| MTK | Support option 1. |

### Sub-topic 1-2 : PSCCH demodulation

**Issue 1-2-1: Payload size**

* Proposals
  + Option 1: 28bits (LG, Qualcomm, CATT, MediaTek)
  + Option 2: 30bit (Intel)
  + Option 3: 24 bits (Huawei)
* Recommended WF
  + Need further discussion. Companies supporting option 1 are encouraged to re-check 28bit payload size considering Huawei 1st round comments for ‘Frequency resource assignment’ bit.

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| **Company** | **Comments** |
| LG | Depending on sub-channel size, it can be slightly different. As Huawei was derived as follow:   * Priority: 3 * Frequency resource assignment: 2 * Time resource assignment: 5 * Resource reservation period: 0 * DMRS pattern: 1 * 2nd-stage SCI format: 2 * Beta\_offset indicator: 2 * Number of DMRS port: 1 * Modulation and coding scheme: 5 * Additional MCS table indicator: 0 * PSFCH overhead indication: 1 * Reserved: 2   For ‘additional MCS table indicator’, I think 1 bit is needed. If 20 sub-channel size for PSSCH is used, payload size will be 25bit. |
| QC | Can LG explain why additional MCS table indicator is needed? We agree with Huawei’s comments in first round, hence 24bits is good for us. |
| Intel | Based our understanding, subchannel size of 10 PRBs will be used for the most of scenarios. Therefore, we prefer to consider “Frequency resource assignment” equal to 4. In case Resource reservation period = 0, we will get 26 bits as another option. |
| LG | To QC, we misunderstood for addition MCS table indicator. We agree 0 for additional MCS table indicator. |
| Huawei | Based on current discussion, “Resource reservation period = 0” is agreeable.  “Frequency resource assignment” = 2 or 4, it depends on the sub-channel size 10 or 20 PRBs, so only 24 bits or 26 bits are applicable for further discussion. |
| MTK | We can accept HW’s suggestion. |

### Sub-topic 1-3 : PSBCH demodulation

**Issue 1-3-1: The number of S-SSB per one period**

* Proposals
  + Option 1: 1 S-SSB (LG, Qualcomm, CATT, Intel, MediaTek)
  + Option 2: 2 S-SSBs (Huawei)
* Recommended WF
  + Need further discussion, but if there is no performance issue, majority view is suggested.

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| **Company** | **Comments** |
| LG | Support option 1.  There are no performance issue, so we prefer to set simple one. |
| Intel | Support Option 1:  @HW: Based on our understanding, if 2 PSBCHs will transmitted with same content then UE can use soft combining to get better performance. Same time, based on our understanding, we don’t consider such scenario here. Therefore, it is not clear what we are going to show by introducing of such test. |
| Huawei | Support option 2.  For scenario to configure 2 SSB within one period, RAN1 did detailed analysis and reached common understanding for introduction such configuration:  **2 S-SSB transmissions within one S-SSB period is used to increase the coverage for 30kHz compared to 15kHz SCS because of low EPER**.  the PSBCH content is not complete same for the 2 S-SSB transmission, based on our evaluations, no big PSBCH performance difference between 1- SSB and 2-SSB without combing under the current agreed propagation condition TDLA30-180, it is very beneficial to configure 2 SSBs within one period to reduce testing time. |
| CATT | Prefer Option 1.  To Huawei, we support option 1 from the perspective of overhead reduction compared to option 2. Option 2 without combining does not bring any performance gain and seems like 1 S-SSB transmission per 80ms. However, we are open to discuss 2 S-SSB transmission with combining. |
| MTK | Support option 1.  From RAN1’s perspective, 2 S-SSB configuration is just for flexible design in SSB transmission other than coverage issue. From our understanding, the communication range had already been restricted by the CP length and SCS, e.g., the communication range is about 1400m in 15kHz SCS, however, it reduces to about 700m in 30kHz SCS. Only repetition the number of SSBs cannot enhance the coverage for SCS=30KHz. Besides, we think 1 S-SSB is stricter than 2 S-SSBs with different contents per one period. Thus, we prefer option 1. |

### Sub-topic 1-4 : PSFCH demodulation

**Issue 1-4-1: Test metric**

* Use ACK/NACK feedback mode and Pr(DTX to ACK)<1% and Pr(ACK miss)<1% for test metric.
* Proposals: Introduce additional test metric as Pr(NACK to ACK) < 0.1%
  + Option 1: Yes (LG, Qualcomm, CATT, MediaTek)
  + Option 2: No (Intel, Huawei, MediaTek)
* Recommended WF
  + Option 2 is reasonable if companies agree with following observation
    - If SNR@ Pr(ACK miss) = 1%, the Pr(NACK to ACK) = 0.1% can be met at the same time

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| **Company** | **Comments** |
| LG | Based on the observation of recommended WF, option 2 is fine. |
| QC | We currently don’t agree with this observation, would like ask Huawei for more clarification. Here is our understanding:  DTX to ACK and ACK miss decisions are done by comparing CS index corresponding to ACK against noise; however, NACK and ACK decision is done by comparing the likelihood of ACK and NACK. For an extreme case, UE can only decide whether there is a signal from any CS index detected, and categories it as ACK always, then UE can pass *Pr(DTX to ACK)<1% and Pr(ACK miss)<1%*, but can’t distinguish ACK/NACK at all. |
| Intel | Based on our results, Pr(NACK to ACK) is lower than 0.1% for SNR corresponding to Pr(ACK miss) = 1%. Same time, QC raised good point about UE which only makes DTX or ACK detection. Therefore, we need some time to think more about this. |
| Huawei | We don’t share the concern raised by QC. Not considering Pr(NACK to ACK) test metric is based on investigation by taking into account all three test metrics to ensure Pr(NACK to ACK) also can be achieved during simulation, not only consider DTX or ACK detection, this logic is using by RAN4 demodulation from LTE, it works well.  Based on our initial simulation results, we have that observation: if SNR@ Pr(ACK miss)=1% is achieved, Pr(NACK to ACK)=0.1% can also be met, that is the reason that we proposed not to consider Pr(NACK to ACK), but if company would like to do more investigations about this observation, it is fine for us.  So company can provide simulation results in next meeting with all three metrics considered:  Pr(DTX to ACK) < 0.1%  Pr(ACK miss) < 1%  Pr(NACK to ACK) < 0.1%  We can decide it based on the results submitted by all interesting companies. |
| CATT | Prefer option 1 but also can compromise to option 2. Our latest simulation results also justify the observation so option 2 is acceptable to us. |
| MTK | We prefer option 1, but option 2 is also fine for us. |

## 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”* |

# Topic #2: Draft CRs for demodulation test cases

This section will discuss the draft CRs for NR V2X demodulation.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014420 | CATT | CR for PSBCH performance requirements for NR V2X |
| R4-2014780 | MediaTek inc. | Draft CR for PSFCH test cases |

## Open issues summary

### Sub-topic 2-1: Draft CR handling

**Issue 2-1-1: Draft CR handling**

* Proposals from moderator
  + Option 1: collect companies’ comments and postpone all draft CRs to the next meeting
* Recommended WF
  + Postpone all draft CRs to the next meeting based on the email discussion summary in the last meeting

## Companies views’ collection for 1st round

### Open issues

Sub-topic 2-1: Draft CR handling

**Issue 2-1-1: Draft CR handling**

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| **Company** | **Comments** |
| LG | We prefer the moderator’s suggestion.  In the last meeting, following summary was captured in Tdoc for summary 2nd round discussion.   * *As moderator, final confirm for the work split with [ ] will be made in the next meeting. Given the status of this meeting, there are no need to prepare draft CRs in the next meeting.* |
| Intel | We are fine with Option 1 from moderator. |
| Huawei | We are fine with Option 1 from moderator. |
| MTK | We agree with moderator’s suggestion. |
| CATT | Agree with moderator’s suggestion. |

### 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** |
| R4-2014420 | LG : According to Big CR approach, formal CR is not allowed in early stage. Resource pool configuration should be defined. |
| CATT: Agree with moderator’s suggestion. It should be a draft CR. |
| Huawei: 1) Mistakes for title: “CR for 38.101-1: Introduce PSBCH performance requirements for NR V2X” shall be changed to be “CR for 38.101-4: Introduce PSBCH performance requirements for NR V2X”  (2) Mistakes for “Proposed change affects”: The CR should affect “ME”, not Radio Access Network. |
| R4-2014780 | LG : Do we need separate NACK to ACK and DTX to ACK requirements?  Resource pool configuration should be defined. |
| - MTK: we can wait the conclusion of Issue 1-4-1 and then make final decision. |
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## 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** | **Issue 2-1-1: Draft CR handling**  *Tentative agreements: collect companies’ comments and postpone all draft CRs to the next meeting. Companies volunteering for draft CR are encouraged to provide draft CRs in the next meeting.*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### 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** |
| R4-2014420 | Postpone to next meeting |
| R4-2014780 | Postpone to next meeting |

## Discussion on 2nd round (if applicable)

### Continue to collect comments for draft CR/CR

Following Tdocs have been already decided by ”postpone” in 1st round, but based on chairmna’s guidance, please add your commnets if companies have further comments for following draft CR/CR. There will be no summary on 2nd round.

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2014420 | LG : According to Big CR approach, formal CR is not allowed in early stage. Resource pool configuration should be defined. |
| CATT: Agree with moderator’s suggestion. It should be a draft CR. |
| Huawei: 1) Mistakes for title: “CR for 38.101-1: Introduce PSBCH performance requirements for NR V2X” shall be changed to be “CR for 38.101-4: Introduce PSBCH performance requirements for NR V2X”  (2) Mistakes for “Proposed change affects”: The CR should affect “ME”, not Radio Access Network. |
| R4-2014780 | LG : Do we need separate NACK to ACK and DTX to ACK requirements?  Resource pool configuration should be defined. |
| - MTK: we can wait the conclusion of Issue 1-4-1 and then make final decision. |
|  |

## Summary on 2nd round (if applicable)

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

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