**3GPP TSG-RAN WG4 Meeting # 98-e R4-21xxxxx**

**Electronic Meeting, 25 Jan. - 5 Feb., 2021**

**Agenda item:** 7.3.6.1 & 7.3.6.2

**Source:** Moderator (LG Electronics)

**Title:** Email discussion summary for [98e][318] V2X\_Demod\_Part1

**Document for:** Information

# Introduction

This email discussion is for Rel-16 NR V2X demodulation performance for single link in Agenda 7.3.6.1 and 7.3.6.2. For the information, in this meeting, email discussion will focus on finalizing the test cases, and draft CRs will be discussed in Topic#2

List of email discussion for 1st and 2nd round is as follows:

* 1st round:
  + Topic#1 : Test cases for demodulation performance
    - Sub-topic 1-1: Test cases for PSSCH demodulation
    - Sub-topic 1-2: QPSK with 500km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-3: 16QAM with 260km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-4: 64QAM with 30km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-5: PSCCH demodulation
  + Topic#2 : Draft CRs for demodulation test cases
* 2nd round:
  + Topic#1 : test cases for demodulation performance
    - Sub-topic 1-1: Test cases for PSSCH demodulation
    - Sub-topic 1-2: QPSK with 500km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-3: 16QAM with 260km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-4: 64QAM with 30km/h relative velocity for PSSCH demodulation
    - Sub-topic 1-5: PSCCH demodulation
  + Topic#2: Draft CRs and naming of RMC

# Topic #1: Test cases for demodulation performance

This section will treat test cases and test parameters for single link performance requirements. **Simulation results will be collected in the summary spreadsheet during e-meeting**.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100407 | CATT | Proposal 1: Configure 20 PRB for PSSCH with one sub-channel for 30km/h, 260km/h and 500km/h test cases.  Proposal 2: For 260km/h PSSCH test, it is proposed to configure 2 DMRS for slot with PSFCH and 3 DMRS for slot without PSFCH.  Proposal 3: It is proposed to configure PSFCH periodicity as 4 for 500km/h PSSCH test, aimed at getting 4 DMRS tracking capability for higher Doppler shift.  Proposal 4: To verify the performance of 1 periodicity for PSSCH test case, it is proposed to configure PSFCH periodicity as 1 for 30km/h PSSCH test.  Proposal 5: Configure 24bits payload size for PSCCH based on 20PRB sub-channel size  Proposal 6: Do not introduce 256QAM demodulation test case in Rel-16.  Proposal 7: Define performance requirement for gNB based sync test with 1300Hz FO and ±24Ts TO |
| R4-2100409 | CATT, GOHIGH | Simulation results of NR V2X single link demodulation test |
| R4-2100628 | Qualcomm, Inc. | Proposal 1: Use TDL\_B 100ns channel for high speed (500km/h) test.  Proposal 2: PSFCH periodicity is set to 4.  Proposal 3: Introduce 64QAM, 30km/h relative speed test, but do not introduce 16QAM, 260km/h relative speed test.  Proposal 4: For 500km/h high speed test, {4,3} DMRS should be used when {w/o PSFCH, w/ PSFCH} configured. Same for 260km/h if the test is introduced.  Proposal 5: Define the requirement based on subchannel size of 10RB for low speed (30km/h) test.  Proposal 6: 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 7: SCI-1 payload size is set to 26 bits. |
| R4-2100657 | LG Electronics Inc. | Proposal 1: Introduce option 2 (64QAM for 30km/h relative velocity) for additional PSSCH demodulation test  Proposal 2: Focus on discussion of remaining parameters rather than sub-channel size.  Proposal 3: 4 periodicity and {3, 4} DMRS symbols as option 2.  Proposal 4: Consider {3, 4} symbol DMRS configuration under TDLA or TDLB propagation condition to define performance requirements for 500km/h relative velocity test case.  Proposal 5: Use 10 PRB PSSCH allocation for 64QAM under low velocity test  Proposal 6: PSFCH periodicity should be 4.  Proposal 7: Postpone 256QAM demodulation and gNB synchronization based demodulation to the future release. |
| R4-2100658 | LG Electronics Inc. | Proposal: Option 1 is slightly preferred. |
| R4-2100659 | LG Electronics Inc. | Simulation results for PSBCH single link test in NR V2X |
| R4-2100661 | LG Electronics Inc. | Simulation results for PSFCH single link test in NR V2X |
| R4-2101065 | MediaTek inc. | Proposal 1: PSSCH testing configuration with 64QAM for 30km/h relative velocity should be defined.  Proposal 2: Not define 16QAM for 260km/h relative velocity for PSSCH testing configuration.  Proposal 3: 20 PRB resource configuration should be defined for PSSCH test case with 30km/h.  Proposal 4: 20 PRB sub-channel size should be defined for PSSCH testing configuration.  Proposal 5: The PSFCH periodicity is 1 for PSSCH test configuration.  Proposal 6: 3 DMRS symbols are configured for PSSCH test case with 500km/h.  Proposal 7: Not to define 256QAM demodulation for PSSCH test case. |
| R4-2101066 | MediaTek inc. | Simulation results for NR V2X PSBCH |
| R4-2101067 | MediaTek inc. | Simulation results for NR V2X PSCCH test case |
| R4-2101068 | MediaTek inc. | Simulation results for NR V2X PSSCH test case |
| R4-2101232 | Intel Corporation | Proposal 1: Define the following Rel-16 NR V2X single link additional PSSCH requirements for scenarios with GNSS-based sync source: 16QAM with 260km/h relative velocity and 64QAM with 30km/h relative velocity.  Proposal 2: Do not define 256QAM performance requirements for Rel-16 NR V2X.  Proposal 3: Use the following simulation assumptions for Rel-16 V2X PSSCH demodulation requirements with GNSS based synchronization and with 500 km/h relative vehicle speed:  • 10 PRB sub-channel size and number of allocated sub-channels is 2  • TDLA30 channel model  • 2 symbol PSCCH  • PSFCH periodicity = 4 slots  • 2nd stage SCI β = 3.5  Proposal 4: Use the following simulation assumptions for Rel-16 V2X PSSCH demodulation requirements with GNSS based synchronization and with 250 km/h relative vehicle speed:  • 10 PRBs PSSCH allocation  • DMRS pattern {3,4}  • 2nd stage SCI β = 5  Proposal 5: Use the following simulation assumptions for Rel-16 V2X PSSCH demodulation requirements with GNSS based synchronization and with 30 km/h relative vehicle speed:  • 10 PRBs PSSCH allocation  • PSFCH periodicity = 4 slots  • 2nd stage SCI β = 5  Proposal 6: 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 7: 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 8: Define applicability rule for requirements with GNSS based and gNB based sync source in case requirements will be defined for same MCS and speed conditions. |
| R4-2101233 | Intel Corporation | Proposal 1: Define Rel-16 NR V2X single link PSCCH requirements with payload 26 bits. |
| R4-2101235 | Intel Corporation | Simulation results for NR V2X Single Link PSBCH requirements |
| R4-2101236 | Intel Corporation | Simulation results for NR V2X Single Link PSFCH requirements |
| R4-2101352 | Huawei, HiSilicon | Proposal 1: Consider option 1(260 km/h) or option 3 (260km/h and 30km/h) for additional test scenarios.  Proposal 2: Use 10RB sub-channel size for all single-link test cases.  Observation 1:   * For case with 30km/h: Performance with 20RBs allocation has 1.26dB and 0.79dB gain compared to 10RBs allocation respectively for PSFCH periodicity=1 and PSFCH periodicity=4. * For case with 260km/h: Performance with 20RBs allocation has 1.34dB and 0.61dB gain compared to 10RBs allocation respectively for DMRS {3,2} and DMRS {4,3}.   Proposal 3: Use 20RBs allocation for all PSSCH single-link tests.  Observation 2: Performance with DMRS pattern {4,3} has 0.57dB gain compared to DMRS pattern{3,2} for cases with 20RBs allocation  Proposal 4: Use DMRS {3,2} for case with 260km/h.  Observation 3:   * For cases with PSFCH periodicity =4, SNR @ 10% BLER of PSSCH for TDLB is 0.52dB lower than TDLA, * For cases with PSFCH periodicity=1, SNR @ 10% BLER of PSSCH for TDLB is 0.58dB lower than TDLA.   Proposal 5: Use TDLA-30 as propagation condition  Observation 4:   * For test with 30km/h: There is 0.18dB performance difference between scenarios with 1 PSFCH periodicity and 4 PSFCH periodicity for cases with 20RBs allocation. * For test with 500km/h: There is 0.30dB performance difference between scenarios with 1 PSFCH periodicity and 4 PSFCH periodicity for cases with TDLA-30-2700   Proposal 6: Use PSFCH periodicity=4 for all single-link PSSCH tests.  Observation 5:   * For test cases with 500km/h, BLER of SCI stage 2 can be ignored conditioned that betta-offset=3.5 when SNR achieves the point where PSSCH BLER=10%. * For test cases with 30km/h and 260km/h, BLER of SCI stage 2 can be ignored conditioned that betta-offset=5 when SNR achieves the point where PSSCH BLER=10%.   Proposal 7: Use betta-offset=3.5 for test case with 500km/h and betta-offset=5 for test cases with 260km/h and 30km/h.  Proposal 8: Don’t introduce 256QAM requirements  Proposal 9: Don’t introduce gNB based sync requirements. |
| R4-2101353 | Huawei, HiSilicon | Simulation results on PSSCH requirements |
| R4-2101354 | Huawei, HiSilicon | Proposal 1: Use payload size 26 bits for PSCCH test. |
| R4-2101355 | Huawei, HiSilicon | Simulation results on PSBCH performance requirements |
| R4-2101356 | Huawei, HiSilicon | Simulation results on PSFCH performance requirements |

## Open issues summary

### Sub-topic 1-1 : Test cases for PSSCH demodulation

**Issue 1-1-1: Additional test cases based on GNSS sync source**

* Proposals
  + Option 1: 16QAM for 260km/h relative velocity (Huawei)
  + Option 2: 64QAM for 30km/h relative velocity (LG, Qualcomm, MediaTek)
  + Option 3: 16QAM for 260km/h relative velocity and 64QAM for 30km/h relative velocity (Intel, Huawei)
* Recommended WF
  + Need further discussion.

**Issue 1-1-2: Other test cases: 256QAM modulation**

* Proposals:
  + Option 1: Do not define 256QAM demodulation requirements in Rel-16 (Intel, Huawei, LG, MediaTek, CATT)
  + Option 2: Define 256QAM demodulation requirements in Rel-16 (Qualcomm)
* Recommended WF
  + Need further discussion
  + But based on majority views, option 1 is recommended, and continue discussion in future release

**Issue 1-1-3: Other test cases: demodulation based on gNB sync source**

* Proposals:
  + Option 1: Do not define demodulation requirements based on gNB sync source in Rel-16 (Huawei, LG, MediaTek)
  + Option 2: Define demodulation requirements based on gNB sync source with applicability rule (Intel, CATT)
* Recommended WF
  + Need further discussion

### Sub-topic 1-2 : QPSK with 500km/h relative velocity for PSSCH demodulation

**Issue 1-2-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Intel, Huawei, LG)
  + Option 2: 20 PRB sub-channel size and number of allocated sub-channel is 1 (CATT, MediaTek, LG)
* Recommended WF
  + Need further discussion

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

* Proposals:
  + Option 1: 1 PSFCH periodicity (MediaTek)
  + Option 2: 4 PSFCH periodicity (Intel, Huawei, LG, CATT, Qualcomm)
* Recommended WF
  + Need further discussion
  + But based on majority views, option 2 is recommended

**Issue 1-2-3: Propagation condition**

* Proposals:
  + Option 1: TDL-A30 (Intel, Huawei, LG)
  + Option 2: TDL-B100 (LG, Qualcomm)
* Recommended WF
  + Need further discussion

**Issue 1-2-4: 2nd stage SCI β**

* Proposals:
  + Option 1: 3.5 (Intel, Huawei, LG)
* Recommended WF
  + Use option 1 for 2nd stage SCI β

### Sub-topic 1-3 : 16QAM with 260km/h relative velocity for PSSCH demodulation

**Issue 1-3-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRBs PSSCH allocation (Intel)
  + Option 2: 10 PRB sub-channel size and number of allocated sub-channel is 2 (Huawei)
  + Option 3: 20 PRBs PSSCH allocation with single sub-channel size (CATT)
* Recommended WF
  + Need further discussion

**Issue 1-3-2: DMRS pattern**

* Proposals:
  + Option 1: {3,4} DMRS symbols (Intel, Qualcomm)
  + Option 2: {2,3} DMRS symbols (Huawei, CATT)
* Recommended WF
  + Need further discussion

**Issue 1-3-3: 2nd stage SCI β**

* Proposals:
  + Option 1: 3.5 (LG)
  + Option 2: 5 (Huawei, Intel)
* Recommended WF
  + Need further discussion

### Sub-topic 1-4 : 64QAM with 30km/h relative velocity for PSSCH demodulation

**Issue 1-4-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRBs PSSCH allocation (Intel, LG, Qualcomm)
  + Option 2: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Huawei)
  + Option 3: 20 PRBs PSSCH allocation with single sub-channel size (CATT, MediaTek)
* Recommended WF
  + Need further discussion

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

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

**Issue 1-4-3: 2nd stage SCI β**

* Proposals:
  + Option 1: 3.5 (LG)
  + Option 2: 5 (Huawei, Intel)
* Recommended WF
  + Need further discussion

### Sub-topic 1-5 : PSCCH demodulation

**Issue 1-5-1: Payload size**

* Proposals:
  + Option 1: 24 (MediaTek, CATT)
  + Option 2: 26 (Qualcomm, LG, Intel, Huawei)
* Recommended WF
  + Need further discussion

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1: Test case for PSSCH demodulation**

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| **Company** | **Comments** |
| QC | **Issue 1-1-1: Additional test cases based on GNSS sync source**  We support option 2, as we explained in our contribution, proponents of 260km/h test argue that 260km/h is the most typical scenario (as listed in TS 22.186) and therefore should be tested. We agree that the performance of typical scenario is crucial for the system, but RAN4 requirements should be designed to achieve best coverage in terms of scenarios with minimum sets of tests. As explained previously, important functional blocks in demodulation, including channel estimation, LLR calculation and decoder are all verified by low speed with high MCS and high speed with low MCS tests. Therefore, in option 3, if 500km/h and 30km/h tests are passed, we believe that the additional test of 260km/h can be passed without issue, it becomes a redundant test. However, if 260km/h test is chosen instead of 30km/h, highest modulation order is not covered. It is possible that UE passing lower modulation order tests may not have satisfactory performance in higher modulation order, therefore a coverage hole is presented in the V2X demod requirement if option 1 is selected.  **Issue 1-1-2: Other test cases: 256QAM modulation**  We support option 2. In the submitted contributions, companies show concern for SNR range and feasibility under different mobility condition. We agree that 256QAM is not feasible in low SNR or high mobility. However, for many applications, including entertainment, the most likely use case is low speed and short range communication, and this is exactly the scenario that 256QAM transmission might be helpful.  For workload, we also propose compromise to reuse configurations from 30km/h test except MCS set to 20 (lowest for 256QAM).  For use case, since unicast is mandatory supported in NR and is a new NR-V2X functionality, we don’t think it is a “limited use case”, unicast could be quite common in R16 secnario.  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  We support option 1. Since the TO and FO considered in gNB sync source are within pulling range of loops, once loops warn up to correct the offset, UE performance is expected to be the same as the smaller TO/FO cases, therefore, an additional test case is not necessary  For option 2, since GNSS sync is mandatorily supported, the application rule basically excludes all the UEs to be tested by gNB sync source test, therefore no need to introduce a test that no UE can be tested. |
| Huawei, HiSilicon | **Issue 1-1-1: Additional test cases based on GNSS sync source**  From our understanding, 260km/h is very typical velocity for V2X scenarios of vehicles platooning and advanced driving as figured out in TS 22.186. It should be included. As compromise, we are fine with option 3 to cover low, medium and high velocity for V2X.  **Issue 1-1-2: Other test cases: 256QAM modulation**  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 hard to achieve such high in practical scenario. We prefer not define the performance requirements for 256 QAM.  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  gNB as sync source is optional for UE operated on band n47. What’s more, the only difference is larger CFO compared to cases with GNSS based sync, we propose not to define the requirements for gNB based sync. |
| LG | **Issue 1-1-1: Additional test cases based on GNSS sync source**  If 64QAM demodulation under low speed should be verified, additional verification for 16QAM demodulation is not needed. And RAN4 already agreed to introduce QPSK under high speed test, so Option 1 scenario can be covered by other two test scenario. And supporting 64QAM modulation order is mandatory for NR V2X UE.  **Issue 1-1-2: Other test cases: 256QAM modulation**  RAN4 has been discussing 256QAM for a couple of meetings, but there have no further progress. So we suggest to postpone this issue in future release.  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  Similar comments with Issue 1-1-2. We suggest to postpone this issue in future release. |
| MTK | **Issue 1-1-1: Additional test cases based on GNSS sync source**  Support Option 2.  As discussed in our paper, we recommended that the velocity configuration can reuse that of LTE V2X PSSCH (e.g., 30km/h and 500km/h) and the medium velocity (e.g., 260km/h) can be defined in PSCCH test case as agreed in previous RAN4 meeting.  **Issue 1-1-2: Other test cases: 256QAM modulation**  Support Option 1.  We have the similar view with HW. Besides, 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 1-1-3: Other test cases: demodulation based on gNB sync source**  Support option 1.  Considering the gNB based sync source is an optional feature and no big difference with GNSS based sync except little CFO difference from Demod perspective, we suggest not to define this test case. |
| CATT | **Issue 1-1-1: Additional test cases based on GNSS sync source**  Prefer option 3 and option 2 is also acceptable to us. The higher modulation order, i.e. 64QAM, should be tested. V2X UE passing lower modulation order test cannot guarantee higher modulation order demodulation performance.  **Issue 1-1-2: Other test cases: 256QAM modulation**  We still think 256QAM is optional feature that is not practical in real implementation. This test should be postponed based on the majority views.  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  Prefer option 2. The sync source for partially used SL operation with Uu in licensed band was discussed in Rel-16 V2X RF session. Many companies proposed network as sync reference source. This issue was postponed and is being discussing in Rel-17 V2X RF session. From this perspective, gNB based sync case should be considered as common scenario for V2X. However, we can compromise to option 1 if companies have concern on the workload. |
| Intel | **Issue 1-1-1: Additional test cases based on GNSS sync source**  Support Option 3. Usually, demodulation requirements try to cover different mandatory modulation formats to have sufficient covarage. Also, different modulations are considered for different speed conditions. Therefore, it will be rather beneficial to verify operation of 64QAM in low speed conditions and 16QAM in medium speed conditions. From LTE V2X requirements, we can observe that all modulation orders are covered: QPSK, 16QAM and 64QAM.  **Issue 1-1-2: Other test cases: 256QAM modulation**  Support Option 1, because this feature will be applicable mainly for unicast transmission in case both Tx UE and Rx UE are capable to process this modulation format. Therefore, the use case can be quite limited.  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  Support Option 2, because, based on our understanding, gNB based sync source is mandatory for concurrent operation, which one of the typical V2X scenarios. If requirements will not be defined for scenarios with gNB based sync source (where CFO and TO is higher than for scenarios with GNSS sync source) then we can guaranty reliable demodulation processing for scenarios with concurrent operation. |

**Sub-topic 1-2: QPSK with 500km/h relative velocity for PSSCH demodulation**

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| **Company** | **Comments** |
| QC | **Issue 1-2-1: PSSCH PRB sub-channel size**  Both options are OK for us  **Issue 1-2-2: PSFCH periodicity**  We support option 2. MediaTek provides the following argument to support option 1:  *The PSSCH in slot n, n+1 and n+2 all need to feed back in PSFCH within slot n+5, it may cause resource collision, power sharing and increase the feedback delay.*  Feedback delay certain is not an issue for demod test. It’s not obvious to us how resource collision and power sharing could be an issue, given that this is a single link test.  For CATT’s concern on performance of PSFCH periodicity 1 to be verified, note that PSFCH is also presented in periodicity 4 cases, its performance is the average across with PSFCH (1 out of 4) and without PSFCH (3 out of 4), hence whatever verified by PSFCH periodicity 1 is also verified in PSFCH periodicity 4  **Issue 1-2-3: Propagation condition**  We support option 2. From simulation results submitted by companies, many of them show error floor above 2% in TDL-A. As we explained in our contribution, additional frequency error introduced by FTL is the main contributor to the error floor. Note that additional margin on top of alignment results to account for implementation and RF impairment is needed both for SNR requirement and error floor. As the frequency error could be introduced, RF impairment impact is expected to be larger in this case. Therefore, TDL-B is a better option for propagation condition.  Note that EVA is used in LTE demod requirement, instead of EPA. EVA delay spread is closer to TDL-B 100ns than TDL-A 30ns, therefore, since LTE requirement can serve as baseline, it is reasonable to choose TDL-B 100ns for high speed test.  To moderator: the option is TDL-B 100ns instead of TDL-B 30ns.  **Issue 1-2-4: 2nd stage SCI β**  We are fine with option 1 |
| Huawei, HiSilicon | **Issue 1-2-1: PSSCH PRB sub-channel size**  From the perspective of resource utilization for 51RBs (20MHz bandwidth and 30 kHz SCS), 10 PRB sub-channel size is more feasible. At the same time, 10 RB sub-channel size is the smallest granularity and can be used for most test cases.  **Issue 1-2-2: PSFCH periodicity**  Based on our simulation results, small performance difference for different PSFCH periodicity can be observed. From the perspective of resource utilization, PSFCH periodicity 4 is more feasible. PSFCH periodicity 4 configuration includes both slot with and without PSFCH and the slot with PSFCH cover PSFCH periodicity 1, so PSFCH periodicity 4 configuration has larger test coverage.  The specific mapping principle between PSSCH and corresponding PSFCH is clearly defined in the core specification, we do not think there are any resource collision and power sharing will happen.  **Issue 1-2-3: Propagation condition**  Option 1. From our simulation results, the SNR@10 % BLER with TDLA is achievable. It is unrealistic to have large Doppler spread and time delay at the same time. Also TDLA is used by all other cases, so we think that it is feasible for case with 500km/h velocity.  **Issue 1-2-4: 2nd stage SCI β**  OK with recommended WF. |
| LG | **Issue 1-2-1: PSSCH PRB sub-channel size**  We don’t have strong view on this issue since there is no performance difference for both options.  **Issue 1-2-2: PSFCH periodicity**  Support option 2. Different DMRS patterns with 4 PSFCH periodicity should be verified and there is no any technical issues such as power sharing, feedback delay, and resource collision to test using 4 PSFCH periodicity.  **Issue 1-2-3: Propagation condition**  There is no performance issue for TDL-A30. We don’t have strong view on this issue.  To Qualcomm,  Thanks for checking. I revised it.  **Issue 1-2-4: 2nd stage SCI β**  Support recommended WF. |
| MTK | **Issue 1-2-1: PSSCH PRB sub-channel size**  We slightly prefer option 2. But, option 1 is also fine for us.  **Issue 1-2-2: PSFCH periodicity**  From our perspective, compared with PSFCH periodicity 4 configuration, PSFCH periodicity 1 configuration can ensure enough feedback resource and also can offer unifier DMRS pattern for test configuration. But, considering the RAN4 NR V2X Demod meeting progress, we can compromise to support 500km/h case with PSFCH periodicity 4 for making progress.  **Issue 1-2-3: Propagation condition**  Support Option 1.  From our simulation results, there is also no performance issues as QC mentioned. We suggest that configuring the unified channel model as earlier agreed.  **Issue 1-2-4: 2nd stage SCI β**  Support recommended WF. |
| CATT | **Issue 1-2-1: PSSCH PRB sub-channel size**  Prefer option 2. Based on the simulation results, there is no performance difference between option 1 and option 2. As we discussed in the last meeting, If PSSCH DMRS and PSCCH are mapped to the same symbol and different sub-channels, the sub-channel size can be smaller than 20 PRB, e.g. 10 PRB. In spite of this, the case that PSSCH DMRS and PSCCH are mapped to the same symbol and same sub-channel should be avoided when the sub-channel size is configured as 10 PRB. This adversely impacts the flexibility of PSSCH DMRS and PSCCH allocation in some certain cases.  **Issue 1-2-2: PSFCH periodicity**  Prefer option 2. The highest frequency shift tracking capability should be enabled for 500km/h test case. 4 PSFCH periodicity allows configure 4 DMRS in slot without PSFCH to track much higher Doppler shift.  **Issue 1-2-3: Propagation condition**  We don’t have strong view on this issue.  **Issue 1-2-4: 2nd stage SCI β**  Support the recommended WF. |
| Intel | **Issue 1-2-1: PSSCH PRB sub-channel size**  Support Option 1.  Usually demodulation requirements are defined for typical/practical scenarios which potentially can be observed in real filed. Based on our understanding, the most typical sub-channel configuration for 20 MHz CBW and 30 kHz SCS is 5 sub-channels of size 10 PRBs which allows to achieve efficient resource utilization and flexible scheduling.  In the previous meeting, there was concern about DMRS mapping for Option 1 and Option 2. In our paper we provide the reference to RAN1 e-mail discussion, from which it is clear that DMRS mapping is same for Option 1 and Option 2. Therefore, from demodulation point of view, these scenarios are identical  **Issue 1-2-2: PSFCH periodicity**  Support Option 2, because it allows to verify correct Rx processing for slots with and without PSFCH in single test.  **Issue 1-2-3: Propagation condition**  Support Option 1. Based on our results, we have sufficient margin between 10^-1 and error floor for TDL-A channel.  **Issue 1-2-4: 2nd stage SCI β**  Support recommended WF. |

**Sub-topic 1-3: 16QAM with 260km/h relative velocity for PSSCH demodulation**

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| **Company** | **Comments** |
| QC | **Issue 1-3-1: PSSCH PRB sub-channel size**  Both option 2 and 3 are fine for us. Option 1 doesn’t provide UE enough DMRS to configure, not suitable for such speed (260km/h).  **Issue 1-3-2: DMRS pattern**  We now support option 2. After checking other companies’ contribution and with additional internal study, we find that {2,3} DMRS symbols actually achieves better throughput. Therefore, if this test is introduced, {2,3} DMRS should be the correct configuration.  **Issue 1-3-3: 2nd stage SCI β**  We slightly prefer option 2 since current simulation is based on option 2. |
| Huawei, HiSilicon | **Issue 1-3-1: PSSCH PRB sub-channel size**  Option 2.  Based our simulation results, UE configured with 20RBs allocation has more samples for CFO estimation and has better performance than 10RBs allocation, therefore 20RBs allocation is feasible for PSSCH single link test.  But 10RBs allocation is the scenario that PSCCH TDM with PSSCH which has the same channel structure as NR Uu and it has been tested in Rel-15. The only big difference for NR V2X is PSSCH DMRS FDMed with PSCCH and we should consider to test.  **Issue 1-3-2: DMRS pattern**  Option 2  UE selects DMRS pattern from resource pool according to the channel conditions, based on our simulation results, the performance difference by using DMRS {3, 2} and DMRS {3, 4} are very limited, but DMRS {3, 4} has higher overhead. It is not necessary to configure the DMRS pattern with the most number of DMRS symbols for 260km/h velocity to achieve similar performance. Moreover, DMRS {4, 3} configuration can be verified in scenario with 500km/h if PSFCH periodicity 4 is agreed.  **Issue 1-3-3: 2nd stage SCI β**  Option 2.  To void the impact of 2nd stage SCI to PSSCH performance during the testing, based on our simulation results, the BLER of SCI stage 2 is very low with betta-offset=5 at SNR for PSSCH BLER=10%. |
| LG | **Issue 1-3-1: PSSCH PRB sub-channel size**  Prefer option 2 or option 3 if this test is introduced.  **Issue 1-3-2: DMRS pattern**  Both options are fine for us.  **Issue 1-3-3: 2nd stage SCI β**  Option 2 is fine for us |
| CATT | **Issue 1-3-1: PSSCH PRB sub-channel size**  Prefer option 2.  For PSSCH demodulation performance, 20RB allocation outperforms 10RB allocation. So 20RB allocation is preferred. From the link level simulation results, no performance difference can be observed between option 2 and option 3. For option 3, smaller sub-channel size possibly lead to more blink detection of PSCCH. Also, we would like to align the PRB allocation and sub-channel size for PSSCH demodulation test cases.  **Issue 1-3-2: DMRS pattern**  Prefer option 2. {2, 3} DMRS can satisfy the demodulation performance for 260km/h. Also, {2,3} DMRS has smaller overhead compared to {3, 4} DMRS.  **Issue 1-3-3: 2nd stage SCI β**  Option 2 is OK with us. |
| Intel | **Issue 1-3-1: PSSCH PRB sub-channel size**  Option 1 or Option 2 is fine for us. Slightly prefer Option 1. 20 PRB allocation was proposed for high speed scenarios due to issue with error floor. Same time, based on our analysis, 16QAM performance with 10 PRB allocation looks fine and this configuration can be used.  **Issue 1-3-2: DMRS pattern**  Support Option 1. Based on our analysis DMRS pattern {3,4} allows to achieve better performance.  **Issue 1-3-3: 2nd stage SCI β**  Prefer Option 2, because in the previous meeting only this option was listed in WF and we’ve checked only this configuration for this meeting. First, we need some time to check Option 1 if there is strong concern from other companies to use Option 2. |

**Sub-topic 1-4: 64QAM with 30km/h relative velocity for PSSCH demodulation**

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| **Company** | **Comments** |
| QC | **Issue 1-4-1: PSSCH PRB sub-channel size**  We support option 1. 10RB is the most common use case and also performance bottleneck, it should be considered as default setting for demod test, especially 30km/h which is typical urban scenario where more cars are communicating. Higher speed cases use 20RB because they require more DMRS, but this is not necessary for lower speed settings.  Note that the argument of “most common case” can use for selecting configuration, but not introducing additional test, while the performance is verified by other tests.  **Issue 1-4-2: PSFCH periodicity**  Same comment as 1-2-2.  **Issue 1-4-3: 2nd stage SCI β**  Same comment as 1-3-3. |
| Huawei, HiSilicon | **Issue 1-4-1: PSSCH PRB sub-channel size**  Option 2.  To unify the test configuration, it is better to use the same configurations across test cases.  **Issue 1-4-2: PSFCH periodicity**  Same comments on 1-2-2.  **Issue 1-4-3: 2nd stage SCI β**  Same comments as 1-3-3. |
| LG | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support option 1. For demodulation performance, different PRB allocation is suitable for test coverage.  **Issue 1-4-2: PSFCH periodicity**  Support option 2. Similar comments with Issue 1-2-2.  **Issue 1-4-3: 2nd stage SCI β**  We are fine with option 2. |
| MTK | **Issue 1-4-1: PSSCH PRB sub-channel size**  Option 2 and Option 3 is ok with us.  As discussed in our contribution, in order to unify the test configuration, we prefer the PSSCH resource allocation keep aligned for different velocity configuration. Besides, the typical V2X data packet is about 200 byte, 10 PRB resource may be not reasonable for PSSCH test case. About the sub-channel size, we are open for 10PRB or 20PRB as mentioned above.  **Issue 1-4-2: PSFCH periodicity**  We have already compromised that PSFCH periodicity 4 can be configured for 500km/h case. As QC mentioned, 30km/h is typical urban scenario where more cars are communicating and need more resource to feedback. Thus, we still want to keep the PSFCH periodicity 1 for test coverage and ensure feedback resource.  **Issue 1-4-3: 2nd stage SCI β**  Option 2 is fine for us. |
| LG | **To MTK,**  For PSFCH, I’m not sure that PSFCH periodicity 1 provides test coverage and feedback resources in in the single link test cases. For the test coverage, more DRMS patterns using PSFCH periodicity 4 can be verified. And we can use PSFCH periodicity 1 for feedback resource issue in multiple link tests. |
| CATT | **Issue 1-4-1: PSSCH PRB sub-channel size**  Option 3. The PSSCH PRB sub-channel size should be aligned across three PSSCH test cases.  **Issue 1-4-2: PSFCH periodicity**  Option 1. Based on the simulation results, no obvious performance difference could be observed between 1 periodicity and 4 periodicity of PSFCH. We propose option 1 to increase the test coverage and to verify the performance of 1 periodicity for PSSCH test case. However, we could compromise to option 2 if 4 PSFCH periodicity will be introduced for 500km/h and 260km/h test cases.  **Issue 1-4-3: 2nd stage SCI β**  Option 2 is OK with us. |
| Intel | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support Option 1 to consider different frequency allocation configuration in comparison to other tests.  **Issue 1-4-2: PSFCH periodicity**  Support Option 2 to have same PSFCH configuration for all tests and verify correct Rx processing for slots with and without PSFCH.  **Issue 1-4-3: 2nd stage SCI β**  Support Option 2. Same comment as for Issue 1-3-3. |

**Sub-topic 1-5: PSCCH demodulation**

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| **Company** | **Comments** |
| QC | **Issue 1-5-1: Payload size**  We support option 2. 10RB subchannel size can cover 10RB and 20RB allocation scenarios, while 20RB subchannel size can only cover 20RB allocation scenario. Hence 10RB is more flexible and should be considered for CCH test. |
| Huawei, HiSilicon | **Issue 1-5-1: Payload size**  Option 2, based on our proposal to use 10RBs sub-channel size. |
| LG | **Issue 1-5-1: Payload size**  Support option 2. |
| MTK | **Issue 1-5-1: Payload size**  It depends on the sub-channel size configuration. As commented in **Issue 1-2-1,** 10 PRB sub-cannel size is also fine for us, so, the option 2 with 26 bits size are also ok with us. |
| CATT | **Issue 1-5-1: Payload size**  Prefer option 1 as our proposal for 20 sub-channel size. |
| Intel | **Issue 1-5-1: Payload size**  Support Option 2, because it corresponds to more typical sub-channel configuration for scenarios with 20 MHz CBW and 30 kHz SCS. |

### 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(Test case for PSSCH)** | **Issue 1-1-1: Additional test cases based on GNSS sync source**  *Tentative agreements: Based on GTW decision, two options will be handled in second round discussion.*  *Candidate options:*   * *Option 1: 64QAM for 30km/h relative velocity (LG, Qualcomm, MediaTek, CATT)* * *Option 2: 16QAM for 260km/h relative velocity and 64QAM for 30km/h relative velocity (Intel, Huawei, CATT)*   *Recommendations for 2nd round: One option should be selected in this meeting.*  **Issue 1-1-2: Other test cases: 256QAM modulation**  *Tentative agreements: Based on GTW decision, 256QAM is not introduced in Rel-16. Considering RAN4 work load and time limitation in Rel-16, RAN4 can further discuss and define corresponding requirements if needed in Rel-17 timeframe i.e. Rel-17 side-link enhancement WI.*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A*  **Issue 1-1-3: Other test cases: demodulation based on gNB sync source**  *Tentative agreements: Based on GTW decision, gNB sync source based test is not introduced in Rel-16. Considering RAN4 work load and time limitation in Rel-16, RAN4 can further discuss and define corresponding requirements if needed in Rel-17 timeframe i.e. Rel-17 side-link enhancement WI.*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |
| **Sub-topic#1-2(QPSK+500km/h)** | **Issue 1-2-1: PSSCH PRB sub-channel size**  *Tentative agreements: Need further discussion but majority view based on companies’ comments is that 10RB subchannel size and number of allocated is 2 as option 1*  *Candidate options:*   * *Option 1: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Intel, Huawei, LG, Qualcomm, MediaTek)* * *Option 2: 20 PRB sub-channel size and number of allocated sub-channel is 1 (CATT, MediaTek, LG, Qualcomm)*   *Recommendations for 2nd round: select one option and confirm whether option 1 is agreeable*  **Issue 1-2-2: PSFCH periodicity**  *Tentative agreements: Based on companies’ comments, 4 PSFCH periodicity as option 2 is agreeable.*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A*  **Issue 1-2-3: Propagation condition**  *Tentative agreements: Need further discussion but majority view based on companies’ comments is TDL-A30 as option 1*  *Candidate options:*   * *Option 1: TDL-A30 (Intel, Huawei, LG, MediaTek)* * *Option 2: TDL-B100 (LG, Qualcomm)*   *Recommendations for 2nd round: select one option and confirm whether option 1 is agreeable*  **Issue 1-2-4: 2nd stage SCI β**  *Tentative agreements: value of 2nd stage SCI beta is 3.5*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |
| **Sub-topic#1-3(16QAM+260km/h)** | **Issue 1-3-1: PSSCH PRB sub-channel size**  *Tentative agreements: Need further discussion but based on companies’ comments, two option will be handled in second round discussion.*  *Candidate options:*   * *Option 1: 10 PRB sub-channel size and number of allocated sub-channel is 2 (Huawei, Qualcomm, LG, Intel, CATT(?))* * *Option 2: 20 PRBs PSSCH allocation with single sub-channel size (CATT, Qualcomm, LG)*   *Recommendations for 2nd round: select one option and confirm whether option 1 is agreeable based on majority view.*  **Issue 1-3-2: DMRS pattern**  *Tentative agreements: Need further discussion but majority view based on companies’ comments is {2,3} DMRS symbol as option 2.*  *Candidate options:*   * *Option 1: {3,4} DMRS symbols (Intel, Qualcomm, LG)* * *Option 2: {2,3} DMRS symbols (Huawei, CATT, Qualcomm, LG)*   *Recommendations for 2nd round: select one option and confirm whether option 2 is agreeable*  **Issue 1-3-3: 2nd stage SCI β**  *Tentative agreements: value of 2nd stage SCI beta is 5*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |
| **Sub-topic#1-4(64QAM+30km/h)** | **Issue 1-4-1: PSSCH PRB sub-channel size**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 10 PRBs PSSCH allocation (Intel, LG, Qualcomm)* * *Option 2: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Huawei, MediaTek)* * *Option 3: 20 PRBs PSSCH allocation with single sub-channel size (CATT, MediaTek)*   *Recommendations for 2nd round: select one option*  **Issue 1-4-2: PSFCH periodicity**  *Tentative agreements: Need further discussion*  *Candidate options:*   * *Option 1: 1 periodicity (CATT, MediaTek)* * *Option 2: 4 periodicity (Intel, Huawei, LG, Qualcomm)*   *Recommendations for 2nd round: select one option*  **Issue 1-4-3: 2nd stage SCI β**  *Tentative agreements: value of 2nd stage SCI beta is 5*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |
| **Sub-topic#1-5(PSCCH)** | **Issue 1-5-1: Payload size**  *Tentative agreements: Need further discussion but majority view based on companies’ comments is 26bit payload size as option 2.*  *Candidate options:*   * *Option 1: 24 (MediaTek, CATT)* * *Option 2: 26 (Qualcomm, LG, Intel, Huawei, MediaTek)*   *Recommendations for 2nd round: select one option and confirm whether option 2 is agreeable* |

*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 | Summary of simulation results for V2X single link demodulation | LG Electronics |
| #3 | Updated simulation assumption for NR V2X single link test cases | 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 : Test cases for PSSCH demodulation

**Issue 1-1: Additional test cases based on GNSS sync source**

* Proposals
  + Option 1: 64QAM for 30km/h relative velocity (LG, Qualcomm, MediaTek, CATT)
  + Option 2: 16QAM for 260km/h relative velocity and 64QAM for 30km/h relative velocity (Intel, Huawei, CATT)
* Recommended WF
  + Need further discussion and one option should be selected in this meeting

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| **Company** | **Comments** |
| LG | As mentioned by some companies in 1st round, if a UE pass the QPSK with high velocity and 64QAM with low velocity tests, we can assume that 16QAM with medium velocity can verified without separated test. Even if 16QAM is typical scenario, additional 16QAM test is unnecessary in terms of RAN4 minimum performance requirements. |
| Huawei | We still prefer Option 2.  260km/h is the most typical velocity for NR V2X UE in the real scenario and the corresponding performance requirements should be guaranteed. Without verification on the related performance requirements, we cannot assume that UE can meet the performance for 16QAM with medium velocity, the verification should be based on the real testing instead of assumptions derived from other test cases.  We have different views from company that argues the important demodulation function block of channel estimations for medium velocity can be covered by higher velocity of 500km/h for NR V2X UE. In LTE V2V, we agree that the case with 500km/h can represent the maximum channel estimation capability of tested UE since the number of symbol for DMRS designed for LTE V2V PSSCH is fixed 4. While in NR V2X, the DMRS pattern is configurable, UE can be configured with different DMRS patterns to handle different scenarios, based on our evaluations, different DMRS patterns can be configured for scenario with velocity of 500km/h and 260km/h taking into account both the performance and overhead, so we cannot simply assume the verification of performance for medium velocity can be derived based on the performance for higher velocity 500km/h, i.e. the test coverage for medium velocity 260km/h cannot be guaranteed without corresponding performance requirements definition.  For the argument from some companies that think scenario with 260km/h can be covered in PSCCH test. From our understanding, DMRS is transmitted in every PSCCH symbol, Doppler shouldn’t be the bottleneck of performance for PSCCH, while Doppler is a key factor affecting performance for PSSCH since the DMRS symbols interval is larger and is different for different DMRS patterns. Therefore, we think that the performance of PSSCH with 260km/h velocity cannot be guaranteed and verified by PSCCH. |
| Intel | Support Option 2, because it does not have big impact on testing. It will be just one additional test which does not require long testing time. Same time, introduction of test with 16QAM and 260 km/h allows to verify performance for typical modulation order and typical speed conditions. We also can not guaranty that if UE passes test with low speed and high modulation and test with high speed and low modulation then UE passes test with medium modulation and medium speed. In test with high speed we consider QPSK modulation which is rather robust to certain inaccuracy in channel estimation. Same time, if UE has inaccuracy in channel estimation then it will be more visible for higher order modulation (i.e. 16QAM), which is more sensitive. Therefore, we think that test 16QAM and 260 km/h should be introduced to ensure reliable UE performance for any conditions. Same time, introduction of this test does not affect WI timelines, because simulation assumptions are rather completed and several companies already did simulations for this scenario.  -------------- 02-02-21 -------------------  If companies have concern on number of tests, then we suggest to define one test with 260 km/h velocity and 64QAM modulation. In case UE passes this test, we can guaranty that UE will pass the test with 260 km/h and 16QAM and will pass the test with 30 km/h and 64QAM. Configuration for test with 260 km/h and 64QAM, potentially, can be reused from discussion for test with 260 km/h and 16QAM.  -------------- 03-02-21 -------------------  We proposed scenario with 260 km/h and 64QAM as compromise option between Option 1 and Option 2. Same time, is we can reach consensus on Option 2, then it will be perfectly fine for us. |
| CATT | OK with both options. |
| MTK | Support Option 1.  As we discussed in 1st round, we think 500km/h with QPSK and 30km/h with 64QAM are enough for PSSCH test case. Actually, in these two cases, we have defined multiple DMRS patterns (e.g., 2/3/4 DMRS symbols). The DMRS pattern test coverages are enough. The medium velocity with medium modulation order is not necessary. |
| QC | Originally, we support [3,4] DMRS pattern for 260km/h test, but as we commented in first round, we can support [2,3] DMRS pattern for 260km/h test, since we found that the throughput is higher. Given this opinion, now we have  500km/h: [3,4] DMRS  260km/h: [2,3] DMRS  30km/h: [2,2] DMRS  This set provide a complete coverage for DMRS configuration with different corresponding speeds, therefore, with [2,3] DMRS configured for 260km/h test, we can support this test case.  We also want to clarify that our understanding is for modulation order, it’s enough to test the highest one only, since LLR/decoder configuration in general is common across all the modulation orders. But channel estimation corresponding to different DMRS configuration and speed might be slightly different and worth to test. |
| Huawei | We think that verification of the important demodulation function of channel estimation by configuring different DMRS pattern and channel model with different Doppler should be guaranteed by defining the corresponding performance requirements, otherwise, the test coverage cannot be ensured. Also like indicated by Intel, the simulation assumptions and even the simulation results are almost ready, the workload is not an issue to worry about.  The DMRS pattern for different scenarios as listed by Qualcomm can provide good test coverage for this WI.  500km/h: [3,4] DMRS  260km/h: [2,3] DMRS  30km/h: [2,2] DMRS  For the modulation order 16QAM, our intention is firstly to ensure the test coverage of different velocity and DMRS pattern to cover the important and more practical velocity 260km/h for V2X that almost all companies acknowledged this typical velocity scenario for vehicles platooning and advanced driving as figured out in TS 22.186 as per the previous discussions. To match such velocity scenario, medium modulation order 16QAM is the best choice.  For the proposal from Intel to define new case of 260km/h with 64QAM, additional evaluations need to be conducted, such as to choose proper Beta offset value and the suitable MCS etc., considering the work progress and no technical issues figured for the current configurations for 260km/h, we prefer to keep it and not introduce additional workload to justify other cases. |

### Sub-topic 1-2 : QPSK with 500km/h relative velocity for PSSCH demodulation

**Issue 1-2-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Intel, Huawei, LG, Qualcomm, MediaTek)
  + Option 2: 20 PRB sub-channel size and number of allocated sub-channel is 1 (CATT, MediaTek, LG, Qualcomm)
* Recommended WF
  + One option should be selected in this meeting
  + Majority view is option 1 and confirm whether option 1 is agreeable

**Issue 1-2-2: Propagation condition**

* Proposals:
  + Option 1: TDL-A30 (Intel, Huawei, LG, MediaTek)
  + Option 2: TDL-B100 (LG, Qualcomm)
* Recommended WF
  + One option should be selected in this meeting
  + Majority view is option 1 and confirm whether option 1 is agreeable

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| **Company** | **Comments** |
| LG | **Issue 1-2-1: PSSCH PRB sub-channel size**  Based on recommended WF, we support option 1.  **Issue 1-2-2: Propagation condition**  Based on recommended WF, we support option 1. |
| Huawei | **Issue 1-2-1: PSSCH PRB sub-channel size**  We support the recommended WF, i.e. Option 1.  Based on our previous analysis, there is no difference for DMRS pattern between two options. 10 RBs subchannel size has the smallest granularity and UE has the flexibility to reserve multiple subchannels to transmit PSSCH/PSCCH according to TS 38.212.  **Issue 1-2-2: Propagation condition**  Support the recommended WF, i.e. Option 1.  From our simulation results, SNR@10% of BLER for TDLA is achievable and feasible for the performance requirements definition for velocity 500km/h. |
| QC | **Issue 1-2-1: PSSCH PRB sub-channel size**  Based on recommended WF, we support option 1.  **Issue 1-2-2: Propagation condition**  We are open to discuss both options, but the concerns we posed in first round haven’t been addressed: we understand that all the alignment results from companies can achieve 10^-1 with TDL-A 30ns, even our results show that error floor is below 10^-1 BLER, but with the implementation margin taken into consideration, the error floor in multiple companies’ results can go over 10^-1. From the arguments and results provided in the first round, TDL-B 100ns is a safer option. |
| Intel | **Issue 1-2-1: PSSCH PRB sub-channel size**  Support Option 1. Same comments as in the first round.  **Issue 1-2-2: Propagation condition**  Support Option 1. Based on our understanding, implementation margin will have mainly impact on SNR operating point and we don’t expect big impact on error floor which mainly cause by inaccuracy in baseband processing (CFO estimation and channel estimation). |
| CATT | **Issue 1-2-1: PSSCH PRB sub-channel size**  We can compromise to the recommended WF considering no performance difference observed between two options  **Issue 1-2-2: Propagation condition**  Support option 1. |
| MTK | **Issue 1-2-1: PSSCH PRB sub-channel size**  Option 1 and Option 2 are ok with us, we support recommended WF.  **Issue 1-2-2: Propagation condition**  Support Recommended WF. |

### Sub-topic 1-3 : 16QAM with 260km/h relative velocity for PSSCH demodulation

These issues depends on conclusion of Issue 1-1.

**Issue 1-3-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRB sub-channel size and number of allocated sub-channel is 2 (Huawei, Qualcomm, LG, Intel, CATT(?))
  + Option 2: 20 PRBs PSSCH allocation with single sub-channel size (CATT, Qualcomm, LG)
* Recommended WF
  + One option should be selected in this meeting depending on conclusion of Issue 1-1
  + Majority view is option 1 and confirm whether option 1 is agreeable

**Issue 1-3-2: DMRS pattern**

* Proposals:
  + Option 1: {3,4} DMRS symbols (Intel, Qualcomm, LG)
  + Option 2: {2,3} DMRS symbols (Huawei, CATT, Qualcomm, LG)
* Recommended WF
  + One option should be selected in this meeting depending on conclusion of Issue 1-1
  + Majority view is option 2 and confirm whether option 2 is agreeable

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| **Company** | **Comments** |
| LG | **Issue 1-3-1: PSSCH PRB sub-channel size**  Based on recommended WF, we support option 1.  **Issue 1-3-2: DMRS pattern**  Based on recommended WF, we support option 2. |
| Huawei | **Issue 1-3-1: PSSCH PRB sub-channel size**  Support Option1  Similar views as Issue 1-2-1.  **Issue 1-3-2: DMRS pattern**  Support Option 2.  From companies’ simulation results, the performance difference is less than 1dB for DMRS pattern {3,4} compared to DMRS pattern{2,3}.It is not necessary to increase the DMRS overhead only for very limited performance gain. What’s more, DMRS pattern {3, 4} has been verified in test case for velocity 500km/h and doesn’t need to be reconsidered in case for medium velocity test. |
| QC | **Issue 1-3-1: PSSCH PRB sub-channel size**  Based on recommended WF, we support option 1.  **Issue 1-3-2: DMRS pattern**  Based on recommended WF, we support option 2. |
| Intel | **Issue 1-3-1: PSSCH PRB sub-channel size**  Support Option 1  **Issue 1-3-2: DMRS pattern**  Option 2 is fine for us. |
| CATT | **Issue 1-3-1: PSSCH PRB sub-channel size**  Support option 1 to align with 500km/h test case.  **Issue 1-3-2: DMRS pattern**  Based on recommended WF, we support option 2. |

### Sub-topic 1-4 : 64QAM with 30km/h relative velocity for PSSCH demodulation

**Issue 1-4-1: PSSCH PRB sub-channel size**

* Proposals:
  + Option 1: 10 PRBs PSSCH allocation (Intel, LG, Qualcomm)
  + Option 2: 10 PRB sub-channel size and number of allocated sub-channels is 2 (Huawei, MediaTek)
  + Option 3: 20 PRBs PSSCH allocation with single sub-channel size (CATT, MediaTek)
* Recommended WF
  + Need further discussion and one option should be selected in this meeting

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

* Proposals:
  + Option 1: 1 periodicity (CATT, MediaTek)
  + Option 2: 4 periodicity (Intel, Huawei, LG, Qualcomm)
* Recommended WF
  + Need further discussion and one option should be selected in this meeting

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| **Company** | **Comments** |
| LG | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support option 1. To define minimum performance requirements, it is better to configure various PSSCH PRB number as much as possible. In LTE V2X, different allocated RBs had been configured depending on modulation order; 8 PRBs for 64QAM and 3 PRBs for QPSK. In NR V2X, we already agreed 20 PRBs for QPSK test, so 10 PRBs configuration for 64QAM test is preferred.  **Issue 1-4-2: PSFCH periodicity**  Support option 2. For the test coverage, different DRMS patterns (symbols) using PSFCH periodicity 4 can be verified. And we can use PSFCH periodicity 1 for feedback resource issue in multiple link tests. |
| Huawei | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support Option 2. We prefer to use the same PRBs allocation for all PSSCH single-link tests.  **Issue 1-4-2: PSFCH periodicity**  Support Option 2. Based on our simulation results, small performance difference for different PSFCH periodicity can be observed. From the perspective of resource utilization, PSFCH periodicity 4 is more feasible. PSFCH periodicity 4 configuration includes both slot with and without PSFCH and the slot with PSFCH cover PSFCH periodicity 1, so PSFCH periodicity 4 configuration has larger test coverage. |
| QC | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support option 1. Given that we already have 10RB allocation for multiple-link tests, we don’t think keep all single-link test with the same number of RB reduces test setup complexity. As we showed in our contribution, 10RB is the performance bottleneck for low speed due to less RSRE available in frequency domain, and it is the most common allocation in low speed, crowded scenario.  **Issue 1-4-2: PSFCH periodicity**  Support option 2. We don’t see any benefit or periodicity 1, hence follow other PSSCH single link test configuration is preferred. |
| Intel | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support Option 1. Based on our understanding, 20 PRBs allocation is considered for other scenarios, to resolve issue with error floor. Same time, such issue does not exist for low speed conditions. Same time, LTE V2X single link requirements are defined for different PSSCH allocations and we can consider same approach for NR requirements.  **Issue 1-4-2: PSFCH periodicity**  Support Option 2. Same comments as LG, Huawei and Qualcomm. |
| CATT | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support option 2 to align sub-channel size for all PSSCH test cases.  **Issue 1-4-2: PSFCH periodicity**  We can accept option 1 considering 1 PSFCH periodicity is used in multiple link test cases. |
| MTK | **Issue 1-4-1: PSSCH PRB sub-channel size**  Support option 2.  We slightly suggest to keep the same PSSCH PRB size as the 500km/h PSSCH case. Considering the QC’s concern, we are also open for Option 1.  **Issue 1-4-2: PSFCH periodicity**  Since most companies support Option 1 and considering the meeting progress and unify the PSFCH configuration procedure, we also can accept the majority views. |

### Sub-topic 1-5 : PSCCH demodulation

**Issue 1-5-1: Payload size**

* Proposals:
  + Option 1: 24 (MediaTek, CATT)
  + Option 2: 26 (Qualcomm, LG, Intel, Huawei, MediaTek)
* Recommended WF
  + One option should be selected in this meeting
  + Majority view is option 2 and confirm whether option 2 is agreeable

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | Based on recommended WF, we support option 2. |
| Huawei | Support option 2. |
| QC | Support option 2. |
| Intel | Support Option 2 |
| CATT | Support option 2 based on the sub-channel size. |
| MTK | Support recommended WF |

## 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”* |

# Topic #2: Draft CRs for demodulation test cases

This section will discuss the draft CRs for NR V2X demodulation. Companies are encouraged to provide comments for test parameters and format for FRC and resource pool configuration.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2100411 | CATT, GOHIGH | DraftCR for 38.101-4, Introduce PSBCH performance requirements for NR V2X |
| R4-2100656 | LG Electronics Inc. | Draft CR for PSSCH demodulation requirements for NR V2X |
| R4-2101069 | MediaTek inc. | draftCR on NR V2X PSFCH demodulation requirements |
| R4-2101234 | Intel Corporation | Draft CR on NR V2X Single Link PSCCH requirements |
| R4-2101942 | Intel Corporation | Draft CR on General section of NR V2X requirements |

## Open issues summary

For draft CR, please comment directly in section 2.3.2.

### Sub-topic 2-1: Numbering for test cases

**Issue 2-1-1: Numbering for test cases**

* Proposals from moderator
  + Option 1: use following numbering and title

|  |
| --- |
| 11. V2X Requirements  11.1 Demodulation performance requirements (conducted requirements)  11.1.1 General  11.1.2 PSSCH demodulation requirements  11.1.3 PSCCH demodulation requirements  11.1.4 PSBCH demodulation requirements  11.1.4 PSFCH demodulation requirements  11.1.5 Power imbalance performance with two links  11.1.6 HARQ buffer soft combining test  11.1.7 PSCCH/PSSCH decoding capability test  11.1.8 PSFCH decoding capability test |

* Recommended WF
  + Need further discussion

## Companies views’ collection for 1st round

### Open issues

Sub-topic 2-1: Numbering for test cases

**Issue 2-1-1: Numbering for test cases**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | Support the proposal. |
| Intel | Support Option 1 |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2101942  (General section) | Company A |
| Company B |
|  |
| R4-2100656  (PSSCH demod) | QC: Come back after sub-topics 1-1 to 1-4 are concluded. |
| Intel:  1) We probably need to further discuss the naming for FRC, because it was modified for NR DL in comparison to LTE DL requirements.  2) Information about Noc can be removed because this information is defined in Section 4.4.3 and applicable to all requirements in specification.  3) It’s not clear why we need PSFCH in Sidelink transmissions. Based on our understanding, we are going to verify only Rx processing for PSCCH+PSSCH.  4) Probably we can add information about “Modulation format and code rate” and “SCS” in table with minimum performance requirements (i.e. similar to DL requirements) |
|  |
| R4-2101234  (PSCCH demod) | LG : For RMC naming, we prefer to align LTE (e.g., PSSCH🡪 CD.x, PSCCH🡪CC.y) if there is no any other issues.  For A.6.1, do we need the sub-section for SCS 15kHz and 60kHz ? |
| Intel: Probably we need to discuss RMC naming for all channels to check whether we need to reuse the methodology which was agreed for NR DL requirements, reuse LTE V2X or define new procedure. |
|  |
| R4-2100411  (PSBCH demod) | LG : CR category is B (not F) even if this is draft CR.  RMC table for PSBCH should be added. |
| CATT: Thanks for careful checking. The CR will be revised correspondingly. |
| Intel:  1) The following configurations probably is required for test setup: sl-NumSSB-WithinPeriod-r16 and sl-TimeOffsetSSB-r16  2) Same note for Noc as for R4-2100656 |
| R4-2101069  (PSFCH demod) | QC: Pr(DTX to NACK)<1% is not SNR dependent, since no signal is transmitted, should specified as 38.104 8.3.1 |
| LG: For DTX to NACK will be ?  Table 11.X.2.2-3 for minimum requirements will be needed. |
| MTK: Thanks for QC and LG’s comments.  I will modify the typo as mentioned by LG. From our understanding, the minimum requirements is needed for V2X test case. Further comments are welcome. |
| LG: My comments was wrong for Table 11.X.2.2-3, sorry about that.  In my understanding, for Table 11.X.2.2-3, we don’t need the table since Pr(DTXtoNACK) should be less than 1%. So, there is no specific SNR point, and requirement is that The DTX to NACK probability shall not exceed 1%. |
| Intel: Same note for Noc as for R4-2100656 |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | **Issue 2-1-1: Numbering for test cases**  *Tentative agreements: use sub-section numbering with option 1 and companies are encouraged to revise draft CR using the sub-section numbering*  *Candidate options: N/A*  *Recommendations for 2nd round: N/A* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **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*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2101942 | *To be revised (draft CR for general section)* |
| R4-2100656 | *To be revised (draft CR for PSSCH demodulation)* |
| R4-2101234 | *To be revised (draft CR for PSCCH demodulation)* |
| R4-2100411 | *To be revised (draft CR for PSBCH demodulation)* |
| R4-2101069 | *To be revised (draft CR for PSFCH demodulation)* |

## Discussion on 2nd round (if applicable)

### Sub-topic 2-1 : Naming of RMC

* Proposals from moderator
  + Option 1: Follow methodology for RMC naming of LTE V2X
    - E.g., PSSCH 🡪 CD.x, PSCCH🡪 CC.y
  + Option 2: Follow methodology for RMC naming of TS38.101-4
    - E.g., R.PSSCH.x, R.PSCCH.y
* Recommended WF
  + Need further discussion

|  |  |
| --- | --- |
| **Company** | **Comments** |
| LG | We slightly prefer to reuse RMC naming of LTE V2X since RMC naming for RRM performance requirements is also reused by that of LTE V2X (e.g., CD.x, CC.y). |
| Huawei | Slightly prefer option 2 to keep alignment with NR Rel-15 UE demodulation requirements across the whole specification. |
| QC | Slightly prefer option 2 |
| Intel | Prefer Option 2 to have unified approach for RMC naming within one specification. We would like to note that DL RMC naming for NR was updated in comparison to LTE. Therefore, we can consider modification of SL RMC for NR specification in comparison to LTE to improve spec drafting procedure. One question: does anyone remember/know the meaning of CC and CD? Abbreviation CC is usually interpreted as component carrier. |
| CATT | Prefer option 2. |

### Sub-topic 2-2 : Draft CRs

Companies are encouraged to provide additional comments based on 1st round comments for draft CRs. Draft Big CR will be handled at e-mail apprvoal after this meeting based on endorsed Draft CRs.

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2101942🡪 R4-2103813  (General section) | Intel: We have not received any comments for this Draft CR in the first round. Therefore, it is not clear whether we need to make any revision. |
| LG: sorry for late comments. One question for section 11.1.1.1.2. In Rel-16, no optional V2X features are introduced. So, I think that we don’t need the section “Applicability of requirements for optional UE V2X features”. If optional feature are introduced in the future release, corresponding section could be added. |
|  |
| R4-2100656🡪 R4-2103815  (PSSCH demod) | Huawei:  Share same views with Intel.  We prefer to move following parameters from RMC Table to test parameters Table 11.1.2-1 to keep alignment with NR PDSCH performance test:   1. 2nd SCI configuration 2. DMRS pattern 3. PSFCH periodicity 4. MinTimeGapPSFCH   For RMC Table: we propose to remove the parameter: “Max. Throughput averaged over 1 frames” that is not agreed test metric for PSSCH. The following parameters should be added to keep alignment with NR PDSCH:   1. MIMO layers 2. Number of DMRS REs   For time offset, we prefer to use CP/2-12\*64\*Tc instead of CP/2-12\*Ts  For resource pool configurations: We prefer to add some configurations:   1. sl-RB-Number-r16:51 RBs 2. sl-X-Overhead-r16: n0   Additionally, we should further discuss whether we should follow LTE V2V to list all the IEs for resource pool defined in TS 38.331. |
| Intel: As for resource pool, we can define single configuration with sl-NumSubchannel-r16 = 10. And for each test, we can define which sub-channels are used for PSCCH and PSSCH transmission.  -------------- 03-02-21 -------------------  More detailed description of our proposal. Resource pool configuration can be defined with sl-NumSubchannel-r16 = 10 for all test. Same time, in Table 11.1.2.1.1-1, we can define the following parameters:   * Sub-channel for PSCCH allocation (which will be equal to 0 for all test) * Sub-channels for PSSCH allocation (which will be equal to 0 or [0.1] depending on test). Or we can call it “PSSCH Frequency resource assignment” to align with naming of this field in SCI. |
| Huawei:  We have different results for tbSize calculation:  , =12,   * For case with 500km/h: * For slots with PSFCH         tbSize=704   * For slots without PSFCH       tbSize=1128   * For case with 260km/h: * For slots with PSFCH     =93    tbSize=1800   * For slots without PSFCH     =129    tbSize=2856  For case with 30km/h, since simulation assumptions have not been finalized, we have not calculated tbSize for the case.  The unit for *γ* may be wrong, it should be REs rather than bits.  We prefer to remove the parameter *γ,* since it is decided by *α,βoffset* and Payloads and not configurable.  For FRC Table, The wording “Note 1: OFDM symbols is for PSCCH/PSSCH transmission not including first symbol (AGC) and PSFCH symbols.” should be changed to “Note 1: OFDM symbols is for PSCCH/PSSCH transmission not including first symbol (AGC) , PSFCH symbols and guard symbols.” |
| R4-2101234🡪 R4-2103816  (PSCCH demod) | Huawei:  For time offset, we prefer to use CP/2-12\*64\*Tc instead of CP/2-12\*Ts  For RMC Table, we propose to add the following notes:” Note: The first OFDM symbol of a PSSCH and its associated PSCCH is duplicated as described in clauses 8.3.1.5 and 8.3.2.3 of TS 38.211 and not used for demodulation.”  For parameter “OFDM symbols per slot”, we propose to add the clarification: ”First AGC OFDM symbol is not included” |
| Intel: Support suggestion from HW. Already included in the revised version with small wording change.  To LG from first round comment “For A.6.1, do we need the sub-section for SCS 15kHz and 60kHz ?”: We think that it will be rather beneficial to have placeholder for this sub-section to have clear spec structure in case these scenarios will be considered in future. Same procedure is used for DL RMC section. Same time, we are fine to remove sub-section with 60 kHz for now because it can be introduced in future without affecting of spec structure. |
|  |
| R4-2100411🡪 R4-2103814  (PSBCH demod) | Huawei:  FRC and resource pool are needed.  For Noc, share same views with Intel from 1st round |
| Huawei:  We don’t understand the note 1 in FRC table“ The first symbol is used for AGC and the last symbol shall be punctured as per TS 38.211.” If our understanding is correct, the last OFDM symbol is used for guard symbol and without PSBCH mapping. |
| CATT: To Huawei, what “the last symbol shall be punctured” means is that the last OFDM symbol is used for guard symbol. |
| R4-2101069🡪 R4-2103817  (PSFCH demod) | Huawei:  For time offset, we prefer to use CP/2-12\*64\*Tc instead of CP/2-12\*Ts  Resource pool should be configured and parameters “*sl-PSFCH-Period-r16*”,” *sl-NumMuxCS-Pair-r16*”,” *sl-MinTimeGapPSFCH-r16*”,” *sl-PSFCH-HopID-r16* ” and “*sl-PSFCH-CandidateResourceType-r16*” should be added for resource pool definition. |
| Intel: As for “The number of PSFCH symbols”, based on our understanding, first symbol is used for AGC. If we define this parameter equal to 2 then we suggest to add note that “First symbol is included. First symbol is used for AGC and not used for demodulation”. Another way, we can define is equal to 1 and add note “First symbol is not included. First symbol is used for AGC and not used for demodulation”. |
| Huawei  #(ACK/NACK bits) should be changed to #(NACK bits) since only NACK bits are transmitted. |
|  |

## 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”* |