**3GPP TSG-RAN WG4 Meeting # 98-e R4-2103757**

**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 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

# 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 sizeProposal 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 testProposal 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 testProposal 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 = 3.5Proposal 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 = 5Proposal 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 = 5Proposal 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 – 180Proposal 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 conditionObservation 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 necessaryFor 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 2UE 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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#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*

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

### 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**  |
| 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)

## 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 Requirements11.1 Demodulation performance requirements (conducted requirements)11.1.1 General11.1.2 PSSCH demodulation requirements11.1.3 PSCCH demodulation requirements11.1.4 PSBCH demodulation requirements11.1.4 PSFCH demodulation requirements11.1.5 Power imbalance performance with two links11.1.6 HARQ buffer soft combining test11.1.7 PSCCH/PSSCH decoding capability test11.1.8 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-r162) 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$, Prob\left(PSFCH DTX\rightarrow Ack bits\right)$ will be $Prob\left(PSFCH DTX\rightarrow NACK bits\right)$ ?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)

## 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”* |