**3GPP TSG-RAN WG4 Meeting # 99-e R4-2108454**

**Electronic Meeting, 19th – 27th May 2021**

**Agenda item:** 9.8.5

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [99-e][329] NR\_HST\_FR2\_Demod

**Document for:** Information

# Introduction

In RAN Plenary #89-e, the RAN4-led work item of NR support for high speed train (HST) scenario in FR2 has been approved [RP-202118] (which has been further revised to [RP-210800] with editorial revisions and updates on time schedule).

Based on the agreement captured in WF [R4-2106102], the feasibility study of supported maximum speed from demodulation perspective was analysed. Meanwhile, the test scope of UE/BS demodulation was under discussion. For this meeting, companies are encouraged to further discuss the test scope for UE/BS demodulation based on the FR2 HST deployment scenarios, and the related test setup for each identified requirements

In this email thread, the following agenda items will be discussed:

* 9.8.5.1 General
* 9.8.5.2 UE demodulation requirements
* 9.8.5.3 BS demodulation requirements

It is suggested to have the following target of 1st and 2nd round email discussion

* 1st round: Further discussion the test scope of UE/BS demodulation based on FR2 HST deployment scenarios and the related test setup for each requirements
* 2nd round: Based on the output of 1st round, try to agree the simulation assumption for each demodulation requirements as much as possible for alignment in future meeting.

# Topic #1: UE demodulation requirement

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109216 | Intel | Observation 1: When UE is served by one RRH the Doppler frequency trajectory is continuous and there are no problems to track it by TRS  Observation 2: To perform switching from one RRH to another UE needs to handle frequency jump which is different for different deployments scenarios. For unidirectional it can be up to max Doppler frequency and in bidirectional up to double max Doppler frequency  Proposal 1: Do not pursue agreement on baseline reference signal for DL frequency tracking.  Proposal 2: Consider one or two additional DMRS symbol for requirements definition (i.e. 1+1 or 1+1+1 configuration)  Proposal 3: Consider 200 MHz BW for DL HST FR2 requirements definition.  Proposal 4: Do not consider UE frequency error in demodulation test cases. |
| R4-2109749 | ZTE | Proposal 2 : It is feasible to use SSB+TRS for frequency offset tracking to support 350km/h  Proposal 3 : TRS or SSB period < 40ms  Proposal 4: one DMRS is enough to demodulation requirement for PDSCH based on Proposal 3. |
| R4-2109750 | ZTE | Proposal 1: Consider output of FR2 HST Deployment scenarios discussion whether to cover scenario A  Proposal 2: DPS scheme 1a could be considered in Uni-directional scenario.  Proposal 3: If another panel cannot be used for beam search, scheme 1a could be considered in Bi-directional scenario. If another panel can be used for beam search, both scheme 1a and 1b could be considered in Bi-directional scenario.  Proposal 4: 120KHz with 200MHz. |
| R4-2109805 | Samsung | Proposal 1: No PDSCH requirement with HST single tap channel model in FR2  Proposal 2: Define PDSCH requirement with Uni/Bi-directional scenario for both A and B. Define the test applicability rule to reduce the test effort. |
| R4-2109807 | Samsung | Proposal 1: Define PDSCH requirement with Doppler shift as 9722Hz with targeting 350km/h UE speed for both Uni-directional and Bi-directional RRH deployment scenarios, the assumption of RS frequency tracking method is up to UE implementation  Proposal 2: FFS to define PDSCH requirement with low Doppler shift as 7222Hz with targeting 260 km/h speed for Bi-directional RRH deployment scenario  Proposal 3: Define PDSCH requirement with DPS scheme 1a in Uni-directional scenario in scenario A. FFS scheme 1b.  Proposal 4: Define PDSCH requirement with DPS scheme 1a and 1b in Uni-directional scenario in scenario B, FFS the number of TCI state configured  Proposal 5: Define PDSCH requirement with DPS scheme 1a in Bi-directional scenario in scenario A and scenario B. FFS scheme 1b.  Proposal 6: Define PDSCH requirement with 1+1+1 DMRS configuration  Proposal 7: Define PDSCH requirement with 120KHz SCS 100MHz CBW |
| R4-2110531 | Huawei, HiSilicon | Observation 1: There is no any feasibility issue for DPS transmission scheme 1b for both Bi-directional and Uni-directional deployment.  Proposal 1: Define requirements for both scenario A/B and Uni/bi-directional deployment, and not define any applicability rule between them.  Proposal 2: Define both DPS transmission scheme 1a and 1b for both Bi-directional and Uni-directional deployment.  Proposal 3: Use 200MHz for PDSCH tests under FR2 HST scenario.  Proposal 4: Do not consider extra UE frequency error for FR2 HST.  Proposal 5: Assume static UE and single Probe. Combine RRM and Demod requirements as a single feature to support HST FR2 operation |
| R4-2110532 | Huawei, HiSilicon | Propose 1: To support 350km/h, RAN4 define performance requirements using TRS+SSB for tracking frequency offset for downlink.  Propose 2: Use DMRS 1+1+1 for FR2 HST PDSCH performance requirements definition. |
| R4-2110643 | Ericsson | Observation 1: Maximum Doppler frequency based on TRS is 14,000Hz if we don’t assume frequency error.  Observation 2: Maximum Doppler frequency based on TRS is 11,000Hz if we assume frequency error of 0.1ppm at 30GHz.  Proposal 1: Assume SSB+TRS as the baseline of frequency offset tracking to support 350km/h​.  Proposal 2: Assume DMRS configuration with 1+1+1 for UE demodulation requirements in HST FR2.  Proposal 3: Assume DMRS configuration without additional DMRS symbols for HST single tap scenario.  Proposal 4: RAN4 define two test cases for HST FR2.  Test 1: HST single tap (Uni-directional) with Scenario A  Test 2: DPS (Uni-directional) with Scenario B  If RAN4 agree to consider both Uni-directional and bi-directional deployment, either test 1 or 2 apply bi-directional model.  Proposal 5: For DPS scenario, RAN4 define both scheme 1a and 1b if the performance is same, but define the same applicability rule as Rel-16 HST, i.e., if a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases, and if a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases.  Proposal 6: Configure CBW=100MHz with SCS=120kHz for UE demodulation requirements in HST FR2.  Proposal 7: Impact of UE frequency error should be included in companies’ impairment results when RAN4 sets the UE demodulation requirements for HST FR2 |
| R4-2110720 | Qualcomm | Observation 1: Assuming zero frequency error, the range of maximum Doppler frequency estimation based on TRS is 14kHz.  Observation 2: In a bidirectional deployment, if Fc=30GHz and the train speed is 350 Km/h, a UE using TRS processing for frequency offset tracking will experience a maximum Doppler shift larger than 19kHz when switching between RRHs pointed in opposite directions, outside of the TRS range and the impact on performance is potentially unbounded.  Observation 3: Using both SSB and TRS for UE Frequency Offset Tracking does not solve the problem of the maximum Doppler shift larger than TRS FO estimation range, if the first resource received at the UE after the switch to a new RRH is TRS and not SSB.  Observation 4: Combining different resources (with different spectral characteristics as in the case of SSB and TRS) for FOT requires a dedicated UE implementation.  Observation 5: Feasibility of supporting maximum speed of 350km/h in downlink using TRS (4 symbol interval) and SSB for frequency offset tracking under bi-directional RRH deployment, assumes an increased complexity in the UE implementation of FOT schemes compared to a baseline UE implementation.  Proposal 1: Define FR2 HST tests assuming TRS for frequency offset estimations only.  Proposal 2: To avoid increasing UE FOT complexity, FR2 HST Demodulation tests should assume UE velocity such that the maximum Doppler shift experienced by the UE when switching across RRHs does not exceed the range of frequency offset estimation of TRS.  Proposal 3: Define Demodulation Tests assuming UE velocity of 350Km/h and Fc=30GHz for unidirectional deployment test only.  Proposal 4: For bidirectional deployment, define demodulation tests with lower UE speed to keep the maximum Doppler shift within the TRS range.  Observation 6: For real FR2 HST deployment, using 1 DMRS might impact performances if the channel is not single tap.  Observation 7: In existing FR1 HST tests, number of additional DMRS is 2.  Proposal 5: For the DMRS configuration for PDSCH demodulation requirement, support Option 2: (1+1+1) DMRS. |

## Open issues summary

Last RAN4 meeting agreements in the WF R4-2106102

List of open issues

* Sub-Topic 1-1: General
  + Issue 1-1-1: RS configuration to enable 350km/h
  + Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario
  + Issue 1-1-3: Whether to introduce PDSCH requirement with HST single tap channel
  + Issue 1-1-4: PDSCH requirement for Bi-directional/ Uni-directional scenario in scenario A and scenario B
  + Issue 1-1-5: UE frequency error assumption
* Sub-Topic 1-2: PUSCH requirement
  + Issue 1-2-1: DPS transmission scheme
  + Issue 1-2-2: DMRS configuration
  + Issue 1-2-3: BW

### Sub-topic 1-1 General

**Issue 1-1-1: RS configuration to enable 350km/h**

* Observations
  + Observation 1 (Intel)
    - When UE is served by one RRH the Doppler frequency trajectory is continuous and there are no problems to track it by TRS
    - To performance switching from one RRH to another UE needs to handle frequency jump which is different for different deployments scenarios. For unidirectional it can be up to max Doppler frequency and in bidirectional up to double max Doppler frequency
  + Observation 2 (Qualcomm)
    - Maximum Doppler frequency based on TRS is 14000Hz if we do not assume frequency error
    - Assuming zero frequency error, the range of maximum Doppler frequency estimation based on TRS is 14kHz
    - In a bidirectional deployment, if Fc=30GHz and the train speed is 350 Km/h, a UE using TRS processing for frequency offset tracking will experience a maximum Doppler shift larger than 19kHz when switching between RRHs pointed in opposite directions, outside of the TRS range and the impact on performance is potentially unbounded.
    - Using both SSB and TRS for UE Frequency Offset Tracking does not solve the problem of the maximum Doppler shift larger than TRS FO estimation range, if the first resource received at the UE after the switch to a new RRH is TRS and not SSB
    - Combining different resources (with different spectral characteristics as in the case of SSB and TRS) for FOT requires a dedicated UE implementation.
    - Feasibility of supporting maximum speed of 350km/h in downlink using TRS (4 symbol interval) and SSB for frequency offset tracking under bi-directional RRH deployment, assumes an increased complexity in the UE implementation of FOT schemes compared to a baseline UE implementation.
  + Observation 3 (Ericsson):
    - Maximum Doppler frequency based on TRS is 14000Hz if we do not assume frequency error
    - Maximum Doppler frequency based on TRS is 11,000Hz if we assume frequency error of 0.1ppm at 30GHz.
* Proposals
  + Option 1 (Samsung, Intel): Do not pursue agreement on baseline reference signal for DL frequency tracking. Assumption of RS for frequency offset tracking is up to UE implementation
  + Option 2 (Huawei, Ericsson, ZTE): Assume SSB +TRS as baseline of frequency offset tracking to support 350km/h
    - Option 2a (ZTE) : TRS or SSB period < 40ms
  + Option 3 (Qualcomm): Define FR2 HST test assuming TRS for frequency offset estimation only
    - To avoid increasing UE FOT complexity, FR2 HST Demodulation tests should assume UE velocity such that the maximum Doppler shift experienced by the UE when switching across RRHs does not exceed the range of frequency offset estimation of TRS.
    - Define Demodulation Tests assuming UE velocity of 350Km/h and Fc=30GHz for unidirectional deployment test only.
    - For bidirectional deployment, define demodulation tests with low UE speed to keep the maximum Doppler shift within the TRS range
* Recommended WF
  + Encourage feedback from companies

**Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**

* Proposals
  + Option 1 (Samsung): FFS to define PDSCH requirement with low Doppler frequency for Bi-directional RRH deployment scenario
  + Option 2 (Qualcomm): For bi-directional deployment, define demodulation tests with low UE speed to keep the maximum Doppler shift within the TRS range
* Recommended WF
  + Encourage feedback from companies

**Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**

* Proposals
  + Option 1 (Samsung): No PDSCH requirement with HST single tap channel model in FR2
  + Option 2 (Ericsson): Define HST single tap (Uni-directional) with scenario A
* Recommended WF
  + Encourage feedback from companies

**Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**

* Proposals
  + Option 1(Samsung): Define PDSCH requirement with Uni/Bi-directional scenario for both A and B, Define the test applicability rule to reduce the test effort
  + Option 2 (Huawei): Define requirements for both scenario A/B, and Uni/Bi-directional deployment, and not define any applicability between
  + Option 3 (ZTE): Consider output of FR2 HST deployment scenario discussion whether to cover scenario A
  + Option 4 (Ericsson): RAN4 define two test cases for HST FR2
    - Test 1: HST single tap (Uni-directional) with scenario A
    - Test 2: DPS (Uni-directional) with scenario B
    - If RAN4 agree to consider both Uni-directional and Bi-directional deployment, either test 1 or 2 apply Bi-directional model
* Recommended WF
  + Encourage feedback from companies

**Issue 1-1-5: UE frequency error assumption**

* Proposals
  + Option 1(Huawei, Intel): Do not consider extra UE frequency error for demodulation tests in FR2 HST WI
    - Option 1a(Ericsson): Impact of UE frequency error should be included in companies’ impairment results when RAN4 sets the UE demodulation requirement for HST FR2
* Recommended WF
  + Encourage feedback from companies

### Sub-topic 1-2 PDSCH

**Issue 1-2-1: DPS transmission scheme**

* Observations
  + Observation 1 (Huawei): There is no any feasibility issue for DPS transmission scheme 1b for both Bi-directional and Uni-directional Deployment
* Proposals
  + Option 1(Samsung):
    - Define PDSCH requirement with DPS scheme 1a in Uni-directional scenario for scenario A. FFS scheme 1b
    - Define PDSCH requirement with DPS scheme 1a and 1b in Uni-directional scenario for scenario B, FFS the number of TCI state configured
    - Define PDSCH requirement with DPS scheme 1a in Bi-directional scenario for scenario A and scenario B. FFS scheme 1b
  + Option 2 (Huawei): Define both DPS transmission scheme 1a and 1b for both Bi-directional and Uni-directional deployment
    - Option 2a (Ericsson): RAN4 define both scheme 1a and 1b if the performance is same, but define the same applicability rule as Rel-16 HST, i.e., if a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases, and if a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases.
  + Option 3 (ZTE):
    - DPS scheme 1a could be considered in Uni-directional RRH scenario
    - If another panel cannot be used for beam search, scheme 1a could be considered in Bi-directional scenario. If another panel can be used for beam search, both scheme 1a and 1b could be considered in Bi-directional scenario.
* Recommended WF
  + Encourage feedback from companies

**Issue 1-2-2: DMRS configuration**

* Observations
  + Observation 1 (Qualcomm):
    - For real FR2 HST deployment, using 1 DMRS might impact performances if the channel is not single tap.
    - In existing FR1 HST tests, number of additional DMRS is 2
* Proposals
  + Option 1(Samsung, Intel, Qualcomm, Huawei, Ericsson ): 1+1+1 DMRS configuration
  + Option 2 (Ericsson, ZTE): 1 DMRS
    - Option 2a (Ericsson): 1 DMRS for HST single-tap channel
* Recommended WF
  + Define PDSCH requirement with 1+1+1 DMRS configuration based on DPS Tx scheme for FR2 HST WI?
  + Encourage company to check whether HST single-tap channel similar as FR1 is valid for FR2?

**Issue 1-2-3: BW**

* Proposals
  + Option 1(Samsung, Ericsson): 100MHz CBW
  + Option 2 (Huawei, Intel, ZTE): 200 MHz CBW
* Recommended WF
  + Encourage feedback from companies

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1-1-1  Issue 1-1-2  Issue 1-1-3  Issue 1-1-4  Issue 1-1-5 |
| Ericsson | **Issue 1-1-1: RS configuration to enable 350km/h**  We tend to agree with option 1 it is up to UE implementation in the end. In our understanding, the conclusion of this issue is captured in the test parameters. Probably we can conclude for FR2 HST UE demodulation requirements configuration as follows:   * Configure SSB every 20ms * Configure TRS every 10ms * Configure PTRS with KPR-RS=2 and TPT-RS=1   **Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**  It depends on the conclusion whether to define UE demodulation requirements with bi-directional deployment.  By the way what is the agreement on high Doppler frequency? Is it 9722 Hz?  **Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**  We support option 2. Single tap model is good UE demodulation performance benchmark to verify UE can track the Doppler shift changes.  Preferably, RAN4 UE demodulation requirements should focus only on the UE demodulation performance; the impact of RRM (e.g., TCI switching) or CSI reporting (e.g., L1-RSRP reporting) should be avoided during the test as much as possible. It seems the bi-directional case requires many RRM issues like TCI switching, and it make demodulation requirements more complex. We think the single tap test is simple and useful to verify the demodulation requirements.  **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  Option 4: We don’t observe significant performance difference from UE demodulation perspective. We don’t need to define a lot of similar test cases.  **Issue 1-1-5: UE frequency error assumption**  Option 1. |
| ZTE | **Issue 1-1-1: RS configuration to enable 350km/h**  Same view with Ericsson, We think configure different RS and Doppler tracking up to UE implementation is a good compromise.  **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  Difference between Scenario A and B is only different Dmin, it could be only effect the Doppler trajectory. We think that if UE could track the bad Doppler trajectory, then tracking good Doppler trajectory could also be verified, so we prefer to define PDSCH requirement for the worst of scenario A and B to reduce the test burden. |
| Qualcomm | **Issue 1-1-1: RS configuration to enable 350km/h**  Option 1 is fine, and we support leaving the choice of FOT resources up to UE implementation.  However, in order to properly design the test it should be guaranteed that the UE can use the resources configured, and so we propose that:   * The maximum doppler shift seen by the moving UE should not exceed the smallest doppler estimation range among all the resources configured;   **Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**  According to our comment to issue 1-1-1, it is our view that the maximum doppler should not exceed the range of the configured resource for tracking, so the Doppler frequency should be reduced according to this criteria.  **Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**  It should be clarified what would be the added coverage of using HST single tap channel model.  For FR1 HST this was the first HST model introduced, but the applicability rules allow UEs to skip HST Single Tap test if HST-DPS tests are passed, so it's debatable whether we need to define this test. Also, the validity of performances tested with this channel model in a real FR2 deployment is to be discussed, since the scenario much different with respect to an FR1 deployment.  **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  There is a parallel ongoing discussion focused on the deployment scenarios, and we should gather input from it before deciding on which requirements to introduce. |
|  | **Issue 1-1-1: RS configuration to enable 350km/h**  Frequency offset tracking strategy is up to UE implementation. Therefore, RAN4 should define test cases with RS configurations that do not preclude any reasonable solutions. We support Option 1 and configuration mentioned by Ericsson.  To Qualcomm: Some implementations may support 350km/h some only less as you mentioned. In this case why we should limit max supported UE speed? In this case it is better to define two sets of requirements: one with 350 km/h and another one with lower speed.  **Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**  What is the problem to perform rough frequency estimation by SSB in bidirectional deployments and then track residual error by TRS? In our understanding 350 km/h can be supported in this deployment with proper UE implementation.  The max Doppler frequency should be 9722 that corresponds to 30 GHz and 350 km/h UE speed.  **Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**  HST Single tap channel model has continuous Doppler frequency trajectory that is not a case as in real field. Realistic channel model has instantaneous frequency jump when UE switches from one RRH to another. Proper UE implementation should not have any problems with handling of this jump. That is why companies did not observe any difference in performance results for different channel models. However, wrong UE implementations may have problems and we should have such verification aspect in channel model.  Support Option 1.  **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  We support Option 3a (new one proposed below). It is immature to make agreements on deployments for requirements definition before outcome of deployment study. From demodulation perspective we do not see big difference between them. However, HST FR1 UE requirements were defined for two scenarios: Tunnel and Open Space. In this case we suggest further analysis on benefits of requirements definition for different scenarios and different deployments.  **Issue 1-1-5: UE frequency error assumption**  Support Option 1 and Option 1a with small modification:  Impact of UE frequency error ~~should~~ can be included in companies’ impairment results when RAN4 sets the UE demodulation requirement for HST FR2 |
| Huawei | **Issue 1-1-1: RS configuration to enable 350km/h**  OK with Option 1.  **Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**  We prefer to only define 350km/h requirements for Bi-directional RRH deployment, SSB can be used for frequency offset tracking.  **Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**  Option 1. Single-tap channel model is too ideal, also performance under single-tap can be verified by DPS. We don’t need to define such channel model for FR2 HST, increasing the test burden.  **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  Both scenario A/B and Uni/Bi-directional deployment requirements should be defined. Otherwise UE may not work in some certain HST deployment.  **Issue 1-1-5: UE frequency error assumption**  Option 1. |
| Qualcomm | **Issue 1-1-1: RS configuration to enable 350km/h**  We are ok with option 1 and leaving RS choice to the UE, but in our view this does not solve the issue that designing a test with RS outside of their working range does not really leave that implementation up to the UE, so we still maintain that the configured UE speed should not exceed the smallest RS doppler estimation range.  @Intel: Our view on the limitation of the UE speed to within the range can be justified by the fact that when some of the resources configured for FOT for a test cannot be used to track frequency offset because the test was designed with a larger UE speed and this exceed the resources’ range, we are placing the burden on the UE to have a more complex tracking implementation for this test.  A UE using the same resources (that can support 350km/h) in the test for an unidirectional deployment is not able to use the same resources in the bidirectional deployment test for the same speed, which requires additional complexity in mixing estimations from multiple sources. Do you have a proposal on how to define different requirements to have a less asymmetrical requirements design? |
| Samsung | Issue 1-1-1  For FR2, it is common understanding that multiple SSBs needs to be transmitted from each RRH, while different TRSs could be linked to diverse SSB indexes. During the PDSCH test, SSB is mandatory to be configured.  Based on maximum Doppler estimation capability analysis, the gap between adjacent RS in SSB is 2. It has the same Doppler tracking capability of PTRS with (L=2), which can support higher velocity. Therefore, SSB+TRS is feasible implementation for frequency offset tracking to support 350km/h for both Uni-directional and Bi-directional RRH deployment.  Regarding the TRS, the maximum Doppler can be estimated is 14000Hz, considering 4 symbol interval. In bi-directional scenario, assuming the switching point is middle of two RRH as Ds/2, the Doppler will jump from the positive maximum value to the negative maximum value, and therefore, the Doppler should be double. Based on the 350km/h and 30GHz carrier frequency, the maximum Doppler should be 9722Hz. At the Ds/2 location, the maximum Doppler change can be up to 19437Hz. It is out of estimation capacity of TRS. With latest available PTRS, it also can benefit the Doppler tracking.  To allow different implementation, we propose to define PDSCH requirement with Doppler shift as 9722Hz with targeting 350km/h UE speed for both Uni-directional and Bi-directional RRH deployment scenarios, the assumption of RS frequency tracking method is up to UE implementation  Regarding the RS configuration, we can further discuss during requirement set up stage.  Issue 1-1-2  In general, whether to apply SSB or PTRS, TRS for Doppler tracking, it is up to implementation. In case of only applying TRS tracking, the supported velocity is lower than 350km for bi-directional RRH deployment.  In that sense, low Doppler frequency with range of TRS tracking ability can be considered.  Issue 1-1-3  In FR1 HST, RAN4 has defined the test applicable rule for DPS transmission schemes, and HST single-tap test. If UE passed HST-DPS 1a or 1b, Rel-15 HST single-tap test and Rel-16 HST single-tap test can be skipped.  Generally, HST single tap channel model is not a realistic model, especially for FR2, It is common understanding that multiple SSBs can be transmitted from each RRH, where different TRSs could be link to diverse SSB index. For FR2, since the Rx beamforming can only point to one direction, it is not feasible that UE can receiver multiple SSBs (TCI states) with different direction  In that sense, it is not feasible to define the PDSCH requirement with HST single tap channel model in FR2.We would like to check whether HST single tap is valid for FR2 HST real deployment.  Issue 1-1-4  We are open to further discuss with taken into account of RRH deployment scenario discussion.  At current state, we still see the difference receiver behavior will be applied  The number of beam per RRH panel will impact on UE receiver behaviour of frequency offset tracking based on RS in different TCI states for demodulation requirement test.  Meanwhile, the RRH/UE boresight direction of antenna panel, beam direction and the number of beam, it will also impact on the switching point of different RRH. The related Doppler shift trajectories observed by UE will be different.  For bi-directional RRH deployment discussion, different schemes were proposed to solve the “RRH-site” coverage issue. The different schemes will also impact the related switching point, and the Doppler shift trajectories.  Therefore, if both scenarios are includes, it is necessary to define PDSCH to cover different scenarios. For test, the test applicability rule can be considered for reducing test effort,  Issue 1-1-5  We are ok with the modification proposed by Intel |

Sub topic 1-2

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| **Company** | **Comments** |
| XXX | Issue 1-2-1  Issue 1-2-2  Issue 1-2-3 |
| Ericsson | **Issue 1-2-1: DPS transmission scheme**  Option 2a  DPS scheme 1a and 1b depend on the number of active TCI states UE is capable of, and it should be independent of deployment scenario. We prefer to define the PDSCH demodulation requirements with 1a and 1b, and to introduce a applicability rule according to UE capability.  For bi-directional and/or uni-directional deployment, we want to wait for the deployment discussion conclusion.  **Issue 1-2-2: DMRS configuration**  Our proposal is not select one of options; 1 DMRS or 1+1+1 DMRS; our proposal is to define both cases according to the channel model, e.g., 1 DMRS for single tap and 3 DMRS for DPS.  It may be true 1 DMRS works only for the HST single tap channel model. We are not discussing the general handset; but FR2 HST dedicated UEs. Such a UE should be able to detect single tap model and use frequency offset compensation before demodulation. As we also presented in our paper, 1 DMRS can achieve higher peak rate compared with 3 DMRS thanks to less overhead.  **Issue 1-2-3: BW**  Option 1  BW depends on the operators, and we think CBW 100MHz is also typical configuration for HST. If necessary, we can check with operators. |
| ZTE | **Issue 1-2-1: DPS transmission scheme**  Agree with Option 1.  The main influence of scheme 1a and 1b on the test setup is the switching duration. If UE have 2 active TCI but only one of them can be traced, we think it could not difference between scheme 1a and 1b on the test setup.  For uni-scenario A, one beam per UE and RRH panel, we prefer scheme 1a.  For uni-scenario B, we prefer define this after conclusion of UE and RRH parameters.  For bi-scenario, we prefer define this after conclusion of UE and RRH parameters.  **Issue 1-2-2: DMRS configuration**  Agree with 1+1+1 DMRS.  We think 1 DMRS is also can be used if Residual frequency offset after compensation is not large.  **Issue 1-2-3: BW**  Agree with Option 2.  From the definition of 38.306, we think 200MHz BW is mandatory, it should be include 200MHz at least.  Words in 38.306 : ”the bits in ***channelBWs-DL*** (without suffix) starting from the leading / leftmost bit indicate 50, 100 and 200MHz. The third / rightmost bit (for 200MHz) shall be set to 1 ”. |
| Qualcomm | **Issue 1-2-1: DPS transmission scheme**  As for Issue 1-1-4, the outcome of the deployment scenarios discussion should be taken into account. Also, if RAN4 will define requirements for both scenario 1a and 1b, the FR1 HST applicability rule regarding 1a/1b should be used also in this context.  **Issue 1-2-2: DMRS configuration**  Support WF, 1+1+1 DMRS.  For single tap channel, see Issue 1-1-3  **Issue 1-2-3: BW**  Most of the PDSCH FR2 requirements in 38.101-4 are defined for 100MHz, and that should be included at least for FR2 HST. |
| Intel | **Issue 1-2-1: DPS transmission scheme**  We tend to agree to Option 2a. As we commented before it is immature to discuss uni/bi-directional deployments hence we prefer not to capture specific deployment in agreement at current stage.  We would like not to mix demodulation and deployment discussion therefore general proposal as option 2a is fine for us.  **Issue 1-2-2: DMRS configuration**  Question to Ericsson, what is the purpose to define requirements HST Single tap channel model besides HST-DPS? HST-Single tap channel model does not give any additional verification points compared to HST-DPS.  For DMRS configuration we support Option 1. It allows to make DMRS based frequency offset estimation and also improve demodulation performance since the baseline receiver according to Rel-15 agreement is MMSE-IRC.  **Issue 1-2-3: BW**  In general, either Option 1 or Option 2 is fine for us but we suggest aligning of PUSCH and PDSCH configurations. |
| Huawei | **Issue 1-2-1: DPS transmission scheme**  OK with Option 2a.  **Issue 1-2-2: DMRS configuration**  Option 1.  **Issue 1-2-3: BW**  Option 2 to achieve large throughput. |
| Samsung | **Issue 1-2-1**  We are open to further discuss with taken into account RRH deployment scenario discussion. At current stage, based on the current Uni-directional RRH deployment discussion, as agreed in scenario A, 1 beam per UE panel, and only one active panel per UE can be used for Tx and Rx, FFS whether another panel can be used for beam search. For Uni-directional scenario, SSB from each RRHs has been transmitted with the same direction. In our view, another panel can be beneficial at the initial stage to assist UE to determine which panel will be used for receiver signal. After determining the panel for Rx, the Rx beam direction will be fixed. In that sense, scheme 1a with only tracking one active TCI state is feasible solution.  Therefore, at least for scenario A with Uni-directional, we think scheme 1a is more feasible  For other scenarios, we can further discuss whether scheme 1b is feasible or not.  **Issue 1-2-2**  Ok with option 1  DMRS is a typical configuration for FR1 HST. Different with uplink, the general FO compensation for current slot is based on the estimated FO in previous slots, which contains TRS or SSB. Due to the period of TRS or SSB, specifically for SSB, the period is 20ms. In FR2, it can be up to 160 slot. For HST scenario, the Doppler shift will change slots by slots. With only 1 DMRS, it may be not efficient to overcome the impact of residual FO. Therefore, it is benefit to configure more DMRS for residual FO estimation and compensation to improve accuracy of channel estimation  **Issue 1-2-3**  We are open to further discuss, we may need some input of operator for FR2 HST deployment, either option 1 and option 2 is fine for us, Option 1 is the exisitng requirement for FR2, we can use it as starting point. |

### 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#1-1** | **Issue 1-1-1: RS configuration to enable 350km/h**  *Tentative agreements:*   * Assumption of RS for frequency offset tracking is up to UE implementation, FFS the RS configuration for PDSCH requirement as   + Configure SSB every 20 ms   + Configure TRS every 10 ms   + Configure PTRS with KPT-RS=2 and LPT-RS=1   *Recommendations for 2nd round: N.A*   * More discussion is needed   **Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**  *Candidate options:*   * FFS to introduce PDSCH requirement in Uni/Bi-directional deployment scenario * Doppler frequency for PDSCH requirement in Bi-directional deployment scenario, if Bi-directional deployment scenario is introduced   + Option 1: 9722Hz targeting 350km/h at 30GHz   + Option 2: 7000Hz with the smallest RS range of frequency offset estimation * Doppler frequency for PDSCH requirement in Uni-directional deployment scenario, if Uni -directional deployment scenario is introduced   + 9722Hz targeting 350km/h at 30GHz   *Recommendations for 2nd round:*   * Taken into account of FR2 HST RRH deployment discussion to discuss whether to cover both Uni/Bi-direction scenario * If RAN4 introduce PDSCH requirement in Uni/Bi-directional deployment scenario, suggest company to discuss whether it is feasible to define set of Doppler frequency requirement for different scenario?     **Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**  *Candidate options:*   * Option 1 (Samsung, Huawei, Qualcomm, ): Do not define PDSCH requirement with HST single-tap channel * Option 2 (Ericsson, Intel): Define PDSDH requirement with HST single-tap channel (Uni-directional) with scenario A   *Recommendations for 2nd round:*   * More discussion is needed   **Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**  *Candidate options:*   * Option 1(Samsung): Define PDSCH requirement with Uni/Bi-directional scenario for both A and B, Define the test applicability rule to reduce the test effort * Option 2 (Huawei): Define requirements for both scenario A/B, and Uni/Bi-directional deployment, and not define any applicability between * Option 3 (ZTE): Consider output of FR2 HST deployment scenario discussion whether to cover scenario A * Option 4 (Ericsson): RAN4 define two test cases for HST FR2   + Test 1: HST single tap (Uni-directional) with scenario A     - Test 2: DPS (Uni-directional) with scenario B     - If RAN4 agree to consider both Uni-directional and Bi-directional deployment, either test 1 or 2 apply Bi-directional model   *Recommendations for 2nd round:*   * Taken into account of FR2 HST RRH deployment discussion and the related channel model to discuss whether to cover both Uni/Bi-direction scenario and scenario A/B   **Issue 1-1-5: UE frequency error assumption**  *Tentative agreements:*   * Do not consider extra UE frequency error for demodulation tests in FR2 HST WI.   + Impact of UE frequency error can be included in companies’ impairment results when RAN4 sets the UE demodulation requirement for FR2 HST   *Recommendations for 2nd round: N.A* |
| **Sub-topic#1-2** | **Issue 1-2-1: DPS transmission scheme**  *Candidate options:*   * Option 1(Samsung):   + Define PDSCH requirement with DPS scheme 1a in Uni-directional scenario for scenario A. FFS scheme 1b   + Define PDSCH requirement with DPS scheme 1a and 1b in Uni-directional scenario for scenario B, FFS the number of TCI state configured   + Define PDSCH requirement with DPS scheme 1a in Bi-directional scenario for scenario A and scenario B. FFS scheme 1b * Option 2 (Huawei): Define both DPS transmission scheme 1a and 1b for both Bi-directional and Uni-directional deployment   + Option 2a (Ericsson, Intel): RAN4 define both scheme 1a and 1b if the performance is same, but define the same applicability rule as Rel-16 HST, i.e., if a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases, and if a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases. * Option 3 (ZTE):   + DPS scheme 1a could be considered in Uni-directional RRH scenario   + If another panel cannot be used for beam search, scheme 1a could be considered in Bi-directional scenario. If another panel can be used for beam search, both scheme 1a and 1b could be considered in Bi-directional scenario.   *Recommendations for 2nd round: N.A*   * Taken into account of FR2 HST RRH deployment discussion to discuss whether to cover both scheme 1a and scheme 1b. * If RAN4 will define requirements for both scenario 1a and 1b, the FR1 HST applicability rule regarding 1a/1b can be applied   **Issue 1-2-2: DMRS configuration**  *Candidate options:*   * Option 1(Samsung, Intel, Qualcomm, Huawei,): 1+1+1 DMRS configuration for DPS * Option 2 (Ericsson, ZTE):   + 1 DMRS for HST single-tap channel   + 1+1+1 DMRS configuration for HST DPS   *Recommendations for 2nd round: N.A*   * More discussion is needed.     **Issue 1-2-3: BW**  *Candidate options:*   * Option 1(Samsung. Ericsson, Qualcomm, Intel): 100MHz CBW * Option 2 (Huawei, Intel, ZTE): 200MHz CBW * Option 3 (Intel): Align the CBW configuration for PDSCH and PUSCH   *Recommendations for 2nd round: N.A*   * More discussion is needed, the input of operator for practical FR2 HST deployment scenario can be considered |

### CRs/TPs

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

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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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

### Sub-topic 1-1 General

**Issue 1-1-1: RS configuration to enable 350km/h**

* Proposals
  + Assumption of RS for frequency offset tracking is up to UE implementation, FFS the RS configuration for PDSCH requirement as
    - Configure SSB every 20 ms
    - Configure TRS every 10 ms
    - Configure PTRS with KPT-RS=2 and LPT-RS=1
* Recommended WF
  + More discussion is needed

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| **Company** | **Comments** |
| Company A |  |

**Issue 1-1-2: Whether to introduce PDSCH requirement with low Doppler frequency in Bi-directional RRH deployment scenario**

* Proposals
  + FFS to introduce PDSCH requirement in Uni/Bi-directional deployment scenario
  + Doppler frequency for PDSCH requirement in Bi-directional deployment scenario, if Bi-directional deployment scenario is introduced
    - Option 1: 9722Hz targeting 350km/h at 30GHz
    - Option 2: 7000Hz with the smallest RS range of frequency offset estimation
  + Doppler frequency for PDSCH requirement in Uni-directional deployment scenario, if Uni -directional deployment scenario is introduced
    - 9722Hz targeting 350km/h at 30GHz
* Recommended WF
  + Taken into account of FR2 HST RRH deployment discussion to discuss whether to cover both Uni/Bi-direction scenario
  + If RAN4 introduce PDSCH requirement in Uni/Bi-directional deployment scenario, suggest company to discuss whether it is feasible to define set of Doppler frequency requirement for different scenario?

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| **Company** | **Comments** |
| Company A |  |

**Issue 1-1-3: Whether to introduce PDSCH requirement with HST single-tap channel**

* Proposals
  + Option 1 (Samsung, Huawei, Qualcomm): Do not define PDSCH requirement with HST single-tap channel
  + Option 2 (Ericsson, Intel): Define PDSDH requirement with HST single-tap channel (Uni-directional) with scenario A
* Recommended WF
  + More discussion is needed

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| **Company** | **Comments** |
| Company A |  |

**Issue 1-1-4: PDSCH requirement for Uni/Bi-directional scenario in scenario A and scenario B**

* Proposals
  + Option 1(Samsung): Define PDSCH requirement with Uni/Bi-directional scenario for both A and B, Define the test applicability rule to reduce the test effort
  + Option 2 (Huawei): Define requirements for both scenario A/B, and Uni/Bi-directional deployment, and not define any applicability between
  + Option 3 (ZTE): Consider output of FR2 HST deployment scenario discussion whether to cover scenario A
  + Option 4 (Ericsson): RAN4 define two test cases for HST FR2
    - Test 1: HST single tap (Uni-directional) with scenario A
* Test 2: DPS (Uni-directional) with scenario B
* If RAN4 agree to consider both Uni-directional and Bi-directional deployment, either test 1 or 2 apply Bi-directional model
* Recommended WF
  + Taken into account of FR2 HST RRH deployment discussion and the related channel model to discuss whether to cover both Uni/Bi-direction scenario and scenario A/B

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| **Company** | **Comments** |
| Company A |  |

### Sub-topic 1-2 PDSCH

**Issue 1-2-1: DPS transmission scheme**

* Proposals
  + Option 1(Samsung):
    - Define PDSCH requirement with DPS scheme 1a in Uni-directional scenario for scenario A. FFS scheme 1b
    - Define PDSCH requirement with DPS scheme 1a and 1b in Uni-directional scenario for scenario B, FFS the number of TCI state configured
    - Define PDSCH requirement with DPS scheme 1a in Bi-directional scenario for scenario A and scenario B. FFS scheme 1b
  + Option 2 (Huawei): Define both DPS transmission scheme 1a and 1b for both Bi-directional and Uni-directional deployment
    - Option 2a (Ericsson, Intel): RAN4 define both scheme 1a and 1b if the performance is same, but define the same applicability rule as Rel-16 HST, i.e., if a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases, and if a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases.
  + Option 3 (ZTE):
    - DPS scheme 1a could be considered in Uni-directional RRH scenario
    - If another panel cannot be used for beam search, scheme 1a could be considered in Bi-directional scenario. If another panel can be used for beam search, both scheme 1a and 1b could be considered in Bi-directional scenario.
* Recommended WF
  + Taken into account of FR2 HST RRH deployment discussion to discuss whether to cover both scheme 1a and scheme 1b.
  + If RAN4 will define requirements for both scenario 1a and 1b, the FR1 HST applicability rule regarding 1a/1b can be applied

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| **Company** | **Comments** |
| Company A |  |

**Issue 1-2-2: DMRS configuration**

* Proposals
  + Option 1(Samsung, Intel, Qualcomm, Huawei,): 1+1+1 DMRS configuration for DPS
  + Option 2 (Ericsson, ZTE):
    - 1 DMRS for HST single-tap channel
    - 1+1+1 DMRS configuration for HST DPS
* Recommended WF
  + More discussion is needed.

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| **Company** | **Comments** |
| Company A |  |

**Issue 1-2-3: BW**

* Proposals
  + Option 1(Samsung. Ericsson, Qualcomm, Intel): 100MHz CBW
  + Option 2 (Huawei, Intel, ZTE): 200MHz CBW
  + Option 3 (Intel): Align the CBW configuration for PDSCH and PUSCH
* Recommended WF
  + More discussion is needed, the input of operator for practical FR2 HST deployment scenario can be considered

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| **Company** | **Comments** |
| Company A |  |

# Topic #2: BS demodualtion requirement

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109217 | Intel | Proposal 1: Consider 200 MHz BW for UL HST FR2 requirements definition.  Proposal 2: Consider PUSCH allocation length as 10 for HST FR2 requirements definition.  Proposal 3: Define PUSCH requirements with MCS 16 and MCS 17. Define requirements with MCS 17 up to BS declaration support.  Proposal 4: Consider Ncs equals to 69 for PRACH HST FR2 requirements definition. |
| R4-2109749 | ZTE | Proposal 1: one DMRS is enough to demodulation requirement for PUSCH. |
| R4-2109805 | Samsung | Proposal 3: Define PUSCH requirement with uni-directional RRH deployment scenario only in scenario A. If both scenarios are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration.  Observation 1: For served RRH k, Doppler shift trajectory in Bi-directional is divided with two non-contiguous segments  Observation 2: For served RRH k, Doppler shift trajectory in Bi-directional is divided with three non-contiguous segments  Observation 3: The performance in Bi-directional scenario for each Doppler shift trajectory segments can be verified by the single-tap performance in Uni-directional scenario  Proposal 4: FFS to define the PUSCH requirement with non-contiguous Doppler shift trajectory, FFS on PUSCH Statistics method during the RRH switching time for requirement definition.  Proposal 5: If needed, define the PUSCH requirement with equivalent contiguous Doppler shift trajectory for bi-directional RRH deployment scenario with scenario A. If both scenarios A and B for bi-directional RRH deployment scenario are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration. |
| R4-2109806 | Samsung | Observation 1: The overhead of 1DMRS +PTRS (L=1, K=2) configuration is the smallest compared with other RS configuration schemes.  Observation 2: Similar performance can be achieved for both bi-directional and un-directional deployment scenario in scenario A  Observation 3: Similar performance can be achieved for un-directional scenario in scenario A and B  Observation 4: Better performance can be achieved for bi-directional scenario in scenario B  Observation 5: With 1 DMRS+PTRS (L=1, K=2) configuration, better performance can be achieved in terms of maximum throughput compared with other RS configurations.  Proposal 1: Define PUSCH demodulation requirement with only 1 DMRS + PT-RS (L=1, K=2) configuration  Proposal 2: For 120 KHz SCS, it is feasible to define PUSCH requirement with Doppler frequency as 19444Hz. FFS to define low Doppler frequency 14444Hz requirement based on target 260km/h.  Proposal 3: Define PUSCH requirement with 120 KHz SCS and 100 MHz CBW, FFS with 50MHz CBW  Proposal 4: Define one set of MCS for PUSCH requirement, MCS 16 can be regarded as starting point. Additional margin can be considered for performance requirement definition to allow different implementation if needed  Proposal 5: Define PUSCH requirement with length of data symbol as 9  Proposal 6: The following simulation assumption for PUSCH requirement with HST single tap setup can be considered as   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Disabled | | Default TDD UL-DL pattern (Note 1) | | 120kHz SCS:  3D1S1U, S=10D:2G:2U | | HARQ | Maximum number of HARQ transmissions | 4 | | RV sequence | 0, 2, 3, 1 | | DM-RS | DM-RS configuration type | 1 | | DM-RS duration | single-symbol DM-RS | | Additional DM-RS symbols | pos0 | | Number of DM-RS CDM group(s) without data | 2 | | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | | DM-RS port(s) | {0} | | DM-RS sequence generation | NID=0, nSCID =0 | | Time domain resource | PUSCH mapping type | B | | Start symbol index | 0 | | Allocation length | 9 | | Frequency domain resource | RB assignment | Full applicable test bandwidth | | Frequency hopping | Disabled | | TPMI index for 2Tx two-layer spatial multiplexing transmission | | 0 | | Code block group based PUSCH transmission | | Disabled | | PT-RS configuration | Frequency density (KPT-RS) | 2 | | Time density (LPT-RS) | 1 | | NOTE 1: The same requirements are applicable to TDD with different UL-DL patterns | | |   Proposal 7: Define UL timing adjustment requirement with only 1 DMRS + PT-RS (L=1, K=2) configuration  Proposal 8: Define UL timing adjustment requirement with MCS 16 as starting point  Proposal 9: Define UL timing adjustment requirement with CP-OFDM waveform  Proposal 10: Define UL timing adjustment requirement with 120 KHz SCS and 100 MHz CBW, FFS with 50MHz CBW  Proposal 11: Define UL timing adjustment requirement with the following RB allocation two UEs as  Moving UE: 0~32 for 100MHz CBW, FFS 0~15 for 50MHz  Stationary UE: 33-65 for 100 MHz CBW, FFS 16~32 for 50 MHz  Proposal 12: SRS bandwidth configuration is proposed as  C\_SRS = 11, B\_SRS =0, for 40RB with 120 KHz SCS and 100 MHz  FFS C\_SRS = 11, B\_SRS =0, for 20RB with 120 KHz SCS and 50 MHz  Transmission comb: KTC=2  Transmission periodicity: TSRS=10  Slots in which sounding RS is transmitted: The last symbol in slot#3 in radio frames  Proposal 13: The timing difference between moving UE and stationary UE should be scaled with  120 KHz SCS: Δτ - (TA −31)×16\*8Tc  Proposal 14: Set frequency offset as 19444Hz for PRACH format requirement to align the Doppler shift assumption of PUSCH  Proposal 15: Reuse the following test parameters for PRAH format requirement   |  |  |  | | --- | --- | --- | | PRACH | PRACH SCS | Time error tolerance | | preamble | (kHz) | AWGN | | C2 | 120 | 0.26us |  |  |  |  |  |  | | --- | --- | --- | --- | --- | | PRACH preamble | SCS (kHz) | Ncs | Logical sequence index | v | | C2 | 120 | 69 | 0 | 0 | |  | |
| R4-2110530 | Huawei, HiSilicon | Proposal 1: Define requirements for both scenario A/B and uni/bi-directional deployment, and not define any applicability rule between them.  Proposal 2: Use 200MHz for PUSCH tests under FR2 HST scenario.  Proposal 3: Use 10 symbols for PUSCH tests under FR2 HST scenario.  Proposal 4: Use MCS 16 for HST FR2 PUSCH requirements definition.  Proposal 5: Align the Doppler value with PUSCH for PRACH tests.  Proposal 6: Using Ncs = 69 for PRACH tests for FR2 HST. |
| R4-2110532 | Huawei, HiSilicon | Observation 1: There is negligible performance difference between DMRS 1+1 and DMRS 1+1+1.  Observation 2: There is about 1.2dB performance degradation between DMRS 1 and the others due to large residual frequency offset using PTRS only for frequency offset estimation.  Proposal 1: Use 1+1+1 DMRS+PTRS (L=1, K=2) for HST FR2 PUSCH requirements definition.  Proposal 2: If companies have strong concern about DMRS 1+1, create an applicability rule that only one DMRS configuration shall be tested by manufacture declaration. |
| R4-2110730 | Ericsson | Observation 1: The performance difference is negligible for PUSCH configured with PT-RS +(1+0) DM-RS and PT-RS +(1+1) DM-RS symbols  Proposal 1: Assume (1+0) DM-RS +PT-RS configuration for PUSCH demodulation  Proposal 2: Define test cases for scenario A only  Proposal 3: Configure 100MHz CBW for PUSCH demodulation requirements  Proposal 4: Configure 10 PUSCH symbols for FR2 HST demodulation requirements  Proposal 5: Configure highest MCS that remains below 20dB SNR (i,e. MCS20) for PUSCH demodulation  Proposal 6: Align CBW and MCS for UL timing adjustment and PUSCH demodulation requirements  Proposal 7: Apply 19444Hz frequency offset for PRACH, which corresponds to 350km/h at 30GHz carrier.  Proposal 8: Use Ncs=0 for PRACH HST FR2.  Proposal 9: RAN4 to decide to use between a). Current timing offset configuration; and b). timing offset configuration based on the largest expected cell radius, i.e., derived from scenario B. |
| R4-2111067 | Nokia | **On the test scope**  Observation 1: The difference in SINR values corresponding to 30% and 70% of PUSCH maximum TPut with the same test configuration in Scenario A and Scenario B is less than 0.3 dB. Scenario B looks to be slightly less challenging because the same relative TPut levels can be achieved at a bit lower SINR.  Observation 2: In HST FR1 PUSCH requirements, the performance difference between Scenario 1 and Scenario 4 in HST propagation conditions are not significant. However, different sets of tests are defined for both scenarios.  Proposal 1: RAN4 to define different sets of requirements for Scenario A and Scenario B.  Observation 3: The difference in SINR values corresponding to 30% and 70% of PUSCH maximum TPut with the same test configuration in uni- and bi-directional deployments is less than 0.1 dB.  Observation 4: The uni-directional and bi-directional scenarios are fundamentally different from the Doppler trajectory point of view.  Proposal 2: RAN4 to consider formulating HST FR2 PUSCH requirements based only one single-tap propagation model with continuous Doppler trajectory, i.e., reuse existing FR1 high speed train conditions with updated parameters.  Proposal 3: If it is decided that single HST conditions are not sufficient for HST FR2, then to define both PUSCH demodulation requirements for uni- and bi-directional RRH deployment scenarios.  **On PUSCH requirements**  Observation 5: 50MHz CBW is the minimal supported BW in FR2. However, in practical deployments, a wider frequency allocation is expected to be used in FR2.  Proposal 4: RAN4 to define HST FR2 BS demodulation requirements with 120KHZ SCS and for 50MHz and 200MHz SCS.  Observation 6: Following Table 6.4.1.1.3-3 in TS 38.211, the density of DM-RS symbols is higher for PUSCH duration in symbols equal to 9 than for duration 10.  Proposal 5: RAN4 to define HST FR2 BS demodulation requirements with the PUSCH duration in symbols equal to 9.  Proposal 6: RAN4 to define HST FR2 BS demodulation requirements only with QAM16, i.e., MCS 16.  Proposal 7: RAN4 to formulate PUSCH demodulation requirements at least with one addition DM-RS symbol per slot.  Proposal 8: RAN4 to formulate PUSCH demodulation requirements with mapping type B, one additional DM-RS position = pos 1 and l0=0.  **On UL timing adjustment requirements**  Proposal 9: Update parameters for UL timing adjustment scenario Y by .  adding the following HST FR2 relevant records: A - 120 kHz: 1.25 s; 120 kHz: 1.04 s-1.  Proposal 10: Update test parameters for testing UL timing adjustment as shown in the Table above   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Transform precoding | | Disabled | | Uplink-downlink allocation for TDD | | 15 kHz and 120 kHz SCS:  3D1S1U, S=10D:2G:2U  30 kHz SCS:  7D1S2U, S=6D:4G:4U | | Channel bandwidth | | 15 kHz SCS: 5MHz, 10 MHz  30 kHz SCS: 10MHz, 40 MHz  120 kHz SCS: 200 MHz | | MCS | | 16 | | HARQ | Maximum number of HARQ transmissions | 4 | |  | RV sequence | 0, 2, 3, 1 | | DM-RS | DM-RS configuration type | 1 | |  | DM-RS duration | single-symbol DM-RS | |  | DM-RS position (*l0*) | FR1: 2  FR2: 0 | |  | Additional DM-RS position | FR1: pos2  [FR2: pos1] | |  | Number of DM-RS CDM group(s) without data | 2 | |  | Ratio of PUSCH EPRE to DM-RS EPRE | -3 dB | |  | DM-RS port | {0} | | Time domain resource assignment | DM-RS sequence generation | NID0=0, nSCID =0 for moving UE  NID0=1, nSCID =1 for stationary UE | |  | PUSCH mapping type | FR1: Both A and B  FR2: B | |  | Allocation length | FR1: 14  [FR2: 9] | | Frequency domain resource assignment | RB assignment | 10MHz CBW: 25 RB for each UE  40MHz CBW: 50 RB for each UE  200MHz CBW: 66 RB for each UE | |  | Starting PRB index | Moving UE: 0  Stationary UE:  12 for 5MHz, 25 for 10 MHz CBW for SCS 15kHz,  12 for 10MHz, 50 for 40 MHz CBW for SCS 30kHz, and  66 for 120 SCS 120 KHz | |  | Frequency hopping | Disabled | | SRS resource allocation | Slots in which sounding RS is transmitted (Note 1) | For FDD: slot #1 in radio frames  For TDD:  - last symbol in slot #3 in radio frames for 15KHz and 120KHz  - last symbol in slot #7 in radio frames for 30KHz | |  | SRS resource allocation | 15 kHz SCS:  CSRS = 5, BSRS =0, for 20 RB  CSRS = 11, BSRS =0, for 40 RB  30 kHz SCS:  CSRS =5, BSRS =0, for 20 RB  CSRS = 21, BSRS =0, for 80 RB  120 kHz SCS:  CSRS = 33, BSRS =0 for 132 RB | | NOTE 1. The transmission of SRS is optional. And the transmission comb and SRS periodic are configured as KTC = 2, and TSRS = 10 respectively. | | |   Proposal 11: RAN4 to discuss if 50MHz CBW shall be added in the scope of UL timing adjustment requirements  **On PRAH requirements**  Proposal 12: RAN4 to discuss PRACH requirements with maximum Doppler shift corresponding to 30GHz CF at 250kmph, i.e,9722Hz  Observation 7: Ncs equal to 69 is the default value used for preamble format C2 in FR2 (120KHz SCS) PRACH requirements in normal mode.  Proposal 13: RAN4 to use Ncs=69 in HST FR2 PRACH test preamble configuration. |
| R4-2111108 | Nokia | Observation 1: There is no significant difference in the demodulation performance between the cases with only one and two DM-RS per slot when PT-RS is present. We can expect a similar behaviour when two additional DM-RS symbols are used.  Observation 2: It is practical to use at least one additional DM-RS symbol per slot in real implementation where fast fading is inevitably present. Moreover, in HST FR1 PUSCH requirements two additional DM-RS symbols are used.  Proposal 1: RAN4 to formulate PUSCH demodulation requirements at least with one addition DM-RS symbol per slot.  Proposal 2: RAN4 to formulate PUSCH demodulation requirements with mapping type B, one additional DM-RS position = pos 1 and l0=0. |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

Last RAN4 meeting agreements in the WF R4-2106102

List of open issues

* Sub-Topic 2-1: General
  + Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement
  + Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement
  + Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B
* Sub-Topic 2-2: PUSCH requirement
  + Issue 2-2-1: RS configuration
  + Issue 2-2-2: CBW
  + Issue 2-2-3: MCS
  + Issue 2-2-4: Length of data symbol
* Sub-Topic 2-3: UL timing adjustment requirement
  + Issue 2-3-1: Waveform
  + Issue 2-3-2: CBW
  + Issue 2-3-3: PUSCH resource allocation
  + Issue 2-3-4: RS configuration
  + Issue 2-3-5: PUSCH mapping type
  + Issue 2-3-6: length of PUSCH allocation
  + Issue 2-3-7: MCS
  + Issue 2-3-8: SRS bandwidth configuration
  + Issue 2-3-9: SRS Transmission comb
  + Issue 2-3-10: SRS Transmission periodicity
  + Issue 2-3-11: Slots in which sounding RS is transmitted
  + Issue 2-3-12: Test Parameters for timing offset
  + Issue 2-3-13: Timing different between moving UE and stationary UE
* Sub-Topic 2-4: PRACH requirement
  + Issue 2-4-1: Frequency offset for requirement
  + Issue 2-4-2: Test Preamble configuration
  + Issue 2-4-3: Timing offset configuration
  + Issue 2-4-4: Test error tolerance

### Sub-topic 2-1 General

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement**

* Proposals
  + Option 1(Samsung): 19444Hz
* Recommended WF
  + RAN4 to introduce PUSCH requirement with Doppler frequency as 19444Hz targeting 350km/h at 30GHz?

**Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement**

* Proposals
  + Option 1(Samsung): FFS to introduce PUSCH requirement with low Doppler frequency 14444Hz based on the targeting 260km/h UE speed at 30GHz carrier frequency
  + Option 2: No, only introduce PUSCH requirement with Doppler frequency 19444Hz
* Recommended WF
  + Encourage feedback from companies

**Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B**

* Observations
  + Observation 1(Samsung):
    - Similar performance can be achieved for both bi-directional and un-directional deployment scenario in scenario A
    - Similar performance can be achieved for Uni-directional scenario in scenario A and B
    - Better performance can be achieved for bi-directional scenario in scenario B compared with Uni-directional scenario
  + Observation 2 (Nokia):
    - The difference in SINR values corresponding to 30% and 70% of PUSCH maximum TPut with the same test configuration in Scenario A and Scenario B is less than 0.3 dB.
    - Scenario B looks to be slightly less challenging because the same relative TPut levels can be achieved at a bit lower SINR.
    - The difference in SINR values corresponding to 30% and 70% of PUSCH maximum TPut with the same test configuration in Uni- and bi-directional deployments is less than 0.1 dB
    - The Uni-directional and bi-directional scenarios are fundamentally different from the Doppler trajectory point of view
* Proposals
  + Option 1 (Samsung):
    - Define PUSCH requirement with Uni-directional RRH deployment scenario only in scenario A. If both scenarios are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration.
    - If both scenarios A and B for bi-directional RRH deployment scenario are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration
  + Option 2 (Nokia):
    - RAN4 to define different sets of requirements for Scenario A and Scenario B
    - If it is decided that single HST conditions are not sufficient for HST FR2, then to define both PUSCH demodulation requirements for Uni- and bi-directional RRH deployment scenarios.
  + Option 3 (Ericsson): Define test cases for scenario A only
  + Option 4 (Huawei): Define requirements for both scenario A/B and Uni/Bi-directional deployment, and not define any applicability rule between them
* Recommended WF
  + Encourage feedback from companies

### Sub-topic 2-2 PUSCH requirement

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: RS configuration**

* Observations
  + Observation 1(Samsung):
    - The overhead of 1DMRS +PTRS (L=1, K=2) configuration is the smallest compared with other RS configuration schemes
    - With 1 DMRS+PTRS (L=1, K=2) configuration, better performance can be achieved in terms of maximum throughput compared with other RS configurations
  + Observation 2 (Ericsson):
    - The performance difference is negligible for PUSCH configured with PT-RS +(1+0) DM-RS and PT-RS + (1+1) DM-RS symbols
  + Observation 3 (Huawei):
    - There is negligible performance difference between DMRS 1+1 and DMRS 1+1+1.
    - There is about 1.2dB performance degradation between DMRS 1 and the others due to large residual frequency offset using PTRS only for frequency offset estimation.
  + Observation 4 (Nokia):
    - There is no significant difference in the demodulation performance between the cases with only one and two DM-RS per slot when PT-RS is present. We can expect a similar behaviour when two additional DM-RS symbols are used.
    - It is practical to use at least one additional DM-RS symbol per slot in real implementation where fast fading is inevitably present. Moreover, in HST FR1 PUSCH requirements two additional DM-RS symbols are used
* Proposals
  + Option 1(Samsung, Ericsson, ZTE): 1 DMRS+ PT-RS (L=1, K=2)
  + Option 2(Nokia): 2 DMRS +PT-RS (L=1, K=2)
  + Option 3(Huawei): 3 DRMS +PT-RS (L=1, K=2)
    - Option 3a: If companies have strong concern about DMRS 1+1, create an applicability rule that only one DMRS configuration shall be tested by manufacture declaration
* Recommended WF
  + Encourage feedback from companies

**Issue 2-2-2: CBW**

* Observations
  + Observation 1 (Nokia): 50MHz is the minimal supported BW in FR2. However, in practical deployments, a wider frequency allocation is expected to be used in FR2
* Proposals
  + Option 1(Samsung): 100 MHz CBW, FFS 50MHz CBW
  + Option 2(Intel, Huawei): 200 MHz CBW
  + Option 3(Ericsson): 100 MHz CBW
  + Option 4(Nokia): 50 MHz CBW and 200 MHz CBW
* Recommended WF
  + Encourage feedback from companies

**Issue 2-2-3: MCS**

* Proposals
  + Option 1(Samsung, Huawei, Nokia): only with MCS16
    - Option 1a(Samsung): Additional margin can be considered for performance requirement definition to allow different implementation if needed
  + Option 2(Intel): Both MCS 16 and MCS17
    - Define requirements with MCS17 up to BS declaration support
  + Option 3(Ericsson): Configure highest MCS that remains below 20dB SNR, i.e, MCS20
* Recommended WF
  + Encourage feedback from companies

**Issue 2-2-4: Length of data symbol**

* Observations
  + Observation 1(Nokia): Following Table 6.4.1.1.3-3 in TS 38.211, the density of DM-RS symbols is higher for PUSCH duration in symbols equal to 9 than for duration 10.
* Proposals
  + Option 1(Samsung, Nokia): 9
  + Option 2(Huawei, Ericsson, Intel): 10
* Recommended WF
  + Encourage feedback from companies

### Sub-topic 2-3 UL timing adjustment requirement

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 2-3-1: Waveform**

* Proposals
  + Option 1(Samsung): CP-OFDM
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-2: CBW**

* Proposals
  + Option 1(Samsung): 100 MHz CBW, FFS 50 MHz CBW
  + Option 2(Ericsson): Align CBW for UL timing adjustment and PUSCH demodulation requirement
    - 100MHz CBW
  + Option 3(Huawei, Nokia): 200MHz CBW
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-3: PUSCH resource allocation**

* Proposals
  + Option 1(Samsung):
    - Moving UE: 0~32 for 100 MHz CBW, FFS 0~15 for 50 MHz CBW
    - Stationary UE: 33~65 for 100MHz CBW, FFS 16~31 for 50MHz CBW
  + Option 2 (Ericsson): Align CBW for UL timing adjustment and PUSCH demodulation requirement
    - Moving UE: 0~32 for 100 MHz CBW
    - Stationary UE: 33~65 for 100MHz CBW
  + Option 3 (Nokia, Huawei):
    - Moving UE: 0~65 for 200 MHz CBW
    - Stationary UE: 66~131 for 200MHz CBW
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-4: RS configuration**

* Proposals
  + Option 1(Samsung, Ericsson): 1 DMRS+ PTRS (L=1.K=2)
  + Option 2(Nokia): 2 DMRS +PTRS (L=1, K=2)
  + Option 3(Huawei): 3 DMRS +PTRS(L=1, K=2)
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-5: PUSCH mapping type**

* Proposals
  + Option 1(Nokia): Type B
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-6: length of PUSCH allocation**

* Proposals
  + Option 1(Nokia, Samsung): 9
  + Option 2(Huawei): 10
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-7: MCS**

* Proposals
  + Option 1(Samsung, Huawei, Nokia): MCS16
  + Option 2(Ericsson):Align MCS for UL timing adjustment and PUSCH demodulation requirement
    - Configure highest MCS that remains blow 20dB SNR, i.e., MCS20
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-8: SRS bandwidth configuration**

* Proposals
  + Option 1(Samsung):
    - C\_SRS =11, B\_SRS =0 for 40RB, with 100 MHz CBW
    - FFS C\_SRS = 5, B\_SRS=0 for 20RB, with 50 MHz CBW
  + Option 2(Huawei, Nokia): C\_SRS=33, B\_SRS=0 for 132RB with 200MHz CBW
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-9: SRS Transmission comb**

* Proposals
  + Option 1(Samsung, Nokia): KTC=2
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-10: SRS Transmission periodicity**

* Proposals
  + Option 1(Samsung, Nokia): TSRS=10
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-11: Slots in which sounding RS is transmitted**

* Proposals
  + Option 1(Samsung, Nokia, Huawei):
    - The last symbol in slot#3 in radio frames for 120KHz SCS
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-12: Test Parameters for timing offset**

* Proposals
  + Option 1(Nokia, Huawei):
    - A: 1.25us
    - 1.04 s-1
* Recommended WF
  + Encourage feedback from companies

**Issue 2-3-13: Timing different between moving UE and stationary UE**

* Proposals
  + Option 1(Samsung):
    - Δτ - (TA −31)×16\*8Tc
* Recommended WF
  + Encourage feedback from companies

### Sub-topic 2-4 PRACH requirement

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 2-4-1: Frequency offset for requirement**

* Proposals
  + Option 1(Samsung, Huawei, Ericsson, Nokia): Set frequency offset as 19444Hz to align the Doppler shift assumption of PUSCH, corresponding to 350km/h at 30GHz carrier
* Recommended WF
  + Define PRACH requirements with frequency offset as 19444Hz under AWGN channel?

**Issue 2-4-2: Test Preamble configuration**

* Observations
  + Observation 1(Nokia): Ncs equal to 69 is the default value used for preamble format C2 in FR2 (120 KHz SCS) PRACH requirements in normal mode
* Proposals
  + Option 1(Samsung, Intel, Huawei, Nokia)
    - Ncs = 69
    - Logical sequence index=0
    - v=0
  + Option 2(Ericsson):
    - Ncs = 0
* Recommended WF
  + Define PRACH requirements with test preamble configuration as ?
    - Ncs = 69
    - Logical sequence index=0
    - v=0

**Issue 2-4-3: Timing offset configuration**

* Proposals
  + Option 1(Ericsson): RAN4 to decide to use between a). Current timing offset configuration; and b). timing offset configuration based on the largest expected cell radius, i.e., derived from scenario B
* Recommended WF
  + More clarification of option 1 is needed.

**Issue 2-4-4: Test error tolerance**

* Proposals
  + ~~Option 1(Samsung): 0.26us for AWGN~~
  + Option 2(Nokia, Huawei, Samsung): 0.07us for AWGN
* Recommended WF
  + Encourage feedback from companies

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 2-1-1: OK with option 1  Issue 2-1-2: We prefer option 2; we do not see a strong motivation to create two sets of requirements; algorithms will anyhow be the same for both cases.  Issue 2-1-3: We do not see any algorithmic difference between the receiver needed for scenario A and for scenario B, hence do not see the need for two sets of requirements. Test coverage is sufficient with just one set. In case we would have 2 sets of requirements, we would not see the need to run tests for both sets on all basestations because anyhow some BS will either be intended for scenario A or for scenario B but not both; which tests would be fulfilled would be declaration. |
| ZTE | **Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement**  Agree with Recommended WF. |
| Intel | **Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement**  Support the recommended WF.  **Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement**  What is the issue to support 350 km/h UE speed? At current stage we prefer Option 2 but would like to see other companies views on justification of requirements with lower UE speed.  **Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B**  We prefer to capture companies observations in WF, but decision on requirements introduction should be FFS until deployment study outcome. In HST FR1 two sets of scenarios are considered: open space and tunnel. However we also do not see big difference in these scenarios from receive processing perspective. |
| Nokia, Nokia Shanghai Bell | **Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement** Proposed WF is OK for us.  **Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement** It looks like none of the companies has objected the support of 350kmph maximum train speed so far. It was agreed that PT-RS shall be configured in the demodulation performance tests. Hence, Option 2 is OK for us. If any problems with the support of 350kmph maximum speed are identified later, this Issue can be re-opened.  **Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B** For the moment, it is hard to justify why requirements shall be based only on one type of deployment scenario (either A or B). On the other hand, the scenarios -A and B are not fundamentally different, and our link-level simulations have shown that demodulation pefromance in those is very close. We can consider selecting only one of the scenarios to be tested but, firstly, the difference in the performance results needs to be checked after the channel models are agreed. Thus, we propose: *Select one of the deployment scenarios for testing (e.g., with applicability rule), if the deference in performance results between Scenario-A and Scenario-B is found to be not meaningful.*  Regarding the uni-and bi-directional deployments, the discussion is also dependent on channel models. One simple solution can be *Re-use only one single-tap channel model already defined for HST FR1 both for uni-directional and bi-directional deployments. Then, no separate bi- and uni-directional requirements are needed.* However, if different channel models are defined, then two different sets of requirements should be defined as well, i.e., Option 2. |
| Huawei | **Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement**  OK with Option 1.  **Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement**  Option 2. We don’t see any problem to support 350km/h.  **Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B**  Both scenario A/B and Uni/Bi-directional deployment requirements should be defined. Manufacture declaration can be used and the case will be tested only when BS vender declares to support it.  We are also OK with the new proposal from Nokia that *Re-use only one single-tap channel model already defined for HST FR1 both for uni-directional and bi-directional deployments.* |
| Samsung | **Issue 2-1-1**  We are ok with option 1  Based on the maximum speed analysis, it is feasible to support 350km/h maximum UE speed for uplink with PTRS configured. Therefore, it is feasible to define PUSCH requirement based on UE velocity of 350km/h. Based on the agreed carrier frequency for Doppler calculation, the related Doppler frequency for Uplink is 19444Hz  **Issue 2-1-2**  In the previous meeting, two candidate maximum support speeds are considered for evaluation based on different RS configurations. In FR1 HST WI, RAN4 defined PUSCH requirement with both 350km/h and 500km/h UE speed. For LTE Rel-16 HST WI, two sets of Doppler value requirements are specified based on BS declaration.  Although it is agreed to configure PTRS of PUSCH, from BS receiver processing perspective, whether to apply PTRS, joint DMRS+PTRS, or DMRS only for Doppler estimation depends on BS implementation. In case of DMRS method, only support 260km/UE speed, therefore, low Doppler frequency should be considered.  We are open to discussion whether it is necessary to define PUSCH requirement with low Doppler frequency value  **Issue 2-1-3**  We are ok to further discuss based on the output of RRH deployment discussion and the related channel model discussion.  While from demodulation perspective, we suggest companies to analysis what the difference for different scenario. At current stage, it is expected that channel model will be different for those scenarios, which we need to analysis which scenario or channel model is more challenge for baseband processing in case those scenarios was agreed.  From performance perspective, according our simulation results, similar performance can be achieved for Uni-directional in scenario A and scenario B. In that sense, there is no necessary to test both, from testing perspective. Since only one of scenario will be applied in the real deployment based on operator required, therefore, which test should be applied depending on BS declaration |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-2-1: To Huawei: We do not see a 1.2dB degradation from using PT-RS, but even if there is some difference it is worth to remember that the achieved data rate is lower if additional DM-RS are allocated. To Nokia: Even with fading, we do not see any performance degradation for 1 DM-RS unless the Doppler spread is pretty high (much greater than would ever be expected from LoS). If there is some scenario in which high Doppler spread should arise, we should capture it and create a requirement with a corresponding channel model.  Issue 2-2-2: We do not think 50MHz is very likely. On the other hand, ruling out 100MHz being set aside for railway developments may not be very wise. Possibly we could consider several bandwidths (but an applicability rule for testing).  Issue 2-2-3: The link conditions will be good for this application. On the other hand, the ability to add capacity by adding more BS is very limited. So the minimum requirements should envisage high spectral efficiency.  Issue 2-2-4 |
| ZTE | **Issue 2-2-1: RS configuration**  Agree with Option 1.  The shorter RS period, the smaller the residual frequency offset after compensation. the coherence time is lager if RFO is small, it could be not time selective fading within the coherence time, 1 DMRS could be used.  **Issue 2-2-2: CBW**  Agree with Option 2.  200MHz should be included at least. |
| Intel | **Issue 2-2-1: RS configuration**  Prefer to consider at least one additional SMRS symbol. It allows to improve frequency estimation accuracy in addition to PTRS based tracking.  **Issue 2-2-2: CBW**  Support Either/both Option 2 or/and Option 3. How many channel bandwidths companies are planning to consider for requirements introduction? From our point of view, one will be enough.  **Issue 2-2-3: MCS**  For some BS implementations it can be challenging to support 64QAM due to post FFT frequency offset compensation and corresponding high ICI. In this case requirements with lower modulation order cannot guarantee operation with 64QAM. Same time if RAN4 will define requirements only with 64QAM it means that some possible BS implementations is precluded. However, different BS implementation might be beneficial for different scenarios.  To summarize we see two issues:   * How to guarantee 64QAM operation? * How to not preclude any possible BS implementations? (with pre and post FFT FOC)   We encourage other companies to provide feedback on these questions.  From our point of view definition of mandatory 16QAM and up to BS declaration 64QAM requirements can address above problems. For HST FR1 we also have requirements for two modulation orders: QPSK and 16QAM. For HST FR2 considering limited number of CPE it is better to consider higher modulations.  **Issue 2-2-4: Length of data symbol**  This issue depends on agreed DMRS configuration. However, we have not a strong preference and both options are fine for us. |
| Nokia, Nokia Shanghai Bell | **Issue 2-2-1: RS configuration** We keep the opinion that, in practice, mmWave channel, even in LoS regime, will be rather dynamic. Hence, it is reasonable to have at least two DM-RS symbols per slot. We support Option 2. Option 3 is also OK for us.  **Issue 2-2-2: CBW** After some further considerations, we think that it is too early to exclude 100 MHz CBW. On the other hand, testing all of CBWs: 50, 100 and 200 MHz can introduce too much overhead. Thus, it makes sense *to define an applicability rule* if requirements for multiple CBWs are defined. |
| Huawei | **Issue 2-2-1: RS configuration**  Option 3 to provide better FOE performance. Also DMRS 1+1+1 can provide more performance benefit for the some implementation that DMRS is used for phase noise estimation.  **Issue 2-2-2: CBW**  Option 2 to achieve larger throughput.  **Issue 2-2-3: MCS**  Option 1. MCS 17 has lower spectral efficiency but high required SNR, so we don’t think it necessary to introduce MCS 17 for HST FR2. Also, MCS 16 is the same MCS for FR1 HST requirements definition.  **Issue 2-2-4**  Option 2 to align with the existing FR2 cases. We don’t see any reason to change it to 9. |
| Samsung | **Issue 2-2-1 RS configuration**  We still prefer option 1.  As for FR2, to enable 350km/h maximum speed, the PTRS should be configured, where the maximum frequency offset tracking capacity is larger than DMRS. Therefore, the number of DMRS is not the bottleneck of frequency tracking for FR2.  Generally, the Doppler estimation is based on the correlation operation between adjacent RS. Based on PTRS method, the number of available correlation group for 1DMRS+PTRS is more, which can improve the estimation accuracy with average operation.  Based on the agreement, only single tap channel is considered for FR2 HST WI. Different with fading channel, there is no necessary to configure more DMRS to overcome the fading impact.  Again, as mentioned in the WID, the roof UE is a decided CPE for HST scenario in FR2. As agreed, RAN4 requirement can be defined based on the baseline of 1 CPE device per train. In that sense, less UE can be served by RRH, where it is not an interference limited scenario or resource limited scenario, different for FR1, more UE can access the network for uplink. Therefore, more resources can be allocated for uplink to improve the uplink throughput in FR2. With more DMRS symbols, the overhead of RS is higher than 1 DMRS+PTRS.  Base our simulation, better throughput can be achieved under 1DMRS+PTRS configuration  **Issue 2-2-2 CBW**  Regarding the BW, 50MHz, 100MHz and 200MHz are available for FR2. From BS receiver processing perspective, there is no difference foreseen for different CBWs.  Based on companies proposal, it seems that all interesting companies do not prefer to define requirement with all the available CBWs in FR2  The test purpose is to verify the Doppler tracking processing, thus, we prefer to select the typical CBWs for requirement,. For FR2, 100MHz should be the typical CBW. While for FR2 HST scenario, the input of operator also need be taken into account. Therefore, we are open to further discuss whether to define 100MHz or 200MHz CBW requirement. Meanwhile, the test coverage should be also be considered. Whether to define additional CBW requirement as 50MHz, in case only 50MHz CBW can be supported based on BS declaration  So, maybe we can narrow down with two options as  Option 1: 100MHz, FFS 50MHz, with test applicable rule  Option 2: 200Mhz, FFS 50MHz, with test applicable rule  **Issue 2-2-3: MCS**  Generally, we agree that both two kinds of FO method can be possible for BS implementation, While whether to apply pre or post-FFT frequency offset compensation, it is up to BS implementation. From my understanding, the manufacture will not design a dedicated product for HST scenario, most likely, it will reuse the existing product for HST deployment scenario. The common UEs around RRH can still access the BS. In that sense, post-FFT frequency offset compensation should be the typical implementation for UL.  We agree that there is demodulation performance degradation. We are not sure whether BS will change the implementation based on the different MCS. Therefore, to address the potential performance misalignment, additional margin can be considered for performance requirement definition to allow different implementation.  Regarding MCS selection, we prefer to only choose one of them, no need to define two sets of MCS.  We are open to further discuss whether high MCS will be considered. For high MCS, the drawback will be the achieved SNR is very higher, it may be higher than 20dB, For FR2, only OTA test can be available, whether the high SNR above 20dB can be tested by TE vendor in Rel-17, we may need some input from TE vendor to confirm there is any test issue.  At this stage, we think MC16 is feasible, we can use it as a starting point  **Issue 2-2-4: Length of data symbol**  Our preference RS configuration is 1 DMRS+PTRS, we are open to down selection of them. In our side, we slightly prefer to use 9 as the length of data symbol. |

Sub topic 2-3

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| **Company** | **Comments** |
| Ericsson | Issue 2-3-1: Option 1 OK for us  Issue 2-3-2: We should use the same bandwidth(s) as agreed for the PUSCH requirements  Issue 2-3-3: Depends on the agreed bandwidth(s)  Issue 2-3-4: We should use the same RS configuration as agreed for the PUSCH requirements  Issue 2-3-5: OK  Issue 2-3-6: We should use the same as agreed for the PUSCH requirements  Issue 2-3-7 We should use the same as agreed for the PUSCH requirements  Issue 2-3-8: Depends on the bandwidth(s). For 100MHz, C\_SRS=17 could be proposed which leads to 64 PRBs and for 50MHz, C\_SRS=9, which leads to 32 PRBs  Issue 2-3-9: OK  Issue 2-3-10: OK  Issue 2-3-11: OK  Issue 2-3-12: OK  Issue 2-3-13: OK |
| ZTE | **Issue 2-3-2: CBW**  Agree with Option 3.  200MHz should be included at least. |
| Intel | **Issue 2-3-1: Waveform**  Option 1 is fine for us.  **Issue 2-3-2: CBW**  100 MHz for each UE is fine for us. (Option 3)  **Issue 2-3-3: PUSCH resource allocation**  Depends on issue 2-3-2 that we suggest resolving first.  **Issue 2-3-4: RS configuration**  Suggest aligning RS configuration with PUSCH once it will be agreed.  **Issue 2-3-5: PUSCH mapping type**  Option 1 is fine for us.  **Issue 2-3-6: length of PUSCH allocation**  Suggest aligning with PUSCH configuration once it will be agreed.  **Issue 2-3-7: MCS**  Prefer to discuss this issue after reaching agreement of PUSCH MCS.  **Issue 2-3-8: SRS bandwidth configuration**  Depends on issue 2-3-2 that we suggest resolving first.  **Issue 2-3-9: SRS Transmission comb**  Option 1 is fine for us.  **Issue 2-3-10: SRS Transmission periodicity**  Option 1 is fine for us.  **Issue 2-3-11: Slots in which sounding RS is transmitted**  Option 1 is fine for us.  **Issue 2-3-12: Test Parameters for timing offset**  Option 1 is fine for us.  **Issue 2-3-13: Timing different between moving UE and stationary UE**  Option 1 is fine for us, but we should take into account possible enhancements for timing adjustment command that is currently discussed in RRM room. |
| Nokia, Nokia Shanghai Bell | It was not discussed before but it should be, firstly, agreed in the Deployment thread if other types of UE than CPEs shall be present in the network. If only CPE devices are considered than it is not a typical situation that stationary and high-speed CPEs are close to each other. Therefore, *the UL timing adjustment requirement might not be needed.*  **Issue 2-3-1: Waveform** Option 1 is OK for us.  **Issue 2-3-2: CBW** We agree that channel BW shall be aligned with PUSCH demodulation requirement, i.e. CBW for UL timing adjustment shall be one of PUSCH CBWs. It should be sufficient to define this requirement only for one CBW. Out of 50MHz, 100Mhz, and 200MHz, 100MHz can be compromise. 50MHz including the split of BW between the tow UEs does not look to be the most typical arrangement. On the other hand, for 200MHz the power range will be reduced. Thus, we also agree with Option 2.  **Issue 2-3-3: PUSCH resource allocation** Option 2 is also fine for us.  **Issue 2-3-4: RS configuration** The configuration should be aligned with PUSCH. Thus, we support Option 2 and Option 3.  **Issue 2-3-5: PUSCH mapping type** Option 1 is OK.  **Issue 2-3-6: length of PUSCH allocation** Also need to align with PUSCH. Support Option 1.  **Issue 2-3-7: MCS** Also need to align with PUSCH. Support Option 1.  **Issue 2-3-8: SRS bandwidth configuration** In Option 1, if 100MHz total CBW is consider (66 PRBs), then C\_SRS=11 will results in 40 PRBs allocated with SRS symbols per UE. It is too much for one UE. Hence, C\_SRS=9 with 32 allocated PRBs for SRS looks to be more reasonable choice. Thus, *an option with 100MHz CBS and C\_SRS=9* will be also OK for us.  **Issue 2-3-13: Timing different between moving UE and stationary UE** Option 1 is OK. |
| Huawei | **Issue 2-3-1: Waveform**  Option 1.  **Issue 2-3-2: CBW**  Option 3 to achieve larger throughput.  **Issue 2-3-3: PUSCH resource allocation**  This issue can be derived after agreement on Issue 2-3-2 is achieved.  **Issue 2-3-4: RS configuration**  Option 3.  **Issue 2-3-5: PUSCH mapping type**  Option 1.  **Issue 2-3-6: length of PUSCH allocation**  Option 2.  **Issue 2-3-7: MCS**  Option 1.  **Issue 2-3-8: SRS bandwidth configuration**  Option 2.  **Issue 2-3-9: SRS Transmission comb**  Option 1.  **Issue 2-3-10: SRS Transmission periodicity**  Option 1.  **Issue 2-3-11: Slots in which sounding RS is transmitted**  Option 1.  **Issue 2-3-12: Test Parameters for timing offset**  Option 1.  **Issue 2-3-13: Timing different between moving UE and stationary UE**  Option 1. |
| Samsung | To Nokia: From my understanding, the manufacture will not design a dedicated product for HST scenario, most likely, it will reuse the existing product for HST deployment scenario. The other UEs around RRH can still access the BS.  Meanwhile, the stationary CPE and moving CPE can still be available at real HST scenario, for example, when the train is moving to train station or far away the train station, there are still some trains staying in the station.  Even without considering common UE can access the BS. Based on the RRH deployment discussion, specifically for uni-directional scenario, there is a large propagation delay when the served RRH switching, around 4CP, where both Rx timing and UL TA will be impacted  Therefore, it is necessary to verify the BS receiver for timing offset estimation  Issue 2-3-1: Waveform  Align with PUSCH requirement under HST, only define UL timing requirement with CP-OFDM only, considering the train is close to the RRH, not targeting cell edge UE. Therefore, there is no need to consider DFT=s-OFDM waveform.  Issue 2-3-2: CBW  Similar view with PUSCH, for typical CBW, we may need some input of operator for FR2 HST deployment. Meanwhile, the test coverage should be also taken into account in case only the minimum CBWs is supported by BS based on declaration  Issue 2-3-3: PUSCH resource allocation  This issue related with CBW for UL timing adjustment  Issue 2-3-4: RS configuration  Option 1,  For timing adjustment requirement, there is no Doppler considering. The timing offset is mainly factor to impact the modulation performance. For timing offset estimation, it was performed at frequency domain. So, there is no need to considering additional DMRS, which will increasing the overhead.  Issue 2-3-5: PUSCH mapping type  Ok with option 1  Issue 2-3-6: length of PUSCH allocation  Ok with option1, also fine with option 2, based on our prefered RS configuratrion as 1 DMRS+1 PTRS  Issue 2-3-7: MCS  Similar with comment of PUSCH, MCS16 can be used as a starting point. With high MCS level, the OTA test ability issue may need to be considered.  Issue 2-3-8: SRS bandwidth configuration  This issue was related with CBW. ,  For FR1 HST, to align with LTE, the allocated SRS bandwidth is smaller than full bandwidth. Whether full bandwidth for SRS should be considered?  Issue 2-3-9: SRS Transmission comb  Ok with option 1  Issue 2-3-10: SRS Transmission periodicity  Ok with option 1  Issue 2-3-11: Slots in which sounding RS is transmitted  Ok with option 1  Issue 2-3-12: Test Parameters for timing offset  In general, the A is setting the double of CP length  Based on the RRH deployment discussion, specifically for uni-directional scenario, there is a large propagation delay when the served RRH switching, around 4CP, where both Rx timing and UL TA will be impacted. In FR1 HST, the speed of the timing change in the eNB time adjustment test is relatively slow, tracking the roundtrip propagation delay changes is not difficult and proper uplink timing can be maintained with small incremental adjustments. While for FR2 HST, as mentioned, for uni-directional,  At current stage, we suggest to further discuss whether the value of A should be increased to 4CP round to 2.5us  Issue 2-3-13: Timing different between moving UE and stationary UE  Ok with option 1 |

Sub topic 2-4

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| **Company** | **Comments** |
| XXX | Issue 2-4-1: OK  Issue 2-4-2: One issue with Ncs = 69 is that it only supports a range of up to around 600m, which is not as large as the scenarios we have considered. As the default for normal FR2 it works, but here it might not be easily used for HST.  Issue 2-4-3: The question is whether to use the same timing offset configuration as other RACH requirements, or to take into account that the cell size will be bigger for HST FR2 (due to the LoS channel) when setting the timing offset parameters.  Issue 2-4-4 |
| Intel | **Issue 2-4-1: Frequency offset for requirement** Support the recommended WF.  **Issue 2-4-2: Test Preamble configuration**  Thanks, Ericsson, for pointing this issue. BS should be able to estimate time offset that corresponds to 2\*(inter-RRH distance/2). Based on our calculations Ncs 69 allows to estimate less than 700m that is not enough for inter-RRH distance as 700m. In this case we change our view and suggest defining requirements with Ncs = 0.  **Issue 2-4-3: Timing offset configuration**  We can leave both options open and check performance next meeting for both option a and b. In this case we should align on time offset values for scenario b.  **Issue 2-4-4: Test error tolerance**  Option 1 can be considered as a baseline because it can depends on analysis for Option 2-4-3. |
| Nokia, Nokia Shanghai Bell | **Issue 2-4-2: Test Preamble configuration** We somewhat agree with the comment from Ericsson that with Ncs = 69 we are on the limit of supported range. However, we also think that it still should be sufficient for the 700m Ds considered in the priority scenarios. Hence, we still prefer Option 1 slightly more.  **Issue 2-4-3: Timing offset configuration** In general, the maximum realistic t-offset is dependent on and can be calculated via the cell size. Even though the FR1 HST cell sites can be potentially larger than HST FR2 ones, 0.9 us maximum time offset was used in FR1 HST. Hence, we propose to keep current timing offset configuration.  **Issue 2-4-4: Test error tolerance** We don't see a reason to change from the former agreed value of TT for 120kHz, i.e., we propose to use 0.07us for AWGN. |
| Huawei | **Issue 2-4-1: Frequency offset for requirement**  OK with Option 1.  **Issue 2-4-2: Test Preamble configuration**  We are OK to use Ncs=0 to solve the coverage issue in RACH.  **Issue 2-4-3: Timing offset configuration**  We prefer to keep current timing offset configuration.  **Issue 2-4-4: Test error tolerance**  We prefer to use 0.07us, i.e. same as Rel-15 FR2 requirements. |
| Samsung | **Issue 2-4-1: Frequency offset**  Ok with option 1  **Issue 2-4-2: Test Preamble configuration**  We are fine with the comment from Ericsson with Ncs=0  **Issue 2-4-3: Timing offset configuration**  We can further check this issue  **Issue 2-4-4: Test error tolerance**  0.26us should be typo of our proposal. 0.07us is correct. |

### 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub-topic#2-1** | **Issue 2-1-1: Maximum Doppler frequency for specifying PUSCH requirement**  *Tentative agreements:*   * Introduce PUSCH requirement with Doppler frequency as 19444Hz targeting 350km/h at 30GHz   *Recommendations for 2nd round: N.A*  **Issue 2-1-2: Whether to introduce low Doppler frequency 14444Hz for PUSCH requirement**  *Tentative agreements:*   * Do not introduce PUSCH requirement with Doppler frequency as 14444Hz targeting 260km/h at 30GHz, if no issue with support 350km/h was identified   *Recommendations for 2nd round: N.A*  **Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B**  *Candidate options:*   * Option 1 (Samsung):   + Define PUSCH requirement with Uni-directional RRH deployment scenario only in scenario A. If both scenarios are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration.   + If both scenarios A and B for bi-directional RRH deployment scenario are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration * Option 2 (Nokia):   + RAN4 to define different sets of requirements for Scenario A and Scenario B   + If it is decided that single HST conditions are not sufficient for HST FR2, then to define both PUSCH demodulation requirements for Uni- and bi-directional RRH deployment scenarios. * Option 3 (Ericsson): Define test cases for scenario A only * Option 4 (Huawei): Define requirements for both scenario A/B and Uni/Bi-directional deployment, and not define any applicability rule between them   *Recommendations for 2nd round: N.A*   * Taken into account of FR2 HST RRH deployment discussion and the related channel model to discuss whether to cover both Uni/Bi-direction scenario and scenario A/B |
| **Sub-topic#2-2** | **Issue 2-2-1: RS configuration**  *Candidate options:*   * Option 1(Samsung, Ericsson, ZTE): 1 DMRS +PTRS (L=1,K=2) * Option 2(Nokia, Intel): 2 DMRS+ PTRS (L=1,K=2) * Option 3(Huawei, Nokia): 3 DMRS +PTRS (L=1,K=2)   *Recommendations for 2nd round: N.A*   * More discussion is needed   **Issue 2-2-2: CBW**  *Candidate options:*   * Option 1: 100MHz, and 50MHz with test applicable rule (Samsung, Nokia) * Option 2: 200MHz, and 50MHz with test applicable rule (Samsung, Nokia) * Option 3: 100MHz only (Intel, Ericsson) * Option 4: 200MHz only (Huawei, Intel, ZTE)   *Recommendations for 2nd round:*   * More discussion is needed   **Issue 2-2-3: MCS**  *Candidate options:*   * Option 1(Samsung, Huawei, Nokia): MCS 16   + Option 1a(Samsung): Additional margin can be considered for performance requirement definition to allow different implementation if needed * Option 2 (Intel): both MCS 16 and MCS 17   + Define requirements with MCS17 up to BS declaration support * Option 3(Ericsson): Configure highest MCS that remains below 20dB SNR, i.e, MCS20   *Recommendations for 2nd round:*   * Encourage companies to check performance difference with MCS 16 and MCS17 in the next meeting   **Issue 2-2-4: Length of data symbol**  *Candidate options:*   * Align the length of data symbol for UL timing adjustment with PUSCH   + Option 1 (Samsung, Nokia, Intel): 9   + Option 2 (Huawei, Intel, Ericsson ): 10   *Recommendations for 2nd round: N.A*   * Encourage companies to check performance difference with option 1 and option 2 in the next meeting |
| **Sub-**  **topic #2-3** | **Issue 2-3-1: Waveform**  *Tentative agreements:*   * CP-OFDM   *Recommendations for 2nd round: N.A*  **Issue 2-3-2: CBW**  *Candidate options:*   * Align CBW for UL timing adjustment and PUSCH demodulation   + Option 1: 100MHz, and 50MHz with test applicable rule (Samsung, Nokia)   + Option 2: 200MHz, and 50MHz with test applicable rule (Samsung, Nokia)   + Option 3: 100MHz only (Intel, Ericsson)   + Option 4: 200MHz only (Huawei, Intel, ZTE)   *Recommendations for 2nd round:*   * More discussion is needed. Suggest to discuss the CBW for PUSCH   **Issue 2-3-3: PUSCH resource allocation**  *Candidate options:*   * Option 1(Samsung):   + Moving UE: 0~32 for 100 MHz CBW, FFS 0~15 for 50 MHz CBW   + Stationary UE: 33~65 for 100MHz CBW, FFS 16~31 for 50MHz CBW * Option 2 (Ericsson): Align CBW for UL timing adjustment and PUSCH demodulation requirement   + Moving UE: 0~32 for 100 MHz CBW   + Stationary UE: 33~65 for 100MHz CBW * Option 3 (Nokia, Huawei):   + Moving UE: 0~65 for 200 MHz CBW   + Stationary UE: 66~131 for 200MHz CBW   *Recommendations for 2nd round:*   * More discussion is needed. Suggest to discuss the CBW for PUSCH   **Issue 2-3-4: RS configuration**  *Candidate options:*   * Option 1 (Samsung, Ericsson, ZTE): 1 DMRS+PTRS (L=1,K=2) * Option 2 (Nokia, Intel): 2 DMRS+PTRS (L=1,K=2) * Option 3 (Huawei, Nokia): 3 DMRS+ PTRS (L=1,K=2)   *Recommendations for 2nd round:*   * More discussion is needed. Suggest to discuss the RS configuration for PUSCH   **Issue 2-3-5: PUSCH mapping type**  *Tentative agreements:*   * Type B   *Recommendations for 2nd round: N.A*  **Issue 2-3-6: length of PUSCH allocation**  *Candidate options:*   * Align with PUSCH for UL timing adjustment   + Option 1 : 10   + Option 2: 9   *Recommendations for 2nd round:*   * Encourage companies to check performance difference with option 1 and option 2 in the next meeting   **Issue 2-3-7: MCS**  *Candidate options:*   * Align with PUSCH for UL timing adjustment   + Option 1(Samsung, Huawei, Nokia): MCS16     - Option 1a(Samsung): Additional margin can be considered for performance requirement definition to allow different implementation if needed   + Option 2 (Intel): both MCS16 and MCS17     - Define requirements with MCS17 up to BS declaration support   + Option 3 (Ericsson):Align MCS for UL timing adjustment and PUSCH demodulation requirement, configure highest MCS that remains blow 20dB SNR, i.e., MCS20   *Recommendations for 2nd round:*   * Suggestion to discussion the MCS for PUSCH firstly. Encourage companies to check performance difference with MCS16 and MCS17 in the next meeting   **Issue 2-3-8: SRS bandwidth configuration**  *Candidate options:*   * Option 1(Samsung, Nokia):   + Option 1a (Samsung):     - C\_SRS =11, B\_SRS =0 for 40RB, with 100 MHz CBW     - C\_SRS = 5, B\_SRS=0 for 20RB, with 50 MHz CBW   + Option 1b (Nokia):     - C\_SRS =9, B\_SRS =0 for 32RB, with 100 MHz CBW   + Option 1c (Ericsson):     - C\_SRS =17, B\_SRS =0 for 64RB, with 100 MHz CBW     - C\_SRS = 9, B\_SRS=0 for 32 RB, with 50 MHz CBW * Option 2(Huawei, Nokia): C\_SRS=33, B\_SRS=0 for 132RB with 200MHz CBW   *Recommendations for 2nd round:*   * Suggestion to discussion the CBW firstly   **Issue 2-3-9: SRS Transmission comb**  *Tentative agreements:*   * KTC=2   *Recommendations for 2nd round: N.A*  **Issue 2-3-10: SRS Transmission periodicity**  *Tentative agreements:*   * TSRS=10   *Recommendations for 2nd round: N.A*  **Issue 2-3-11: Slots in which sounding RS is transmitted**  *Tentative agreements:*   * The last symbol in slot#3 in radio frames for 120KHz SCS   *Recommendations for 2nd round: N.A*  **Issue 2-3-12: Test Parameters for timing offset**  *Candidate options:*   * Option 1(Nokia, Huawei, Ericsson, Intel):   + A: 1.25us   + s-1 * Option 2(Samsung): FFS on A =2.5 us   *Recommendations for 2nd round: N.A*   * More discussion is needed.   **Issue 2-3-13: Timing different between moving UE and stationary UE**  *Tentative agreements:*   * Option 1(Samsung, Huawei, Intel, Ericsson, Nokia):   + [Δτ - (TA −31)×16\*8Tc] * Note: The timing different can be updated with taken into account the output of possible enhancements for timing adjustment command discussion in RRM session   *Recommendations for 2nd round: N.A* |
| **Sub-topic#2-4** | **Issue 2-4-1: Frequency offset for requirement**  *Tentative agreements:*   * Define PRACH requirements with frequency offset as 19444Hz under AWGN channel   *Recommendations for 2nd round: N.A*  **Issue 2-4-2: Test Preamble configuration**  *Candidate options:*   * Option 1 (Nokia): Ncs=69 * Option 2 (Ericsson, Huawei, Intel, Samsung): Ncs =0 as baseline   *Recommendations for 2nd round:*   * Encourage companies to check whether option 2 is acceptable?   **Issue 2-4-3: Timing offset configuration**  *Candidate options:*   * Option 1: Reuse Rel-15 FR2 timing offset configuration for PRACH, i.e., 0.8us (Huawei, Nokia, Ericsson) * Option 2: Update the timing offset configuration based on the largest expected cell radius, i.e., derived from scenario B, (Ericsson) * Note:   + Scenario A (Ds=700m, Dmin=10m), cell radius = 700m   + scenario B (Ds=700m, Dmin=150ms), cell radius = 716ms   *Recommendations for 2nd round:*   * More discussion is needed. Encourage companies can check performance difference between option 1 and option 2 in next meeting.   **Issue 2-4-4: Test error tolerance**  *Tentative agreements:*   * Test error tolerance: 0.07us for AWGN   *Recommendations for 2nd round: N.A* |

### CRs/TPs

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

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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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

### Sub-topic 2-1 General

**Issue 2-1-3: PUSCH requirement for Uni/Bi-directional RRH scenarios in scenario A and scenario B**

* Proposals
  + Option 1 (Samsung):
    - Define PUSCH requirement with Uni-directional RRH deployment scenario only in scenario A. If both scenarios are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration.
    - If both scenarios A and B for bi-directional RRH deployment scenario are introduced for PUSCH requirements, define the test applicability rule to reduce the test effort with only one of them will be selected for testing based on manufacture of declaration
  + Option 2 (Nokia):
    - RAN4 to define different sets of requirements for Scenario A and Scenario B
    - If it is decided that single HST conditions are not sufficient for HST FR2, then to define both PUSCH demodulation requirements for Uni- and bi-directional RRH deployment scenarios.
  + Option 3 (Ericsson): Define test cases for scenario A only
  + Option 4 (Huawei): Define requirements for both scenario A/B and Uni/Bi-directional deployment, and not define any applicability rule between them
* Recommended WF
  + Taken into account of FR2 HST RRH deployment discussion and the related channel model to discuss whether to cover both Uni/Bi-direction scenario and scenario A/B

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| **Company** | **Comments** |
| Company A |  |

### Sub-topic 2-2 PUSCH requirement

**Issue 2-2-1: RS configuration**

* Proposals
  + Option 1(Samsung, Ericsson, ZTE): 1 DMRS +PTRS (L=1,K=2)
  + Option 2(Nokia, Intel): 2 DMRS+ PTRS (L=1,K=2)
  + Option 3(Huawei, Nokia): 3 DMRS +PTRS (L=1,K=2)
* Recommended WF
  + More discussion is needed

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-2-2: CBW**

* Proposals
  + Option 1: 100MHz, and 50MHz with test applicable rule (Samsung, Nokia)
  + Option 2: 200MHz, and 50MHz with test applicable rule (Samsung, Nokia)
  + Option 3: 100MHz only (Intel, Ericsson)
  + Option 4: 200MHz only (Huawei, Intel, ZTE)
* Recommended WF
  + More discussion is needed

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-2-3: MCS**

* Proposals
  + Option 1(Samsung, Huawei, Nokia): MCS 16
    - Option 1a(Samsung): Additional margin can be considered for performance requirement definition to allow different implementation if needed
  + Option 2 (Intel): both MCS 16 and MCS 17
    - Define requirements with MCS17 up to BS declaration support
  + Option 3(Ericsson): Configure highest MCS that remains below 20dB SNR, i.e, MCS20
* Recommended WF
  + Encourage companies to check performance difference with MCS 16 and MCS17 in the next meeting

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-2-4: Length of data symbol**

* Proposals
  + Align the length of data symbol for UL timing adjustment with PUSCH
    - Option 1 (Samsung, Nokia, Intel): 9
    - Option 2 (Huawei, Intel, Ericsson ): 10
* Recommended WF
  + Encourage companies to check performance difference with option 1 and option 2 in the next meeting

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| **Company** | **Comments** |
| Company A |  |

### Sub-topic 2-3 UL timing adjustment requirement

**Issue 2-3-2: CBW**

* Proposals
  + Align CBW for UL timing adjustment and PUSCH demodulation
    - Option 1: 100MHz, and 50MHz with test applicable rule (Samsung, Nokia)
    - Option 2: 200MHz, and 50MHz with test applicable rule (Samsung, Nokia)
    - Option 3: 100MHz only (Intel, Ericsson)
    - Option 4: 200MHz only (Huawei, Intel, ZTE)
* Recommended WF
  + More discussion is needed. Suggest to discuss the CBW for PUSCH

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-3: PUSCH resource allocation**

* Proposals
  + Option 1(Samsung):
    - Moving UE: 0~32 for 100 MHz CBW, FFS 0~15 for 50 MHz CBW
    - Stationary UE: 33~65 for 100MHz CBW, FFS 16~31 for 50MHz CBW
  + Option 2 (Ericsson): Align CBW for UL timing adjustment and PUSCH demodulation requirement
    - Moving UE: 0~32 for 100 MHz CBW
    - Stationary UE: 33~65 for 100MHz CBW
  + Option 3 (Nokia, Huawei):
    - Moving UE: 0~65 for 200 MHz CBW
    - Stationary UE: 66~131 for 200MHz CBW
* Recommended WF
  + More discussion is needed. Suggest to discuss the CBW for PUSCH

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-4: RS configuration**

* Proposals
  + Option 1 (Samsung, Ericsson, ZTE): 1 DMRS+PTRS (L=1,K=2)
  + Option 2 (Nokia, Intel): 2 DMRS+PTRS (L=1,K=2)
  + Option 3 (Huawei, Nokia): 3 DMRS+ PTRS (L=1,K=2)
* Recommended WF
  + More discussion is needed. Suggest to discuss the RS configuration for PUSCH

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-6: length of PUSCH allocation**

* Proposals
  + Align with PUSCH for UL timing adjustment
    - Option 1 : 10
    - Option 2: 9
* Recommended WF
  + Encourage companies to check performance difference with option 1 and option 2 in the next meeting

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-7: MCS**

* Proposals
  + Align with PUSCH for UL timing adjustment
    - Option 1(Samsung, Huawei, Nokia): MCS16
* Option 1a(Samsung): Additional margin can be considered for performance requirement definition to allow different implementation if needed
  + - Option 2 (Intel): both MCS16 and MCS17
* Define requirements with MCS17 up to BS declaration support
  + - Option 3 (Ericsson):Align MCS for UL timing adjustment and PUSCH demodulation requirement, configure highest MCS that remains blow 20dB SNR, i.e., MCS20
* Recommended WF
  + Suggestion to discussion the MCS for PUSCH firstly. Encourage companies to check performance difference with MCS16 and MCS17 in the next meeting

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-8: SRS bandwidth configuration**

* Proposals
  + Option 1(Samsung, Nokia):
    - Option 1a (Samsung):
* C\_SRS =11, B\_SRS =0 for 40RB, with 100 MHz CBW
* C\_SRS = 5, B\_SRS=0 for 20RB, with 50 MHz CBW
  + - Option 1b (Nokia):
* C\_SRS =9, B\_SRS =0 for 32RB, with 100 MHz CBW
  + - Option 1c (Ericsson):
* C\_SRS =17, B\_SRS =0 for 64RB, with 100 MHz CBW
* C\_SRS = 9, B\_SRS=0 for 32 RB, with 50 MHz CBW
  + Option 2(Huawei, Nokia): C\_SRS=33, B\_SRS=0 for 132RB with 200MHz CBW
* Recommended WF
  + Suggestion to discussion the CBW firstly

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-3-12: Test Parameters for timing offset**

* Proposals
  + Option 1(Nokia, Huawei, Ericsson, Intel):
    - A: 1.25us
    - s-1
  + Option 2(Samsung): FFS on A =2.5 us
* Recommended WF
  + More discussion is needed.

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| **Company** | **Comments** |
| Company A |  |

### Sub-topic 2-4 PRACH requirement

**Issue 2-4-2: Test Preamble configuration**

* Proposals
  + Proposals
    - Option 1 (Nokia): Ncs=69
    - Option 2 (Ericsson, Huawei, Intel, Samsung): Ncs =0 as baseline
* Recommended WF
  + Encourage companies to check whether option 2 is acceptable?

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| **Company** | **Comments** |
| Company A |  |

**Issue 2-4-3: Timing offset configuration**

* Proposals
  + Option 1: Reuse Rel-15 FR2 timing offset configuration for PRACH, i.e., 0.8us (Huawei, Nokia, Ericsson)
  + Option 2: Update the timing offset configuration based on the largest expected cell radius, i.e., derived from scenario B, (Ericsson)
  + Note:
    - Scenario A (Ds=700m, Dmin=10m), cell radius = 700m
    - scenario B (Ds=700m, Dmin=150ms), cell radius = 716ms
* Recommended WF
  + More discussion is needed. Encourage companies can check performance difference between option 1 and option 2 in next meeting.

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| **Company** | **Comments** |
| Company A |  |

# Topic #3: FR2 HST UE Testablity

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2109216 | Intel | Proposal 5: Do not discuss any testability aspects in HST FR2 WI unless it is captured in WID. |
| R4-2110531 | Huawei, HiSilicon | Proposal 5: Assume static UE and single Probe. Combine RRM and Demod requirements as a single feature to support HST FR2 operation |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

Last RAN4 meeting agreements in the WF R4-2106102

List of open issues

* Sub-Topic 3-1: FR2 HST UE Testability
  + Issue 3-1-1: FR2 HST UE Testability

### Sub-topic 3-1 FR2 HST UE Testability

**Issue 3-1-1: FR2 HST UE Testability**

* Proposals
  + Option 1(Intel): Do not discuss any testability issue aspects in HST FR2 WI unless it is captured in WID
  + Option 2(Huawei): Assume static UE and single Probe. Combine RRM and Demod requirements as a single feature to support HST FR2 operation
* Recommended WF
  + Encourage feedback from companies

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | **Issue 3-1-1: FR2 HST UE Testability**  We are fine with assuming static UE and single Probe. |

### 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** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| **Sub- topic #3-1** | **Issue 3-1-1: FR2 HST UE Testability**  *Candidate options:*   * Option 1 (Intel): Do not Do not discuss any testability issue aspects in HST FR2 WI unless it is captured in WID * Option 2 (Huawei, Qualcomm): Assume static UE and single Probe. Combine RRM and Demod requirements as a single feature to support HST FR2 operation   *Recommendations for 2nd round:*   * More discussion is needed |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

### Sub-topic 3-1 FR2 HST UE Testability

**Issue 3-1-1: FR2 HST UE Testability**

* Proposals
  + Option 1 (Intel): Do not Do not discuss any testability issue aspects in HST FR2 WI unless it is captured in WID
  + Option 2 (Huawei, Qualcomm): Assume static UE and single Probe. Combine RRM and Demod requirements as a single feature to support HST FR2 operation
* Recommendations for 2nd round:
  + More discussion is needed

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on demodulation requirements for FR2 HST | Samsung |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Noted |  |
| R4-2109216 | View on DL demodulation requirements for HST FR2 | Intel Corporation | Noted |  |
| R4-2109217 | View on UL demodulation requirements for HST FR2 | Intel Corporation | Noted |  |
| R4-2109749 | Discussion on Reference Signal for UL and DL | ZTE Corporation | Noted |  |
| R4-2109750 | Discussion on UE Demodulation Requirements for FR2 HST | ZTE Corporation | Noted |  |
| R4-2109805 | View on demodulation requirement for Rel-17 FR2 HST | Samsung | Noted |  |
| R4-2109806 | View on BS demodulation requirement for Rel-17 FR2 HST | Samsung | Noted |  |
| R4-2109807 | View on UE demodulation requirement for Rel-17 FR2 HST | Samsung | Noted |  |
| R4-2110530 | Discussion on BS demodulation requirements for FR2 HST | Huawei, HiSilicon | Noted |  |
| R4-2110531 | Discussion on UE demodulation requirements for FR2 HST | Huawei, HiSilicon | Noted |  |
| R4-2110532 | Discussion on general issues for NR FR2 HST demodulation requirements | Huawei, HiSilicon | Noted |  |
| R4-2110643 | UE demodulation requirements for HST FR2 | Ericsson | Noted |  |
| R4-2110720 | Maximum UE velocity and RS configuration for FR2 HST UE Demod Performance Test | Qualcomm Incorporated | Noted |  |
| R4-2110730 | BS demodulation requirements for HST FR2 | Ericsson | Noted |  |
| R4-2111067 | On HST FR2 BS Demodulation Requirements | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2111108 | On HST FR2 DM-RS Configuration in UL Direction | Nokia, Nokia Shanghai Bell | Noted |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents