**3GPP TSG-RAN WG4 Meeting # 96-e R4-2017624**

**Electronic Meeting, 17-28 Aug., 2020**

**Agenda item: 7.15.3.1**

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [97e][326] NR\_HST\_Demod\_UE

**Document for:** Information

# Introduction

This email discussion focuses on UE demodulation for NR HST, including agenda 7.15.3.1.1~7.15.3.1.5. Five topics are included in total, including transmission schemes, HST-SFN, HST single tap, muti-path fading channel, and other general open issues mentioned in companies’ contributions.

The email discussion is based on the approved way forward in last meeting: R4-2012668 WF on Rel-16 NR HST UE demodulation.

According to last meeting, the work split is provided as follows:

|  |  |  |
| --- | --- | --- |
|  | | **Responsibility** |
| Simulation results summary for NR-HST demodulation | | Huawei, HiSilicon |
| CR on HST-SFN requirements | FDD | Intel |
| TDD | CMCC |
| CR on HST-single tap and multi-path fading channel requirements | FDD | Qualcomm |
| TDD | Huawei, HiSilicon |
| CR on propagation condition on high speed train scenario | | Intel |
| CR on FRC | | Ericsson |
| CR on applicability | | Huawei, HiSilicon |
| CR on release independent | | CMCC |
| CR on HST DPS transmission scheme | | Huawei, HiSilicon |

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

* 1st round: discuss the open issues and strive to minimize the open issues, and provide comments on the CRs
* 2nd round: according to 1st round discussion, discuss left open issues for 2nd round, and strive to minimize the open issues, and strive to approve CRs.

# Topic #1: Requirements for DPS transmission scheme(s)

*Agenda 7.15.3.1.1*

## Companies’ contributions summary

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| **TDoc** | **Title** | **Source** | **Proposals/ Observations** |
| [**R4-2014633**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014633.zip) | View on NR HST demod | Qualcomm, Inc. | Proposal 1: Introduce the following applicability rules to DPS schemes:  (1) If UE passed both HST-SFN and HST single tap tests, DPS 1a is not applicable.  (2) If UE passed both HST-SFN and HST single tap tests, DPS 1b is not applicable.  Proposal 2: Every RRH has to transmit QCL’ed SSB and TRS for every TCI state used in the DPS schemes. |
| [**R4-2015602**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015602.zip) | Summary of ideal and impairment results for NR HST demodulation requirements | Huawei, HiSilicon |  |
| [**R4-2014216**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014216.zip) | Discussion on DPS transmission scheme in HST | Apple | Proposal 1: In test setup for DPS 1a, PDSCH associated with TCI #0 is transmitted during the slots from 0 to (n-1) + HARQ needed time + 3ms.  Proposal 2: Number of active TCI states in DPS transmission mode 1b case is 2.  Proposal 3: in step 3, TE transmits PDCCH and PDSCH associated with TCI #0 from TRP#1 from slot 0 to n-1 +  HARQ needed time + 3ms  Proposal 4: Option 1 “The switch command is transmitted via MAC CE, the corresponding PDSCH carrying that MAC CE should be ensured to be decoded successfully and lower MCS should be used, such as MCS 4” is recommended.  Proposal 5: For DPS transmission mode 1a, PDCCH/PDSCH are DTXed from the time gNB indicate MAC CE TCI state switch + HARQ processing time + 3ms, to the time UE received and processed the first TRS from the new TRP. |
| [**R4-2014553**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014553.zip) | Views on UE demodulation requirements for DPS transmission scheme for NR HST | Intel Corporation | Proposal #1: Define performance requirements for DPS Tx scheme with 2 and 3 active TCI states.  Proposal #2: Use MCS 17 for HST DPS performance test cases.  Proposal #3: Schedule PDSCH in TDD special slots.  Proposal #4: Use same SNR point for all DPS Tx schemes requirements definition. To do this the following test setup should be performed:  - Skip PDSCH allocation on slots with TRS transmission  - Skip PDSCH data allocation on slots from n to m, where n slots are equivalent to time that needed to pass middle point between two RRH and m is a slot which corresponds to HARQ needed time on MAC CE command in DPS scheme 1a.  Proposal #5: Consider MCS 4 for PDSCH which carries MAC CE command  Proposal #6: Define the following applicability rule: If UE passed HST-SFN requirements it does not need to be tested in HST-DPS.  Proposal #7: Define the following applicability rule: If UE passed HST DPS requirements with more than 1 active TCI state it does not need to be tested in HST-DPS with smaller number of active TCI states. |
| [**R4-2014563**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014563.zip) | CR to TS 38.101-4: Propagation conditions for HST scenarios | Intel Corporation |  |
| [**R4-2014701**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014701.zip) | Further discussion on DPS for NR HST | CMCC | it is not preferred to introduce applicability rule between DPS and HST-SFN requirements. |
| [**R4-2014704**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014704.zip) | Simulation results for DPS transmission scheme | CMCC |  |
| [**R4-2015020**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015020.zip) | UE demodulation requirements for DPS transmission scheme | ZTE Corporation | Proposal 1: Use MCS13 for HST-DPS test case.  Proposal 2: Scheduled in special slots and the special slot configuration as S: 6D 4G 4U.  Proposal 3: UE can skip HST-DPS scheme 1a/1b if UE pass HST-SFN test cases. |
| [**R4-2015603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015603.zip) | CR on HST DPS requirements | Huawei, HiSilicon |  |
| [**R4-2015604**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015604.zip) | Discussion on UE performance requirements for DPS transmission scheme | Huawei, HiSilicon | Proposal 1: For test setup for DPS 1a, modify test setup as following:  − PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n + HARQ needed time + 3ms + first TRS + TRS processing, 0) to ((2k+1)n-1) + HARQ needed time + 3ms + first TRS + TRS processing, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.  Proposal 2: For DPS 1a, PDSCH should be scheduled in special slots.  Proposal 3: Use MCS 17 for DPS 1a.  Proposal 4: Only define PDSCH performance requirements with 2 active TCI states.  Proposal 5: For scenario with 3 active TCI states, TE transmits PDSCH associated with TCI #1 from TRP#1 from slot n to N  Proposal 6: For DPS requirements definition, besides the 70% maximum throughput, define an extra test metric that,  − for DPS 1a, UE should meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms + first TRS + TRS processing during the test  − for DPS 1b with 2 active TCI states, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms during the test  − for DPS 1b with more than 2 active TCI state, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n+1 during the test |
| [**R4-2015605**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015605.zip) | Simulation results on UE performance requirements for DPS 1a transmission scheme | Huawei, HiSilicon |  |
| [**R4-2015812**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015812.zip) | PDSCH demodulation requirements for HST-DPS | Ericsson | Proposal 1: Set MCS13/Rank2 for HST-DPS.  Proposal 2: Not schedule PDSCH in TDD special slots for HST-DPS TDD tests.  Observation 1: UE cannot decode PDSCH even with lower MCS such as MCS4 during the period from the time gNB switches TCIs for PDCCH/PDSCH transmission to the time UE receives the TRS from the new RRH.  Proposal 3: TE keeps the PDCCH/PDSCH scheduling with the same MCS (e.g., MCS13) during the period gNB indicates MAC CE TCI state switch to the time UE receive the first TRS from the new RRH. |

## Open issues summary

### Test parameters for DPS scheme 1a

**Issue 1-1: MCS**

* Agreements in RAN4#96e meeting: *MCS*
  + *Option 1: MCS 13 based on 64QAM table (same as HST-SFN)*
  + *Option 2: MCS 17 based on 64QAM tables*
* Proposals in RAN4#97e meeting:
  + *Option 1 (ZTE, Ericsson): MCS 13 based on 64QAM table (same as HST-SFN)*
  + *Option 2 (Intel, Huawei): MCS 17 based on 64QAM tables*
* Recommended WF
  + 4 companies discuss this issue, 2 companies support option1 and 2 companies support option2. In order to move forward, moderator suggests companies provide your views on the above two options, and make a decision based on majority view after 1st round discussion

**Issue 1-2: Scheduling in TDD special slot**

* Agreements in RAN4#96e meeting:
  + *PDSCH is scheduled in DL, FFS for special slots*
* Proposals in RAN4#97e meeting:
  + *Option 1 (Intel, Huawei): Schedule PDSCH in TDD special slots.*
  + *Option 2 (ZTE): Scheduled in special slots and the special slot configuration as S: 6D 4G 4U.*
  + *Option 3 (Ericsson): Not schedule PDSCH in TDD special slots for HST-DPS TDD tests*
* Recommended WF
  + 4 companies discuss this issue, 3 companies support to schedule PDSCH in TDD special slots, 1 company support to not schedule PDSCH in special slots. Moderator suggests companies check whether the following recommended WF is acceptable:
    - *Scheduled PDSCH in TDD special slots and the special slot configuration as S: 6D 4G 4U.*

### Transmission scheme 1b

***Agreements in RAN4#96e meeting:***

* *Number of active TCI states in DPS transmission scheme 1b*
  + *Option 1: with 2 active TCI states.*
  + *Option 2: with 2 and more than 2 active TCI states.*

**Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**

* Agreements in RAN4#96e meeting: *Number of active TCI states in DPS transmission scheme 1b*
  + *Option 1: with 2 active TCI states.*
  + *Option 2: with 2 and more than 2 active TCI states.*
* Proposals in RAN4#97e meeting:
  + *Option 1 (Apple, Huawei): with 2 active TCI states.*
  + *Option 2 (Intel): with 2 and 3 active TCI states.*
* Recommended WF
  + 3 companies discuss this issue, 2 companies support to define test case with 2 active TCI states, 1 companies support to define test case with 2 and 3 active TCI state. Since this is the last meeting for this WI, can we agree with option 1 to define test case with 2 active TCI states for DPS transmission scheme 1b?

### Test setup for DPS transmission scheme 1a

***Agreements in RAN4#96e meeting:***

1. Two RRH s of RRH#(2k) and RRH#(2k+1) are assumed, and SSB#0 is transmitted from both TRPs, where k is the RRH number with k=0,1, 2, …
   * UE is configured with TCI#(k mod 2) and TCI#(k+1 mod 2) that are associated with TRS#(k mod 2) and TRS#(k+1 mod 2) transmitted from RRH#(2k) and RRH#(2k+1) respectively by RRC signalling tci-StatesToAddModList in the PDSCH-Config and tci-PresentInDCI is not configured;
   * All the configured TCI states are known to UE. UE is configured with NZP-CSI-RS resource for L1-RSRP measurements by RRC signaling nzp-CSI-RS-ResourceSet within the CSI-ResourceConfig and periodic CSI reporting by setting reportConfigType to periodic and reportQuantity to cri-RSRP (Note: reported L1-RSRP mesurements are not tested)
2. TE actives TCI #0 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE”;
3. PDSCH associated with TCI #0 is transmitted during the slots from 0 to (n-1) + HARQ needed time + 3ms + first TRS + TRS processing time;
4. In slot n TE start triggering TCI state switching command to TCI #1 by “TCI State Indication for UE-specific PDCCH MAC CE”;
5. PDSCH associated with TCI #1 is transmitted in slots from n + HARQ needed time + 3ms + first TRS + TRS processing time to N.

PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n, 0) to ((2k+1)n-1) + HARQ needed time + 3ms + first TRS + TRS processing, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.

**Issue 1-4: Modified step 3 for transmission scheme 1a**

* Proposals
  + Option 1 (Apple): In test setup for DPS 1a, PDSCH associated with TCI #0 is transmitted during the slots from **0 to (n-1) + HARQ needed time + 3ms**.
* Recommended WF
  + Companies please provide your comments based on the proposal of modified step 3

**Issue 1-5: Modified test setup for transmission scheme 1a**

* Proposals
  + **Option 1 (Huawei): PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n + HARQ needed time + 3ms + first TRS + TRS processing, 0) to ((2k+1)n-1) + HARQ needed time + 3ms + first TRS + TRS processing, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.**
* Recommended WF
  + Companies please provide your comments based on the modified test setup proposal

**Issue 1-6: SSB and TRS transmission**

* Proposals
  + Option 1 (Qualcomm): Every RRH has to transmit QCL’ed SSB and TRS for every TCI state used in the DPS schemes
* Recommended WF
  + Companies please provide your comments based on the above proposal.

### Test setup for DPS transmission scheme 1b

**Issue 1-7: Transmission scheme 1b with 2 active TCI states**

* Agreements in RAN4#96e meeting:
* Test setup for transmission scheme 1b
  + Use following as baseline for DPS transmission scheme 1b test setup (agreement in last meeting)
  + for scenario with 2 active TCI states

(total 2 active TCI states): PDCCH TCI state switching delay caused by MAC CE, but less than DPS 1a with pre-tracking of second TCI state and only HARQ needed time + 3ms delay is needed, UE tracks 2 active TCI states in advance so that UE can quickly get better Doppler shift estimation for the second TRP compared to DPS 1a.

* 1. UE is configured with two different TCI states (TCI #0 and TCI #1) associated with two different RRHs by RRC signalling tci-StatesToAddModList in the PDSCH-Config and tci-PresentInDCI is not configured;
  2. TE activates TCI #0 and TCI #1 for PDSCH at the same time by “TCI States Activation/Deactivation for UE-specific PDSCH MAC CE” and activates TCI #0 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE” command with the field of CORESET ID set to 0;
  3. TE transmits PDCCH and PDSCH associated with TCI #0 from TRP#1 from slot 0 to n-1;
  4. In slot n TE start triggering TCI state switching command to TCI #1 by “TCI State Indication for UE-specific PDCCH MAC CE”;
  5. TE transmits PDCCH and PDSCH associated with TCI #1 from TRP#2 from slot n [+ HARQ needed time + 3ms] to N.

where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH

* Proposals
  + Option 1 (Apple): **In step 3, TE transmits PDCCH and PDSCH associated with TCI #0 from TRP#1 from slot 0 to n-1 + *HARQ needed time + 3ms***
* Recommended WF
  + Companies please provide your comments based on the proposal of modified step 3. And other than step 3, are there any new comments for this test setup?

**Issue 1-8: Transmission scheme 1b with 3 active TCI states**

* Agreements in RAN4#96e meeting:
  + - *for scenario with 3 active TCI states*

*(Total 3 active TCI states): No PDCCH TCI state switching delay by using MAC CE, but 3 active TCI states to track, UE needs to report supporting of maxNumberActiveTCI-PerBWP = n4*

* + - * 1. *UE is configured with three different TCI states (TCI #0, TCI #1 and TCI #2) associated with two different RRHs by RRC signalling tci-StatesToAddModList in the PDSCH-Config;*
        2. *TE activates TCI #0 and TCI #1 for PDSCH at the same time by “TCI States Activation/Deactivation for UE-specific PDSCH MAC CE” and activates TCI #2 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE” command with the field of CORESET ID set to 0;*
        3. *TE transmits PDCCH associated with TCI#2 from TRP#1 and TRP#2 from slot 0 to N*
        4. *DCI contains pointer to TCI#0 from slot 0 to n-1 and pointer to TCI#1 from slot n to N*
        5. *TE transmits PDSCH associated with TCI #0 from TRP#0 from slot 0 to n-1*
        6. *TE transmits PDSCH associated with TCI #1 from TRP#1 from slot [n or n+1] to N*

*where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH*

* Proposals
  + Option 1 (Huawei): **For scenario with 3 active TCI states, TE transmits PDSCH associated with TCI #1 from TRP#1 from slot n to N (step 6)**
* Recommended WF
  + If test case with 3 active TCI states are introduced, can we agree with the above test setup with updated step 6 (from n to N)?

### Statistics during the switching time for both DPS 1a and 1b

***Agreements in RAN4#96e meeting:***

* Statistics during the switching time for both DPS 1a and 1b
  + Option 1: The switch command is transmitted via MAC CE, the corresponding PDSCH carrying that MAC CE should be ensured to be decoded successfully and lower MCS should be used, such as MCS 4.
  + Option 2: PDCCH/PDSCH are DTXed from the time gNB indicates MAC CE TCI state switch to the time UE receive the first TRS from the new TRP.
  + Option 3: Use same SNR point for all DPS Tx schemes requirements definition:
    - Skip PDSCH allocation on slots with TRS transmission
    - Skip PDSCH allocation on slots from n to m, where n slots are equivalent to time that needed to pass middle point between two RRH and m is a slot which corresponds to HARQ needed time on MAC CE command in DPS scheme 1a.
  + Other options are not precluded.

**Issue 1-9: Switch command**

* Proposals
  + Option 1 (Apple, Intel): The switch command is transmitted via MAC CE, the corresponding PDSCH carrying that MAC CE should be ensured to be decoded successfully and lower MCS should be used, such as MCS 4.
  + Option 2 (Ericsson):
    - UE cannot decode PDSCH even with lower MCS such as MCS4 during the period from the time gNB switches TCIs for PDCCH/PDSCH transmission to the time UE receives the TRS from the new RRH.
    - TE keeps the PDCCH/PDSCH scheduling with the same MCS (e.g., MCS13) during the period gNB indicates MAC CE TCI state switch to the time UE receive the first TRS from the new RRH.
* Recommended WF
  + 3 companies discuss this issue. 2 companies support switch command with lower MCS4, 1 company’s simulation results show even with MCS4 UE cannot decode PDSCH during the switch period, and suggest keep the same MCS during the switch.
  + Companies please provide your views based on above options.

**Issue 1-10: PDCCH and PDSCH setting during the transition time**

* Proposals
  + Option 1 (Apple): For DPS transmission mode 1a, PDCCH/PDSCH are DTXed from the time gNB indicate MAC CE TCI state switch + HARQ processing time + 3ms, to the time UE received and processed the first TRS from the new TRP.
  + Option 2 (Intel):
    - Use same SNR point for all DPS Tx schemes requirements definition:
    - Skip PDSCH allocation on slots with TRS transmission
    - Skip PDSCH allocation on slots from n to m, where n slots are equivalent to time that needed to pass middle point between two RRH and m is a slot which corresponds to HARQ needed time on MAC CE command in DPS scheme 1a.
* Recommended WF
  + Companies please provide your views based on above options.

**Issue 1-11: Extra test metric for DPS requirements**

* Proposals
  + Option 1 (Huawei): For DPS requirements definition, besides the 70% maximum throughput, define an extra test metric that,
    - for DPS 1a, UE should meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms + first TRS + TRS processing during the test
    - for DPS 1b with 2 active TCI states, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms during the test
    - for DPS 1b with more than 2 active TCI state, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n+1 during the test
* Recommended WF
  + Companies please provide your views on this extra test metric for DPS requirements.

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| **CMCC** | **Issue 1-1: MCS**  **Option 2. According to companies’ simulation results, maximum throughput could be achieved with MCS 17.**  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  **To move forward, we are fine with option 1**  **Issue 1-5: Modified test setup for transmission scheme 1a**  **We are Ok with option 1** |
| **Intel** | **Issue 1-1: MCS**  Based on link-level results provided by companies there are no performance issues to support MCS 17 in HST-DPS deployment. For HST-SFN max supported MCS is limited by extreme propagation conditions. DPS much easier scenario which may bring performance benefits comparing to HST-SFN. Therefore, we do not see reasons to use same relatively small MCS value 13.  Propose Option 2: MCS 17.  **Issue 1-2: Scheduling in TDD special slot**  Agree with recommended WF. From test perspective there is no need to align HST-SFN and HST-DPS configurations.  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  Considering selection between 1b with 2 active TCI states and 3 active TCI states, scenario with 3 active TCI states is more preferable from test perspective. Both of them correspond to case when UE can pre-track time/frequency of the second TRP and make switching smoother. Same time 3 active TCI states allow to make switching quicker than other schemes. Moreover, scenario with 3 active TCI states corresponds to completely new configuration comparing to scenarios with 1 or 2 active TCI states. In scenario with 3 active TCI states PDCCH is transmitted in SFN manner which allows to use DCI based TCI switching. Same time scenario with 2 active TCI states use the same approach at scheme 1a when PDCCH is transmitted in DPS manner and switching is performed by MAC CE.  Same time supporting of 2 or 3 active TCI states is up to UE capability. Therefore, both of the scenarios might be considered as practical. Also. We do not think that requirements definition for both of them will take much efforts. We suggest Option 2: define requirements with 2 and more than 2 active TCI states.  If companies think that we should make prioritisation – we propose a compromise option3: Define requirements only for scenario with more than 2 active TCI states.  **Issue 1-4: Modified step 3 for transmission scheme 1a**  Agree with Option 1.  **Issue 1-5: Modified test setup for transmission scheme 1a**  Agree with Option 1, but it should be revised according to Issue 1-4  **Issue 1-6: SSB and TRS transmission**  Agree with Option 1.  **Issue 1-7: Transmission scheme 1b with 2 active TCI states**  Agree with proposed Option 1.  **Issue 1-8: Transmission scheme 1b with 3 active TCI states**  Agree with Option 1 and recommended WF.  **Issue 1-9: Switch command**  MAC CE command is transmitted by PDSCH which is associated to TCI#0 from left side TRP. In this case to decode this PDSCH UE will use proper assumptions on Doppler spread derived from TCI#0. In this case there will be no problems to decode MAC CE mentioned by Ericsson.  We propose to consider MCS 4 to improve reliability of MAC CE command transmission to guarantee that UE can decode it regardless of instant SNR. Otherwise even UE with proper HST processing may fail the test. Suggest Option 1.  **Issue 1-10: PDCCH and PDSCH setting during the transition time**  In general, we are ok with Option 1 or do not consider option 1 or option 2 at all since an impact of PDSCHs transmitted during the switching time on whole statistic is quite negligible. Our intention to consider same SNR point for different DPS schemes is to honestly reduce the simulation efforts to be able to define requirements for different DPS scenarios.  **Issue 1-11: Extra test metric for DPS requirements**  We do not think that the one of test motivations is to ensure that UE can decode PDSCH during the TCI switching time or to compare different DPS Tx schemes in terms of provided performance. RAN4 has to guarantee that UE can properly operate in different DPS scenarios in HST deployments. For this case difference in test setups is enough. Suggest not considering additional test metric. |
| **Huawei** | **Issue 1-1: MCS**  We prefer Option 2, i.e. MCS 17.  As per simulation results provided by companies, MCS 17 with Rank 2 is feasible for DPS, no technical reason to preclude MCS 17, also it is not necessary to align with SFN considering that they are separate test case.  **Issue 1-2: Scheduling in TDD special slot**  We prefer Option 1, i.e. Schedule PDSCH in TDD special slots.  As per theory analysis, the performance become worse in special slot for SFN or multi-path fading channel since that only one column of DMRS cannot handle large Doppler spread well when UE performs channel estimation and other procedures. However, in DPS scenario, there is no large Doppler spread, therefore the performance should not be deteriorated significantly. Also the simulation results support the above point.  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  For DPS 1b, there will not exist TCI state switching delay if UE supports more than two active TCI states tracking while switching delay of HARQ needed time + 3ms is needed if UE supports two active TCI states, but considering the UE capability to support more than 2 active TCI states and the WI completion date, it is fine for us to only define performance requirements for DPS 1b with 2 active TCI states.  **Issue 1-4&1-5&1-7: Modified step 3 for transmission scheme 1a & Modified test setup for transmission scheme 1a & Transmission scheme 1b with 2 active TCI states**  For DPS 1a, it is feasible for both the current and modified version since there is undefined UE behaviour during the time period from UE decode TCI switching command correctly to the first TRS is processed completely. In addition, if we consider unified scheduling for “DPS 1a” and “DPS 1b with 2 TCI states”, it is more feasible to transmit PDCCH/PDSCH associated with new scheduled TCI state for that time period. Therefore, we slightly prefer that:   * + In test setup for **both “DPS 1a” and “DPS 1b with 2 TCI states”**,     - PDSCH associated with TCI #0 is transmitted during the slots from **0 to (n-1) + HARQ needed time + 3ms**.     - PDSCH associated with TCI #1 is transmitted in slots from **n + HARQ needed time + 3ms ~~+ first TRS + TRS processing time~~ to N**.   The generalized version can be:   * + For **both “DPS 1a” and “DPS 1b with 2 TCI states”**, PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n + HARQ needed time + 3ms, 0) to ((2k+1)n-1) + HARQ needed time + 3ms, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.   **Issue 1-6: SSB and TRS transmission**  Agree with Option 1.  **Issue 1-8: Transmission scheme 1b with 3 active TCI states**  We prefer Option 1, i.e. For scenario with 3 active TCI states, TE transmits PDSCH associated with TCI #1 from TRP#1 from slot n to N (step 6).  In our view, slot n is suitable considering that UE is tracking active TCIs for both TRP#0 and TRP#1, no additional 1 slot is needed for UE to switch TCI state.  **Issue 1-9: Switch command**  We prefer Option 1, i.e. The switch command is transmitted via MAC CE, the corresponding PDSCH carrying that MAC CE should be ensured to be decoded successfully and lower MCS should be used, such as MCS 4.  It is necessary to ensure TCI switch command can be decoded 100% correctly considering FRC to be determined.  For Option 2, in our view, MCS 4 should be used only for the slot that TCI switch command is scheduled.  **Issue 1-10: PDCCH and PDSCH setting during the transition time**  Same view as Issue 1-4&1-5&1-7.  For the last item of Option 2, for DPS 1a, it can reworded: PDSCH can be scheduled in slots from **n + HARQ needed time + 3ms** to **n + HARQ needed time + 3ms + first TRS + TRS processing time** but skipped for performance statistics.  **Issue 1-11: Extra test metric for DPS requirements**  We prefer Option 1 to verify UE behaviour to properly process the TCI state switching. The test metric is to check if UE can successfully decode the PDSCH with new TCI state after TCI state switching, not to check the PDSCH during the TCI state switching, also it is important to check different UE behaviour and performance for different scenarios. |
| **QC** | **Issue 1-2: Scheduling in TDD special slot**  We support option 3. Although delay spread is not an issue in DPS scenarios, frequency offset estimation error can result in phase ramping and “artificially” introduce time variation across symbols. This issue can be mitigated by more DMRS symbols, which we don’t have in special subframe. Therefore, special subframe PDSCH scheduling is still better to avoid.  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  We support option 1, as we don’t see any benefit of having 3 active TCI state. Signals are coming from two directions, two TCI states are enough to cover both directions.  **Issue 1-4: Modified step 3 for transmission scheme 1a**  We support option 1.  **Issue 1-5: Modified test setup for transmission scheme 1a**  We have a question for this setup: in this setup, one RRH has just one TCI state associated with it. But one RRH requires to cover UEs on both side (left and right), and if directional antenna/beamforming is used, how can both side covered by the same TCI state while the direction is the opposite?  With this question addressed, then under the assumption of one RRH has on TCI state cover from midpoint in left-hand side to right-hand side, the proposal is correct.  **Issue 1-6: Transmission scheme 1b with 2 active TCI states**  In our opinion, PDSCH on TCI#0 should stop after switching command, and TCI#1 should start after switching completion at slot n + HARQ needed time + 3ms  **Issue 1-7: Transmission scheme 1b with 3 active TCI states**  We don’t think 3 active TCI state is needed as the benefit is not clear.  **Issue 1-8: Switch command**  We can support option 1.  **Issue 1-9: PDCCH and PDSCH setting during the transition time**  We believe PDSCH should not be scheduled during transition time, as UE behaviour is not defined.  **Issue 1-10: Extra test metric for DPS requirements**  We don’t agree with option 1. This PDSCH interruption requirement should be tested in RRM tests, not demod test. In demod test we should focus on the scenario in which UE behaviour is clear and verify under common UE receiver structure assumption, how good UE performance can maintain under different channel condition and test configurations, in this case the high speed train with DPS scheme. |
| **Apple** | Issue 1-1: Prefer option 1, MCS 13, same as HST-SFN  Issue 1-2: OK with WF.  Issue 1-3: Agree with WF. Option 1, 2 active TCI states.  Issue 1-4: Agree.  Issue 1-5: Need to be modified if issue 1-4 is agreed.  Issue 1-6: Agree  Issue 1-7: Agree  Issue 1-8: Do not think 3 TCI states are needed.  Issue 1-9: Option1  Issue 1-10: Option 1  Issue 1-11: Do not think the extra test metric is needed. |
| **ZTE** | **Issue 1-2: Scheduling in TDD special slot**  Agree the recommended WF.  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  Agree with option 1.  **Issue 1-4: Modified step 3 for transmission scheme 1a**  Agree with option 1.  **Issue 1-5: Modified test setup for transmission scheme 1a**  Agree with option 1.  **Issue 1-6: SSB and TRS transmission**  Agree with option 1.  **Issue 1-10: PDCCH and PDSCH setting during the transition time**  Agree with option 1. |
| **Ericsson** | Issue 1-1: From UE demodulation point of view, we are now thinking HST-DPS is similar to HST single tap scenario. So we are ok with option 2.  Issue 1-2: We are ok to schedule PDSCH in the special slots. So we are ok with the moderator’s recommended WF.  Issue 1-3: We are fine with the moderator’s recommended WF – Option 1, define HST-DPS test case with 2 active TCI states. It also makes the test setup simple.  Issue 1-4: If we understand correctly, Apple refers to TS38.133 8.10.3 as follows:   |  | | --- | | If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / *NR slot length*. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + . |   If so, we agree UE is not required to receive PDCCH with the old TCI state after slot n+THARQ+3ms.  On the other hand NW can still transmit PDCCH with the old TCI state until (slot n + THARQ + 3ms + first TRS + TRS processing time) because UE is NOT required to receive PDCCH with the new TCI during the period from (slot n + THARQ + 3ms) to (slot n + THARQ + 3ms + first TRS + TRS processing time) according to 8.10.3.  We are fine with either way (keeping the original assumption or option 1), but it is important that UE is not expected to decode PDSCH during the period from (slot n + THARQ + 3ms) to (slot n + THARQ + 3ms + first TRS + TRS processing time). So TE should not consider this period for throughput calculation.  Issue 1-5: We are fine with option 1.  Issue 1-6: Support option 1.  Issue 1-7: Same comment as Issue 1-4.  Issue 1-9: We misunderstood the options. We are ok with Option 1 (use MCS4 for PDSCH carrying MAC-CE).  Issue 1-10: Same comment as 1-4. Probably it is enough to mention TE does not consider the transition period for throughput calculation.  Issue 1-11: We understand the motivation, but in our understanding, the switching point '(2k+1)n + HARQ needed time + 3ms + first TRS + TRS' requires only up to 10ms. We are wondering how many TCI switching is needed to verify 99% of HARQ-ACK transmission success rate.  Since we have already agreed Ds=700m. We guess it take very long test time considering the assumed UE velocity of 500km/h. |
| **vivo** | **Issue 1-2: Scheduling in TDD special slot**  Agree the recommended WF. However, the MCS tested in special slot can be different.  **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b**  We are ok with option 1.  **Issue 1-6: SSB and TRS transmission**  We support Option 1.  **Issue 1-9: Switch command**  Agree with option 1. The MCS of switch command should be lower. |

### CRs/TPs comments collection

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| **CR tdoc number** | **Comments collection** |
| [**R4-2014563**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014563.zip) **(Intel)** | Huawei: For DPS in B.3.3, there is a typo that “Table B.3.2-1: HST-SFN scenario” should be “Table B.3.3-1: HST-DPS scenario” |
| Ericsson: Title of Table B.3.2-1 should be ‘HST-DPS’.  For Figures B.3.3-2/3, it possible, X is set from 0 m to ~3000m (Set the same range as HST-SFN). |
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| **CR tdoc number** | **Comments collection** |
| [**R4-2015603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015603.zip) **(Huawei)** | Intel: We think that TCI state switching procedures should be captured in section with test description. |
| Huawei: For the detailed test setup for TCI state switching, from our understanding and the proposal from Ericsson before the meeting by email, it is better to capture it in detail in the Annex, the test configuration just refer to it as stated in our CR for PDCCH TCI state configuration:  TCI state #0 or TCI state #1 as specified in Annex B.3.X |
| QC: Applicability rule between 2Rx and 4Rx (do not need to pass 2Rx test when 4Rx is passed is missing), this should apply to all tests, following LTE. |
| Huawei: The revised version has been loaded to capture comments from Intel about TCI state switching scheduler  To QC: in current spec TS 38.101-4, applicability rule about 2Rx and 4Rx has been stated in section 5.1.1.2. |
| Ericsson:  Should update the CR template version from 12.0 to 12.1.  For TCI State #0/#1 in Table 5.2.2.1.10-2, ‘CSI-RS resource 1’ should be ‘CSI-RS resource’?  This CR refers to 'B.3.X'. What is expected to be specified in B.3.X? Transmission model?  Propagation condition may not need distinguish between DPS 1a and 1b if we look the draft CR by Intel (R4-2014563). The difference between 1a and 1b could be captured in B.3.x?  Ericsson (comments for revised R4-2015603):  As a general comment, you set ‘underlined’ for parameter table in Table 5.2.3.2.10-2 and Table 5.2.3.2.10-2. It should be turned off.  For TCI state in PDCCH configuration, we think it is enough to refer to Note 1 as follows:   |  |  |  |  | | --- | --- | --- | --- | | PDCCH configuration | TCI state |  | Note 1 |   Regarding the Note 1, Don’t we need max(0,… ) as follows?  Max [0, ] |
| To Ericsson:  Thanks for your careful checking and valuable comments. Your comments are captured as the revised version:   * The format issues have been solved. * For TCI State #0/#1 in Table 5.2.2.1.10-2, ‘CSI-RS resource 1’ is derived from Table 5.2-1: Common test parameters. * 'B.3.X' is refer to 'B.3.3' that means HST-DPS Channel Profile defined in Intel’s CR R4-2014563 above. * Maybe we can distinguish DPS 1a and 1b via updating the TCI switching scheduler in ‘Note 1’. * ‘max(0,… )’ in Note 1 has been updated. |

## 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** |
| **Issue 1-1: MCS** | **o Option 1 (ZTE, Apple): MCS 13 based on 64QAM table (same as HST-SFN)**  **o Option 2 (Intel, Huawei, CMCC, Ericsson): MCS 17 based on 64QAM tables**  Agreement: **MCS 17 based on 64QAM tables** |
| **Issue 1-2: Scheduling in TDD special slot** | **Option 1 (Intel, Huawei, ZTE, Apple, vivo, Ericsson): Scheduled PDSCH in TDD special slots and the special slot configuration as S: 6D 4G 4U.**  **Option 2 (QC): Not schedule PDSCH in TDD special slots for HST-DPS TDD tests**  **Tentative Agreement:** Scheduled PDSCH in TDD special slots and the special slot configuration as S: 6D 4G 4U as baseline based on the assumption that no obvious performance degradation compared to no slots scheduled in special slot. (pending on further check by QC) |
| **Issue 1-3: Number of active TCI states in DPS transmission scheme 1b** | **o Option 1 (Apple, Huawei, CMCC, QC, Apple, ZTE, vivo, Ericsson): with 2 active TCI states.**  **o Option 2 (Intel): with 2 and 3 active TCI states.**  **o Option 3 (Intel): Define requirements only for scenario with more than 2 active TCI states.**  Go with option 1 in Rel-16 , RAN4 can decide whether to further discuss test cases with >2 active TCI states in Rel-17 timeframe i.e. in Rel-17 FR1 HST WI. |
| **Issue 1-4: Modified step 3 for transmission scheme 1a**  **Issue 1-5: Modified test setup for transmission scheme 1a**  **Issue 1-7: Transmission scheme 1b with 2 active TCI states** | **Recommended WF: Further check the following agreement and [] in 2nd round**  Agreement: In test setup for DPS 1a (Step3), PDSCH associated with TCI #0 is transmitted during the slots from 0 to [n] + HARQ needed time + 3ms.   * Note: MAC CE transmitted in slot n   **Test setup for transmission scheme 1a:**  Two RRH s of RRH#(2k) and RRH#(2k+1) are assumed, and SSB#0 is transmitted from both TRPs, where k is the RRH number with k=0,1, 2, …  UE is configured with TCI#(k mod 2) and TCI#(k+1 mod 2) that are associated with TRS#(k mod 2) and TRS#(k+1 mod 2) transmitted from RRH#(2k) and RRH#(2k+1) respectively by RRC signalling tci-StatesToAddModList in the PDSCH-Config and tci-PresentInDCI is not configured;  All the configured TCI states are known to UE. UE is configured with NZP-CSI-RS resource for L1-RSRP measurements by RRC signaling nzp-CSI-RS-ResourceSet within the CSI-ResourceConfig and periodic CSI reporting by setting reportConfigType to periodic and reportQuantity to cri-RSRP (Note: reported L1-RSRP mesurements are not tested)  TE actives TCI #0 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE”;  PDSCH associated with TCI #0 is transmitted during the slots from 0 to (n-1) + HARQ needed time + 3ms ~~+ first TRS + TRS processing time;~~  In slot n TE start triggering TCI state switching command to TCI #1 by “TCI State Indication for UE-specific PDCCH MAC CE”;  PDSCH associated with TCI #1 is transmitted in slots from n + HARQ needed time + 3ms + first TRS + TRS processing time to N.  PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n + HARQ needed time + 3ms +[ first TRS + TRS processing time], 0) to ((2k+1)n-1) + HARQ needed time + 3ms, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.] |
| **Issue 1-6: SSB and TRS transmission** | Agreement: Every RRH has to transmit QCL’ed SSB and TRS for every TCI state used in the DPS schemes |
| **Issue 1-8: Transmission scheme 1b with 3 active TCI states** | No further discussion |
| **Issue 1-9: Switch command** | Agreement: The switch command is transmitted via MAC CE, the corresponding PDSCH carrying that MAC CE should be ensured to be decoded successfully and MCS 4 should be used. |
| **Issue 1-10: PDCCH and PDSCH setting during the transition time** | **o Option 1 (Apple, ZTE): For DPS transmission mode 1a, PDCCH/PDSCH are DTXed from the time gNB indicate MAC CE TCI state switch + HARQ processing time + 3ms, to the time UE received and processed the first TRS from the new TRP.**  **o Option 2 (Intel):**   * **Use same SNR point for all DPS Tx schemes requirements definition:** * **Skip PDSCH allocation on slots with TRS transmission** * **Skip PDSCH allocation on slots from n to m, where n slots are equivalent to time that needed to pass middle point between two RRH and m is a slot which corresponds to HARQ needed time on MAC CE command in DPS scheme 1a.**   **o Option 3 (Ericsson):** **TE does not consider the transition period for throughput calculation**  Agreement: For transmission scheme 1a :  For DPS transmission mode 1a, PDCCH/PDSCH are DTXed from the time gNB indicate MAC CE TCI state switch + HARQ processing time + 3ms, to the time UE received and processed the first TRS from the new TRP.  TE does not consider the transition period for throughput calculation  OCNG pattern will be applied for DTXed period. |
| **Issue 1-11: Extra test metric for DPS requirements** | **Recommended WF: Further discussion in 2nd round**  Q1: Whether to define extra test metric?   * Option 1 (Huawei): Yes * Option 2 (Apple, Intel, Ericsson): No   Q2: How to define extra test metric?  Option 1 (Huawei): For DPS requirements definition, besides the 70% maximum throughput, define an extra test metric that,  ~~for DPS 1a, UE should meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms + first TRS + TRS processing during the test~~  for DPS 1b with 2 active TCI states, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms during the test  ~~for DPS 1b with more than 2 active TCI state, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n+1 during the test~~ |

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2014563**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014563.zip) **(Intel)** | to be revised |
| [**R4-2015603**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015603.zip) **(Huawei)** | to be revised |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on NR HST UE demodulation | CMCC |

## Discussion on 2nd round (if applicable)

### Open issues summary

**Issue 1-1: Scheduling in TDD special slot**

**Tentative Agreement:** Scheduled PDSCH in TDD special slots and the special slot configuration as S: 6D 4G 4U as baseline based on the assumption that no obvious performance degradation compared to no slots scheduled in special slot. (pending on further check by QC)

**Recommended WF: Please check whether the above tentative agreement is agreeable.**

**Issue 1-2: Test setup for transmission scheme 1a**

**Test setup for transmission scheme 1a:**

* + Two RRH s of RRH#(2k) and RRH#(2k+1) are assumed, and SSB#0 is transmitted from both TRPs, where k is the RRH number with k=0,1, 2, …
    - * UE is configured with TCI#(k mod 2) and TCI#(k+1 mod 2) that are associated with TRS#(k mod 2) and TRS#(k+1 mod 2) transmitted from RRH#(2k) and RRH#(2k+1) respectively by RRC signalling tci-StatesToAddModList in the PDSCH-Config and tci-PresentInDCI is not configured;
      * All the configured TCI states are known to UE. UE is configured with NZP-CSI-RS resource for L1-RSRP measurements by RRC signaling nzp-CSI-RS-ResourceSet within the CSI-ResourceConfig and periodic CSI reporting by setting reportConfigType to periodic and reportQuantity to cri-RSRP (Note: reported L1-RSRP mesurements are not tested)
  + TE actives TCI #0 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE”;
  + PDSCH associated with TCI #0 is transmitted during the slots from 0 to [n]+ HARQ needed time + 3ms ~~+ first TRS + TRS processing time;~~
  + In slot n TE start triggering TCI state switching command to TCI #1 by “TCI State Indication for UE-specific PDCCH MAC CE”;
  + PDSCH associated with TCI #1 is transmitted in slots from n + HARQ needed time + 3ms + first TRS + TRS processing time to N.
  + PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n + HARQ needed time + 3ms +[ first TRS + TRS processing time], 0) to ((2k+1)n-1) + HARQ needed time + 3ms, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.]

**Recommended WF: Please check the [] in the above test setup in 2nd round**

**Issue 1-3: Test setup for transmission scheme 1b**

* PDCCH TCI state switching delay caused by MAC CE, but less than DPS 1a with pre-tracking of second TCI state and only HARQ needed time + 3ms delay is needed, UE tracks 2 active TCI states in advance so that UE can quickly get better Doppler shift estimation for the second TRP compared to DPS 1a.
  1. UE is configured with two different TCI states (TCI #0 and TCI #1) associated with two different RRHs by RRC signalling tci-StatesToAddModList in the PDSCH-Config and tci-PresentInDCI is not configured;
  2. TE activates TCI #0 and TCI #1 for PDSCH at the same time by “TCI States Activation/Deactivation for UE-specific PDSCH MAC CE” and activates TCI #0 for PDCCH by “TCI State Indication for UE-specific PDCCH MAC CE” command with the field of CORESET ID set to 0;
  3. TE transmits PDCCH and PDSCH associated with TCI #0 from TRP#1 from slot 0 to n-1;
  4. In slot n TE start triggering TCI state switching command to TCI #1 by “TCI State Indication for UE-specific PDCCH MAC CE”;
  5. TE transmits PDCCH and PDSCH associated with TCI #1 from TRP#2 from slot n [+ HARQ needed time + 3ms] to N.

where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH

**Recommended WF: Please check the above test setup for transmission scheme 1b**

**Issue 1-4: Extra test metric for DPS requirements**

**o** Option 1 (Huawei): For DPS requirements definition, besides the 70% maximum throughput, define an extra test metric that,

* + for DPS 1b with 2 active TCI states, UE meet probability of 99% (ACK and NACK) transmission for all PDSCH scheduled at each switching time point of (2k+1)n + HARQ needed time + 3ms during the test

**Recommended WF: Further discussion in 2nd round**

**Q1: Whether to define extra test metric?**

* **Option 1 (Huawei): Yes**
* **Option 2 (Apple, Intel, Ericsson): No**

**Q2: How to define extra test metric?**

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| **Huawei** | **Issue 1-2/1-3**  To align with the TS 38.133, the typos should be corrected.    For DPS 1a:   * PDSCH associated with TCI #1 is transmitted in slots from n +1 + HARQ needed time + 3ms + first TRS + TRS processing time to N. * Generalized: PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n +1 + HARQ needed time + 3ms +[ first TRS + TRS processing time], 0) to ((2k+1)n~~-1~~) + HARQ needed time + 3ms, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.   For DPS 1b:   * TE transmits PDCCH and PDSCH associated with TCI #0 from TRP#1 from slot 0 to n~~-1~~+ HARQ needed time + 3ms; * TE transmits PDCCH and PDSCH associated with TCI #1 from TRP#2 from slot n +1 + [+ HARQ needed time + 3ms] to N. * Generalized: PDSCH associated with TCI #(k mod 2) (k=0,1,2,…) is transmitted in slot from max((2k-1)n +1 + HARQ needed time + 3ms, 0) to ((2k+1)n~~-1~~) + HARQ needed time + 3ms, where n slots are equivalent to time that needed to pass middle point between two RRHs, N slots is equivalent to time that needed to pass second RRH. And k is the RRH number in the channel model.   Updated comments:  Response to CMCC: As per the core specification TS 38.133:” *If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / NR slot length.*”, so additional 1 slot should be added.  Also we confirm the part with square bracket is OK. |
| **Ericsson** | **Issue 1-2/1-3**  We are fine with Huawei’s correction above.  We suggest to clarify that n is the slot where PDSCH carrying MAC CE activation command is transmitted to activate new TCI.  **Issue 1-4:**   * + - 1. Option 2. As we commented in the 1st round, TCI switch happens every ~5,000 slots for FDD and ~10,000 slots for TDD. If we verify HARQ-ACK transmission with the probability of 99%, we guess the test time is much longer than compared with the test only with 70% of maximum throughput. |
| **CMCC** | **Issue 1-2/1-3**  To Huawei: we are wondering why additional 1 slot is needed for TCI #1, as shown in above Huawei’s comments. In our view, with the assumption that MAC CE transmitted in slot n, taking DPS 1a as example:  PDSCH associated with TCI #0 is transmitted in slots from 0 to n+ HARQ needed time + 3ms  PDSCH associated with TCI #1 is transmitted in slots from n+ HARQ needed time + 3ms + first TRS + TRS processing time to N  **Issue 1-4: Extra test metric for DPS requirements**  We understand the motivation of this extra test metric is to verify different UE behavior in DPS 1a and 1b. During the email discussion and GTW discussion, companies comment that for DPS 1a, due to the transition time, the PDSCH performance in DPS 1a may be worse than DPS 1b. If so, the different UE behavior can be verified by the different SNR values. In this case, the extra test metric may be not needed. Another consideration is that this meeting is the last meeting for this WI, and the discussion on the extra test metric was firstly triggered in this meeting, which may not be very easy to be concluded and may have impact on the completion of the WI. Taking above into consideration, we prefer option 2. |
| **Intel** | **Issue 1-2/1-3**  Thank Huawei for pointing it out. We are fine with this correction. UE should be able to receive target TCI state at the first slot after …which means that we need to add n+1.  **Issue 1-4: Extra test metric for DPS requirements**  Considering test time issue mentioned by Ericsson we think it is not feasible to define such test metric. Same time we are open to further discuss how to ensure that UE supporting 2 active TCI states make pre-tracking of Doppler shift from second TCI and further reduce TCI state switching. At current stage we do not see any possible options to do this considering agreed test design, but we understand the importance of it. |

## Summary on 2nd round (if applicable)

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| **R4-2017549 WF on NR HST UE demodulation** | **Agreeable** |
| **R4-2017647 Summary of ideal and impairment results for NR HST demodulation requirements** | **Noted** |
| **R4-2017539 revision of [R4-2014563](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014563.zip) (Intel)** | **Agreeable** |
| **R4-2017540 revision of [R4-2015603](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015603.zip) (Huawei)** | **Agreeable** |
| **R4-2017541 revision of [R4-2014690](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014690.zip) (CMCC)** | **Agreeable** |
| **R4-2017542 revision of [R4-2014562](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014562.zip) (Intel)** | **Agreeable** |
| **R4-2017543 revision of [R4-2014696](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014696.zip) (CMCC)** | **Agreeable** |
| **R4-2017544 revision of R4-2014698 (CMCC)** | **Agreeable** |
| **R4-2017545 revision of [R4-2015606](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015606.zip) (Huawei)** | **Agreeable** |
| **R4-2017546 revision of [R4-2016108](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016108.zip) (Ericsson)** | **Agreeable** |
| **R4-2017547 revision of [R4-2016500](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016500.zip) (Qualcomm)** | **Agreeable** |
| **R4-2017548 revision of [R4-2015607](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015607.zip) (Huawei)** | **Agreeable** |

# Topic #2: Requirements for HST-SFN

*Agenda 7.15.3.1.2*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Source** |
| [**R4-2014562**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014562.zip) | CR to TS 38.101-4: HST-SFN FDD performance requirements | Intel Corporation |
| [**R4-2014690**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014690.zip) | CR on HST-SFN requirements for TDD | CMCC |
| [**R4-2014696**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014696.zip) | CR on release independent for Rel.16 NR HST UE demodulation requirements | CMCC |
| [**R4-2014698**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014698.zip) | CR on release independent for Rel.16 NR HST UE demodulation requirements | CMCC |
| [**R4-2015813**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015813.zip) | Simulation results of PDSCH with HST-SFN | Ericsson |

## Open issues summary

## Companies views’ collection for 1st round

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR tdoc number** | **Comments collection** |
| [**R4-2014690**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014690.zip) **(CMCC)** |  |
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| --- | --- |
| **CR tdoc number** | **Comments collection** |
| [**R4-2014562**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014562.zip) **(Intel)** | CMCC: one thing to be noted is that Rel-16 HST WI targets to be finalized in this meeting (RP-201614), we are not sure the CR with TBA will be implemented to the spec. TBA is suggested to be updated based on the simulation results summary. |
| Huawei: latest simulation results summary is uploaded, but still larger span than 2.5dB can be observed for two cases with 30kHz SCS, companies are welcome to check their results and discussion is needed on how to handle the final requirements. |
| QC: Applicability rule between 2Rx and 4Rx (do not need to pass 2Rx test when 4Rx is passed is missing) |
|  |

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| --- | --- |
| **CR tdoc number** | **Comments collection** |
| [**R4-2014696**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014696.zip) **(CMCC)** |  |
| Ericsson: RAN4 need to discuss the spec structure in TS38.307, whether we add new clause per WI like this CR, or as LTE we only have one clause '3A.4 Other release independent features'.  We have the same comment for UE performance enhancement (R4-2014501).  We may need note 'Rel-15 UEs supporting the high speed train are assumed to read the Rel-16 high speed train scenario information, which is broadcast to all UEs.'. |
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| **CR tdoc number** | **Comments collection** |
| **R4-2014698 (CMCC)** | Intel: One minor comment that the CR title should be Rel-15, not Rel-16. It is better to fix this typo at least in CR spreadsheet. |
| Ericsson: Same comment as R4-2014696. |
|  |

## 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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| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2014690**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014690.zip) **(CMCC)** | To be revised. Update the SNR values based on latest simulation results summary |
| [**R4-2014562**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014562.zip) **(Intel)** | To be revised |
| [**R4-2014696**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014696.zip) **(CMCC)** | To be revised.  Spec structure of 38.307 needs to be further discussed. Also need to align with performance enhancement WI CRs  Option 1: create new section for each WI in 38.307  Option 2: follow LTE structure, i.e. other features are captured in one section |
| **R4-2014698 (CMCC)** | To be revised  Same situation as [**R4-2014696**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014696.zip) |

*Suggestion on WF/LS assignment*

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

## Discussion on 2nd round (if applicable)

### Open issues summary

### *Open issues*

## Summary on 2nd round (if applicable)

# Topic #3: Requirements for HST single tap

*Agenda 7.15.3.1.3*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **TDoc** | **Title** | **Proposals / Observations** |
| [**R4-2015606**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015606.zip) | CR on HST single-tap and HST multi-path fading requirements | Huawei, HiSilicon |
| [**R4-2016108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016108.zip) | CR to TS38.101-4: Addition of Rel-16 HST FRCs | Ericsson |
| [**R4-2016500**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016500.zip) | CR on FDD HST Single-Tap and Multipath Fading Requirements | Qualcomm Incorporated |

## Open issues summary

## Companies views’ collection for 1st round

### CRs/TPs comments collection

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| --- | --- |
| **CR tdoc number** | **Comments collection** |
| [**R4-2015606**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015606.zip) **(Huawei)** |  |
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| **CR tdoc number** | **Comments collection** |
| [**R4-2016108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016108.zip) **(Ericsson)** |  |
| Ericsson: We would like to request a revision on this CR since we also made changes to Rel-15 FRCs (R.PDSCH.1-8.1 FDD, and R.PDSCH.2-10.1 TDD). We would like to exclude this change to avoid misalignment between the Rel-15 spec and the Rel-16 spec. |
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| **CR tdoc number** | **Comments collection** |
| [**R4-2016500**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016500.zip) **(Qualcomm)** | CMCC: one thing to be noted is that Rel-16 HST WI targets to be finalized in this meeting (RP-201614), we are not sure the CR with TBD will be implemented to the spec. It is suggested to update TBD based on the simulation results summary. |
|  |
|  |

## 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.*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2015606**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015606.zip) **(Huawei)** | To be revised. Update the SNR values based on latest simulation results summary |
| [**R4-2016108**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016108.zip) **(Ericsson)** | To be revised |
| [**R4-2016500**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016500.zip) **(Qualcomm)** | To be revised. Update TBD with values based on latest simulation results summary |

*Suggestion on WF/LS assignment*

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

## Discussion on 2nd round (if applicable)

### Open issues summary

### Open issues

## Summary on 2nd round (if applicable)

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
|  |  |

# Topic #4: Requirements for multi-path fading channels

*Agenda 7.15.3.1.4*

## Companies’ contributions summary

## Open issues summary

# Topic #5: Applicability rule

## Companies’ contributions summary

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| --- | --- | --- | --- |
| **TDoc** | **Title** | **Source** | **Proposals / Observations** |
| [**R4-2014217**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014217.zip) | Discussion on applicability rule for HST test | Apple | Proposal 1: If a UE support R16 HST-SFN,  • If a UE pass HST-SFN test cases, then the UE can skip R15 and R16 HST single tap test  • If a UE pass HST-SFN test cases, then the UE can skip HST multiple-path test  • If a UE pass HST-SFN test cases, then the UE can skip HST-DPS scheme 1a/1b  Proposal 2: If a UE does not support R16 HST-SFN,  • For DPS:  • If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped HST single tap test cases and scheme 1a test cases  • If a UE only support 1 TCI state, the UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases  • Multi-path FDD: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.1.1-3 Test 1-2 and Table 5.2.3.1.1-3 Test 1-2) is not applicable for a UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD  • Multipath TDD: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.2.1-3 Test 1-2 and Table 5.2.3.2.1-3 Test 1-2) is not applicable for a UE that passes Rel-16 multi-path fading tests TDLC300-1200 for TDD |
| [**R4-2014700**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014700.zip) | Discussion on applicability rule for UE demodulation requirements for NR HST | CMCC | Proposal 1:  • it is not preferred to define applicability rule between Rel-15 TDLC300-100 multi-path fading tests and Rel-16 TDLC300-600 for FDD  • it is not preferred to define applicability rule between Rel-15 TDLC300-100 multi-path fading tests and Rel-16 TDLC300-1200 for TDD  Proposal 2: it is not preferred to define applicability rule between HST-SFN and HST multi-path fading. |
| [**R4-2015313**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015313.zip) | Views on HST applicability rules | NTT DOCOMO, INC. | Observation 1: In LTE, UE must pass HST single-tap@300km/h and multi-path fading requirements regardless of whether UE support the advanced-receiver or not.  Proposal 1: Consider following option for test applicability between HST-SFN and HST single tap   Option 1: Skip the Rel-15 HST single tap test, if UE passes the requirements for HST-SFN  Proposal 2: Consider following option for test applicability between HST-SFN and HST multi-path fading   Option 2: Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases  Proposal 3: Consider following option for test applicability between different Doppler frequencies for the same channel model  For FDD:   Option 1: no applicability rule  For TDD:   Option 1: no applicability rule |
| [**R4-2015607**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015607.zip) | CR on applicability rules for HST scenarios | Huawei, HiSilicon |  |
| [**R4-2015608**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015608.zip) | Discussion on applicability rules for different scenarios | Huawei, HiSilicon | Proposal 1: If finally requirements for DPS 1b is defined with only 2 active TCI states, then UE can declare supporting 1, 2 TCI states.  − If UE declared supporting > 1 TCI states, UE will pass scheme 1b and skipped HST single tap test cases and scheme 1a test cases  − If UE only support 1TCI state, UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases  If finally requirements for DPS 1b is defined with both 2 active TCI states and more than 2 active TCI states, then UE can declare supporting 1, 2 or 4 TCI states.  − If UE declared supporting 4 TCI states, UE will pass scheme 1b with more than 2 TCI states and skipped HST single tap test cases and other DPS test cases  − If UE declared supporting 2 TCI states, UE will pass scheme 1b with 2 TCI states and skipped HST single tap test cases and other DPS test cases  − If UE only support 1TCI state, UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases  Proposal 2: Do not define any applicability rule between HST SFN and HST DPS scenario.  Proposal 3: Skip both Rel-15 and Rel-16 HST single tap test, if UE passes the requirements for HST-SFN.  Proposal 4: Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases.  Proposal 5: Adopt Option 2 for both FDD and TDD, i.e. Rel-15 multi-path fading tests with TDLC300-100 are not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600. |
| [**R4-2015814**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015814.zip) | Applicability rule for PDSCH demodulation requirements in HST WI | Ericsson | Proposal 1: For UE supporting > 1 TCI states, and that passes HST-DPS 1b, both Rel-15/16 HST single tap test cases and scheme 1a test cases can be skipped.  Proposal 2: For UE supporting only 1 TCI states, and that passes HST-DPS 1a, both Rel-15/16 HST single tap test cases and scheme 1b test cases can be skipped.  Proposal 3: For UE capable of HST-SFN demodulation and it passes HST-SFN requirements, Rel-15/16 HST single tap tests can be skipped.  Proposal 4: Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases  Proposal 5: Not introduce applicability rules between Rel-15 multi-path fading with TDLC300-100 and Rel-16 multi-path fading tests TDLC300-600 (FDD) and TDLC300-1200 (TDD).  If RAN4 agree with the applicability rules above, we should point Rel-15/16 HST single tap tests may be always skipped. RAN4 may need to discuss whether to define a rule UE performs at least one of HST single tap tests.  Proposal 6: RAN4 may need to ensure at least one of HST single tap requirements are tested. |

## Open issues summary

### Test applicability between HST-SFN, HST single tap and HST multi-path fading performance test cases

**Agreements in RAN4#96e meeting:**

* Test applicability between HST-SFN and HST single tap
  + Do not test UE under HST single-tap, if UE passes the requirements for HST-SFN.
    - Option 1: Skip the Rel-15 HST single tap test, if UE passes the requirements for HST-SFN
    - Option 2: Skip both Rel-15 and Rel-16 HST single tap test, if UE passes the requirements for HST-SFN
* Test applicability between HST-SFN and HST multi-path fading
  + Option 1: Do not test UE under HST multi-path scenarios, if UE passes the requirements for HST-SFN.
  + Option 2: Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases

**Issue 5-1: Test applicability between HST-SFN and HST single tap**

* Proposals
  + Option 1 (DOCOMO): Skip the Rel-15 HST single tap test, if UE passes the requirements for HST-SFN
  + Option 2 (Apple, Huawei, Ericsson): Skip both Rel-15 and Rel-16 HST single tap test, if UE passes the requirements for HST-SFN
* Recommended WF
  + 4 companies discuss this issue, 3 of them support option2. Moderator suggests companies check whether option2 is agreeable.

**Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**

* Proposals
  + Option 1 (Apple): Do not test UE under HST multi-path scenarios, if UE passes the requirements for HST-SFN.
  + Option 2 (DOCOMO, CMCC, Huawei, Ericsson): Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases
* Recommended WF
  + 5 companies discuss this issue, 4 of them support option2. Moderator suggests companies check whether option2 is agreeable.

### Test applicability between different Doppler frequencies for the same channel model

**Agreements in RAN4#96e meeting:**

* Test applicability between different Doppler frequencies for the same channel model
  + For FDD
    - Define applicability rule for TDLB100-400
      * Rel-15 multi-path fading with TDLB100-400 (Table 5.2.2.1.1-3 Test 1-1 and Table 5.2.3.1.1-3 Test 1-1) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD
    - FFS whether to define applicability rule for TDLC300-100
      * Option 1: no applicability rule
      * Option 2: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.1.1-3 Test 1-2 and Table 5.2.3.1.1-3 Test 1-2) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD
  + For TDD
    - Not define any applicability rule for TDLB100-400 multi-path fading tests between Rel-15 and
    - FFS whether to define applicability rule for TDLC300-100
      * Option 1: no applicability rule
      * Option 2: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.2.1-3 Test 1-2 and Table 5.2.3.2.1-3 Test 1-2) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-1200 for TDD

**Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**

* Proposals
  + Option 1 (Apple, Huawei):
    - For FDD:
      * Option 2: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.1.1-3 Test 1-2 and Table 5.2.3.1.1-3 Test 1-2) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD
    - For TDD:
      * Option 2: Rel-15 multi-path fading with TDLC300-100 (Table 5.2.2.2.1-3 Test 1-2 and Table 5.2.3.2.1-3 Test 1-2) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-1200 for TDD
  + Option 2 (CMCC, DOCOMO, Ericsson)
    - For FDD
      * Option 1: no applicability rule
    - For TDD
      * Option 1: no applicability rule
* Recommended WF
  + 5 companies discuss this issue, 3 of them support to not define applicability rule for TDLC300-100. Companies please check whether the following recommended WF is agreeable.
  + For FDD
    - ***(Last meeting agreement)*** Define applicability rule for TDLB100-400
      * Rel-15 multi-path fading with TDLB100-400 (Table 5.2.2.1.1-3 Test 1-1 and Table 5.2.3.1.1-3 Test 1-1) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD
    - Not define any applicability rule for TDLC300-100
  + For TDD
    - ***(Last meeting agreement)*** Not define any applicability rule for TDLB100-400 multi-path fading tests
    - Not define any applicability rule for TDLC300-100 multi-path fading tests

### Test applicability for DPS schemes

***Agreements in RAN4#96e meeting:***

* *Introduce DPS transmission scheme 1b test cases with test applicable rules which can be further discussed among below options*
  + *Option 1:*
    - *If UE declared supporting > 1 TCI states, UE will pass scheme 1b and skipped HST single tap test cases and scheme 1a test cases*
    - *If UE only support 1TCI state, UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases*
  + *Option 2:* 
    - *If UE pass HST-SFN test cases, then UE can skip HST-DPS scheme 1a/1b*

**Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**

* Proposals
  + *Option 1 (Intel, ZTE, Apple):* 
    - *If UE passed HST-SFN requirements it does not need to be tested in HST-DPS.*
  + *Option 2 (CMCC, Huawei):*
    - *Do not introduce applicability rule between DPS and HST-SFN requirements*
  + *Option 3 (Ericsson)*
    - *If UE passed HST-DPS 1a or 1b, both Rel-15/16 HST single tap test cases can be skipped.*
  + *Option 4 (Qualcomm): Introduce the following applicability rules to DPS schemes:*
    - *If UE passed both HST-SFN and HST single tap tests, DPS 1a is not applicable.*
    - *If UE passed both HST-SFN and HST single tap tests, DPS 1b is not applicable.*
* Recommended WF
  + 7 companies discuss this issue. Option4 is same as option1, since we already agreed HST single tap can be skipped if UE passed HST-SFN. Companies please comment based on following options:
    - *Option 1 (Intel, ZTE, Apple):* 
      * *If UE passed HST-SFN requirements it does not need to be tested in HST-DPS.*
    - *Option 2 (CMCC, Huawei):*
      * *Do not introduce applicability rule between DPS and HST-SFN requirements*
    - *Option 3 (Ericsson)*
      * *If UE passed HST-DPS 1a or 1b, both Rel-15/16 HST single tap test cases can be skipped.*

**Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**

* Proposals
  + *Option 1 (Intel):* 
    - *If UE passed HST DPS requirements with more than 1 active TCI state it does not need to be tested in HST-DPS with smaller number of active TCI states.*
  + *Option 2 (Apple, Huawei, Ericsson):*
    - *If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped HST single tap test cases and scheme 1a test cases*
    - *If a UE only support 1 TCI state, the UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases*
* Recommended WF
  + 4 companies discuss this issue, option2 is more detailed proposal compared to option1. Companies please check whether option2 is agreeable.
    - *Option 2 (Apple, Huawei, Ericsson):*
      * *If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped HST single tap test cases and scheme 1a test cases*
      * *If a UE only support 1 TCI state, the UE need to pass both scheme 1a and HST single tap test cases and skip scheme 1b test cases*

### Others

**Issue 5-6: HST single tap requirements**

* Proposals
  + *Option 1 (Ericsson): Rel-15/16 HST single tap tests may be always skipped. RAN4 may need to discuss whether to define a rule UE performs at least one of HST single tap tests.*
* Recommended WF
  + Depending on the outcome of applicability rule discussion, Rel-15/16 HST single tap tests may be always skipped. If so, do companies think RAN4 should discuss whether to define a rule UE performs at least one of HST single tap tests?

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| **docomo** | **Issue 5-6**  **We prefer to define a rule UE performs at least one of HST single tap tests.**  **For the following reasons, we prefer to exclude Rel-16 Single-tap requirement with FDD from all HST applicability rules to treat this test as a mandatory.**  **[HST-SFN]**  **From the LTE applicability rule, HST Single-tap@300km/h requirements are treated as a mandatory test, regardless of whether UE pass HST-SFN requirements. Since RAN4 use the same deployment model of Single-tap and HST-SFN as LTE in Rel-16 NR discussion, it is straightforward to use the same applicability rule as LTE.**  **[DPS]**  **In Rel-16 NR, the new scenario, i.e. DPS is introduced. Considering the condition of DPS except for the period of TCI-switch, the Doppler frequency compensated by UE is same as that of Single-tap. Thus, if UE passes the DPS requirement, it can also pass the Single-tap requirement. However, RAN4 should consider the difference in the maximum Doppler frequency between DPS requirements and Single-tap requirements. In TDD, the maximum Doppler frequency of DPS and Single-tap is the same value, i.e. 1667Hz. On the other hand, in FDD, the maximum Doppler frequency of Single-tap (972Hz) is higher than that of DPS (870Hz). Thus, if UE passes the FDD DPS requirement, it cannot pass the FDD Single-tap requirement.**  **Issue 5-1: Test applicability between HST-SFN and HST single tap**  **We can compromise the introduction of test applicability rule between HST-SFN and Rel-16 TDD Single-tap. However, as we mentioned in Issue 5-6, we cannot compromise the introduction of test applicability rule between HST-SFN and Rel-16 FDD Single-tap.**  **We prefer Option 2 with “except for Rel.16 FDD Single-tap”, i.e. skip Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap, if UE passes the requirements for HST-SFN**  **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**  **We prefer Option 2.**  **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**  **We are OK with the recommended WF**  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  **For Option3, since the maximum Doppler frequency of Rel.16 FDD HST Single-tap (972Hz) is higher than that of DPS (870Hz), we prefer Option 3 with “except for Rel.16 FDD Single-tap”, i.e. if UE passed HST-DPS 1a or 1b, Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap test can be skipped.**  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  **We prefer Option 2 with “except for Rel.16 FDD Single-tap”.**  **Option 2 (Apple, Huawei, Ericsson):**  **If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped HST Single-tap test cases except for Rel.16 FDD Single-tap and scheme 1a test cases**  **If a UE only support 1 TCI state, the UE need to pass both scheme 1a and HST Single-tap test cases and skip scheme 1b test cases** |
| **CMCC** | **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**  **Option 2.**  **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**  **Option 2. Considering that Rel-15 multi-path fading tests with TDLC300-100 verify the performance of partial RB allocation (6RB allocation), while the Rel-16 multi-path fading tests are for full RB allocation, it is not preferred to define applicability rule for TDLC300-100 multi-path fading tests between Rel-15 and Rel-16.**  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  **Option 2. According to the previous discussion, different companies have different UE implementation, the DPS performance cannot be guaranteed if the UE passes the HST-SFN test case.**  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  **We are OK with option 2** |
| **Intel** | **Issue 5-1: Test applicability between HST-SFN and HST single tap**  We prefer Option 1 to have at least one HST Single Tap test case since deployment parameters and corresponding Doppler trajectory is different in HST-SFN and HST Single tap. Also, this issue is strictly related to Issue 5-6. To resolve both of them we are wondering if companies can compromise to Option 1.  **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**  Prefer Option 2. Multi-path propagation conditions with high Doppler spread cannot be covered by HST-SFN UE behaviour.  **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**  Based on companies’ preferences we do not think that we can find compromise to define some applicability rule which will allow to reduce the test efforts. In this case support proposed moderator suggestion to not define any applicability rule for remaining scenarios at all  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  To move forward we are fine with Option 2 and Option 3  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  We agree with the first bullet of the Option2. Same time for the second bullet we cannot make such agreement at current stage since it contradictive to option 3 in issue 5-4. Prefer to resolve first of all issue 5-4.  **Issue 5-6: HST single tap requirements**  Define such applicability rule will make the whole applicability process quite complicated and not clear. To avoid definition of such rule we suggest considering option 1 on Issue 5-1: Skip only Rel-15 HST single tap test, if UE passes the requirements for HST-SFN. |
| **Huawei** | **Issue 5-1: Test applicability between HST-SFN and HST single tap**  We prefer Option 2 since that HST-SFN cases have more strict requirements comparing to single-tap.  **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**  We prefer Option 2.  **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**  To move forward, we are fine with the recommended WF.  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  We prefer Option 2 and Option 3.  For the applicability between SFN and DPS, as per the agreement reached in RAN4#95e meeting, it is agreed that “*Define RAN4 requirements with the assumption of frequency tracking up to UE implementation*”. From our understanding, it cannot distinguish whether large Doppler jump can be observed or not at the middle point of two RRUs since it is up to UE implementation. We believe that gradual Doppler shift change without large Doppler jump is more typical implementation since that the performance for tracking a synthesized frequency is better than that for tacking the strongest tap as per our evaluation. It can be seen that the performance under large Doppler jump cannot be ensured although UE has passed the HST-SFN cases with above typical UE implementation. Therefore, we don’t think it is proper to define such applicability rule.  For Option 1 and Option 4, as per our contribution R4-2007233, the difference between SFN and DPS cases are:   * Different channel model and test setup * Different TCI state processing * Different Doppler trajectory and Doppler shift estimation capability   Therefore, we do not think Option 1 and Option 4 are suitable.  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  1st bullet is fine for us in Option 2, but as Intel indicated, the 2nd bullet is contradictive to Option 3 in Issue 5-4.  **Issue 5-6: HST single tap requirements**  There is no technical reason that at least one of HST single tap tests is needed. Considering DPS cases have more strict requirements comparing to single-tap, we do not think it is necessary to keep at least one of HST single tap tests. |
| **QC** | **Issue 5-1: Test applicability between HST-SFN and HST single tap**  We support option 2.  **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading**  We support option 1, since the speed considered in this WI mostly feasible in lightly populated areas with less reflector, hence HST-SFN model is more representative than multi-path fading model. Moreover, HST-SFN model has larger delay spread than HST multi-path fading model.  **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model**  We support option 2 and recommended WF, since TDL-C 300-100 test is also verifying dynamic TDD performance, not only Doppler spread.  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  We support option 1  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  We support option 2 |
| **Ericsson** | Issue 5-1: Option 2. In Rel-14 LTE HST, the test case with the single tap with 500km/h is skipped if UE passes HST-SFN with 500km/h. We would like to apply the same rule. On top of that, RAN4 has already agreed that if UE pass Rel-16 HST single tap, then UE can skip Rel-15 HST single tap. Eventually, UE can skip both Rel-15 and Rel-16 HST single tap test, if UE passes the requirements for HST-SFN  Issue 5-2: Support Option 2. We believe the UE receiver algorithm for HST-SFN and multi-path fading is different. This is also the reason RAN4 introduced the UE capability and network signalling for HST-SFN requirements.  Issue 5-3: Support the moderator’s recommended WF.  Issue 5-4: Our proposal implicitly supports option 2 also. We understand HST-DPS scenario reuses HST-SFN deployment. However now we are thinking UE demodulation algorithm for HST-DPS is close to HST single tap because it does not require advanced frequency tracking discussed in HST-SFN. We are proposing to define applicability rule between:  - HST-SFN and HST single tap  - HST-DPS and HST single tap  But we don’t want to define applicability rule between HST-SFN and HST-DPS.  Issue 5-5: Support the moderator’s recommended WF, i.e., Option 2.  Issue 5-6: We understand HST single tap is simple compared with HST-SFN, HST-DPS, or multi-path fading. However RAN4 had made effort to specify the requirements. So we would like to discuss whether to define a rule UE performs at least one of HST single tap tests, depending on the discussion on the applicability rule. |
| **vivo** | **Issue 5-1: Test applicability between HST-SFN and HST single tap**  We prefer option 2.  **Issue 5-4: Applicability rules between HST-SFN, single tap and DPS schemes**  We support option 1. In our view if UE can pass HST-SFN, it would be able to pass DPS, and no need for duplicated test case.  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state**  We are generally fine with the principle of option 2 but agree with Huawei that some details in the second bullet may need further discussion. |

### CRs/TPs comments collection

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| **CR tdoc number** | **Comments collection** |
| [**R4-2015607**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015607.zip) **(Huawei)** |  |
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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** |
| **Issue 5-1: Test applicability between HST-SFN and HST single tap**  **Issue 5-6: HST single tap requirements** | **– Option 1 (DOCOMO, Intel): Skip the Rel-15 HST single tap test, if UE passes the requirements for HST-SFN**  **– Option 2 (Apple, Huawei, Ericsson, vivo): Skip both Rel-15 and Rel-16 HST single tap test, if UE passes the requirements for HST-SFN**  **– Option 3 (DOCOMO): Skip both Rel-15 and Rel-16 HST single tap test except for Rel-16 FDD HST single-tap, if UE passes the requirements for HST-SFN**  Agreement: Skip both Rel-15 and Rel-16 HST single tap test except for Rel-16 FDD HST single-tap, if UE passes the requirements for HST-SFN |
| **Issue 5-2: Test applicability between HST-SFN and HST multi-path fading** | **– Option 1 (Apple, QC): Do not test UE under HST multi-path scenarios, if UE passes the requirements for HST-SFN.**  **– Option 2 (DOCOMO, CMCC, Huawei, Ericsson): Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases**  Agreement: Do not define any applicability rules between HST-SFN and HST multi-path fading performance test cases. |
| **Issue 5-3: Test applicability between different Doppler frequencies for the same channel model** | Agreement:   * + For FDD     - ***(Last meeting agreement)*** Define applicability rule for TDLB100-400       * Rel-15 multi-path fading with TDLB100-400 (Table 5.2.2.1.1-3 Test 1-1 and Table 5.2.3.1.1-3 Test 1-1) is not applicable for UE that passes Rel-16 multi-path fading tests TDLC300-600 for FDD     - Not define any applicability rule for TDLC300-100   + For TDD     - ***(Last meeting agreement)*** Not define any applicability rule for TDLB100-400 multi-path fading tests     - Not define any applicability rule for TDLC300-100 multi-path fading tests |
| **Issue 5-4: Applicability rules between HST-SFN, and DPS schemes**  **Issue 5-4b: Applicability rules between HST-SFN, single tap and DPS schemes**  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state** | **Issue 5-4: Applicability rules between HST-SFN, and DPS schemes**  **– Option 1 (Intel, ZTE, Apple, Qualcomm, vivo):**  **If UE passed HST-SFN requirements it does not need to be tested in HST-DPS.**  **– Option 2 (CMCC, Huawei, Ericsson):**  **Do not introduce applicability rule between DPS and HST-SFN requirements**  **Issue 5-4b: Applicability rules between HST-SFN, single tap and DPS schemes**  **– Option 1 (Ericsson, Huawei)**  **If UE passed HST-DPS 1a or 1b, both Rel-15/16 HST single tap test cases can be skipped.**  **– Option 2 (DOCOMO)**  **If UE passed HST-DPS 1a or 1b, Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap test can be skipped.**  **Issue 5-5: Applicability rules between DPS with 1 and more than 1 active TCI state–**  **Option 1 (Intel):**   * **If UE passed HST DPS requirements with more than 1 active TCI state it does not need to be tested in HST-DPS with smaller number of active TCI states.**   **– Option 2 (Apple, Huawei, Ericsson, Qualcomm, vivo):**   * **If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped ~~HST single tap test cases and~~ scheme 1a test cases** * **If a UE only support 1 TCI state, the UE need to pass ~~both~~ scheme 1a ~~and HST single tap test cases~~ and skip scheme 1b test cases**   Agreement: If UE passed HST-DPS 1a or 1b, Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap test can be skipped.  No test applicable rules among HST-SFN and HST DPS schemes 1b  FFS whether test applicable rules for HST-SFN, HST DPS scheme 1a needed or not  If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases  If a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases |

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| [**R4-2015607**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015607.zip) **(Huawei)** | To be revised. Update based on latest agreement |

*Suggestion on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
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## Discussion on 2nd round (if applicable)

### Open issues summary

**Issue 5-1: Applicability rule package**

If UE passed HST-DPS 1a or 1b, Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap test can be skipped.

No test applicable rules among HST-SFN and HST DPS schemes 1b

FFS whether test applicable rules for HST-SFN, HST DPS scheme 1a needed or not

If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skipped scheme 1a test cases

If a UE only support 1 TCI state, the UE need to pass scheme 1a and skip scheme 1b test cases

**Recommended WF: Further discuss in 2nd round whether to define applicability rule for HST-SFN and HST DPS scheme 1a**

### Open issues

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| **Company** | **Comments** |
| **Huawei** | **FFS whether test applicable rules for HST-SFN, HST DPS scheme 1a needed or not**  In our view, the difference between SFN and DPS 1a cases are similar as SFN and DPS 1b that we agreed to not define test applicability rule between them from the following aspects:   * Different channel model and test setup * Different TCI state processing * Different Doppler trajectory and Doppler shift estimation capability * Different implementations between SFN and DPS 1a/1b   So no test applicability rule between HST-SFN and DPS 1a is needed. |
| **Ericsson** | **Issue 5-1:**  We share the same view as Huawei. We don’t think applicability rule is necessary between HST-DPS 1a and HST-SFN. This is our proposal:   * If UE passed HST-DPS 1a or 1b, Rel-15 HST Single-tap test and Rel-16 HST Single-tap test except for Rel-16 FDD HST Single-tap test can be skipped. * No test applicable rules among HST-SFN and HST-DPS schemes 1a/1b * If a UE declared supporting > 1 TCI states, the UE will pass scheme 1b and skip scheme 1a test cases * If a UE only support 1 TCI state, the UE need to pass HST-DPS 1a and skip HST-DPS 1b test cases |
| **CMCC** | **Issue 5-1: FFS whether test applicable rules for HST-SFN, HST DPS scheme 1a needed or not**  As mentioned in the1st round discussion and GTW discussion, different companies have different UE implementation, the DPS performance cannot be guaranteed if the UE passes the HST-SFN test case. This issue also exists for DPS 1a. We are not OK to introduce applicable rules between HST-SFN and HST DPS scheme 1a. |
| **Intel** | **Issue 5-1: FFS whether test applicable rules for HST-SFN, HST DPS scheme 1a needed or not**  We are fine not to define applicability rule between HST-SFN and HST-DPS 1a. |

## Summary on 2nd round (if applicable)

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
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