**3GPP TSG-RAN WG4 Meeting #101-bis-e R4-210XXXX**

**Electronic Meeting, 17th – 25th Jan, 2022**

**Agenda item:** 6.9.5

**Source:** Moderator (Samsung)

**Title:** Email discussion summary for [101-bis-e][314] NR\_HST\_FR2\_Demod\_Part1

**Document for:** Information

# Introduction

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

Based on the agreement captured in WF [R4-2120775], the test scope of UE demodulation was under discussion. For this meeting, companies are encouraged to further discuss the test scope for UE demodulation based on the FR2 HST deployment scenarios, and the related test setup for each identified requirements

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

* 6.9.2 High speed train deployment scenario in FR2
* 6.9.5.1 General
* 6.9.5.2 UE demodulation requirements
* 6.9.5.2.1 PDSCH requirements under Uni-directional scenario
* 6.9.5.2.2 PDSCH requirements under Bi-directional scenario

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

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

# Topic #1: FR2 HST Deployment Scenarios

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2201000 | Huawei, HiSilicon | TP to TR 38.854 on Deployment Scenario Analysis for FR2 HST |
| R4-2201524 | Ericsson | TP to TR 38.854: Coverage analysis |

## Open issues summary

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2201000(TP to TR 38.854) | Company A |
| Company B |
|  |
| R4-2201524(TP to TR 38.854) | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: General

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200743 | Samsung | Simulation results summary |
| R4-2200744 | Samsung | CR work split for Rel-17 FR2 HSTProposal 1: Agree the CR work split table above, interest companies are encouraged for joint contribution. |
| R4-2200745 | Samsung | Proposal 1: Define PDSCH requirement for Bi-directional scenario with 9722Hz.Proposal 2: No NWA signaling introduce to inform the UE whether a jump is expected (including Deployment type, intra/Inter-RRH TCI state switching type)Proposal 3: Do not introduce the UE capability to differentiate requirement for Bi/Uni-directional scenarioProposal 4: Do not consider the following period after receiving MAC CE active TCI switching from the throughput statistics* Bi-directional scenario DPS scheme1a, THARQ +TMAC Proc +TfirstSSB + TSSB proc + TfirstTRSafterSSB+ TTRS pro
* Uni-directional scenario DPS scheme1b, THARQ +TMAC Proc

Proposal 5: Configure SSB period configuration as 20ms, and 10ms for TRS period configuration Observation 1: Similar performance can be achieved for Uni-directional scenario with A and BObservation 2: About 1 dB performance loss for Bi-directional compared with Uni-directional scenarioProposal 6: MCS 17 with Rank2 is feasible for FR2 HST PDSCH requirement. |
| R4-2200837 | ZTE | Proposal 1: Not to define signaling distinguishing UE capability between uni-directional deployment and bi-directional deployment.Proposal 2: To support UE capability signaling differentiating different speed if the need of different speeds is confirmed. |
| R4-2201001 | Huawei, HiSilicon | Proposal 1: Do not introduce higher layer signalling to inform the UE of the FR2 HST deployment typology (Uni-directional and Bi-directional scenario) for PDSCH demodulation requirement.Proposal 2: Do not introduce MAC-CE signalling to inform the UE of the TCI switching typology (Intra/Inter -RRH) for PDSCH demodulation requirement.Proposal 3: Select 10ms for TRS for HST FR2 PDSCH requirements definition. |
| R4-2201002 | Huawei, HiSilicon | Draft CR on minimum requirements for PDSCH HST-DPS (38.101-4) |
| R4-2201004 | Huawei,HiSilicon | Proposal 1: For Uni-directional scenario A with DPS scheme 1b, reuse same throughput statistics method as the existing FR1 DPS1b cases that the switching point is the slot#n+THARQ +TMAC Proc and there is no switching interruption during the test, where in slot#n TCI state switching MAC CE command is transmitted. |
| R4-2201005 | HuaweiHiSilicon | Proposal 1: For Bi-directional scenario B with DPS scheme 1a, only define 350km/h requirements and do not introduce any UE capability to support 250km/h speed.Proposal 2: For Bi-directional scenario B with DPS scheme 1a, reuse same throughput statistics method as the existing FR1 DPS1a cases but change the TRS receiving and processing time to the SSB receiving and processing time that the first time that new TCI state applied is the slot#n+THARQ +TMAC Proc +TfirstSSB + TSSB proc, where in slot#n TCI state switching MAC CE command is transmitted. |
| R4-2201425 | Ericsson | Proposal 1: Schedule the active TCI switching for PDSCH demodulation test with the channel model assuming the Uni-directional Scenario A as follows:* Switch from RRH #(k-1) to RRH #k at the location of $\left(k-1\right)⋅D\_{s}-D\_{s\\_offset}, k=0,1,2,…$

Proposal 2: RAN4 demodulation requirements do not consider the following period after receiving MAC CE active TCI switching from the throughput statistics:* **D**PS Scheme 1a (UE capable of one active TCI state): THARQ + TMAC proc + TfirstRS + TRS proc
* DPS Scheme 1b (UE capable of two or more active TCI states): THARQ + TMAC proc
	+ THARQ: Number of slots between PDSCH and corresponding HARQ-ACK information
	+ TMAC proc: Number of slots for MAC CE processing
	+ TfirstRS: Larger number of slots to the first SSB transmission and the first TRS transmission after MAC CE command is decoded by the UE
	+ TRS proc: Larger number of slots for SSB processing and TRS processing

Proposal 3: No signaling is needed to indicate the deployment topology for FR2 HST UE demodulation requirements. Proposal 4: RAN4 define UE demodulation requirements with transmission schemes DPS 1a and 1b only with the channel model based on Bi-directional Scenario B.

|  |  |  |  |
| --- | --- | --- | --- |
| Test number | Channel model and active TCI switching scheduling | DPS Tx scheme | Channel model parameters |
| 1 | HST-DPS-FR2(derived based on Bi-directional Scenario B) | 1a / 1b according to UE capability of the number of active TCI states.  | v: 350km/hDs: 700msDmin: 150m |

Proposal 5: Configure SSB with the periodicity of 20ms and TRS with the periodicity of 10ms.  |
| R4-2201426 | Ericsson | Proposal 1: For the PDSCH demodulation requirements for the Bi-directional Scenario B deployment in HST FR2, set the maximum Doppler shift to 9722Hz only.Proposal 2: The PDSCH demodulation requirements defined in Rel-17 WI HST FR2 are only applicable for UE capable of UE power class 6 (High Speed Train Roof-Mounted UE). Proposal 3: Schedule the active TCI switching for PDSCH demodulation test with the channel model assuming the Bi-directional Scenario B as follows:* Switch from RRH #(k-1) to RRH #(k+1) at the location of 2k⋅1/2 D\_s,k=0,1,2,…
* Switch from RRH #(k+1) to RRH #k at the location of 2(k+1)⋅1/2 D\_s,k=0,1,2,…
 |
| R4-2201718 | Qualcomm | Observation 1: If the FR2 HST UE is not informed on the deployment type by the network via higher layer signaling, the UE is expected to guess based on direct observations of the network signal. The details of this observations are up to the UE.Observation 2: A wrong UE assumption on the Deployment type can have impacts on performance and power consumption.Observation 3: With the agreed Single Panel UE test setup, it’s unclear how a correct UE autonomous identification of the FR2 HST Deployment type used to derive the channel model can be ensured during PDSCH performance testing for FR2 HST.Observation 4: We cannot support option 1 (No UE capability for FR2 HST) because a minimum implementation UE is not able to cope with the expected Doppler Jump in FR2 HST Bidirectional deployment with the expected train speed and additional UE processing is required;Observation 5: Option 3 does not allow for the UE to receive TRS before resuming throughput performance evaluation and as such should not be considered;Observation 6: Option 1 and 2 seem fundamentally to be the same, but we consider Option 1 to be more immediate and clearer to understand;Proposal 1: To avoid performance and power impact in a real deployment and to ensure proper setup during testing of the PDSCH demodulation requirements, we recommend RAN4 to agree on the introduction of higher layer signaling (ie. System Information, RRC)) to inform the UE of the FR2 HST deployment typology (Uni-directional and Bi-directional scenario). Proposal 2: If an agreement is reached on the introduction of higher layer signaling to inform the UE of the FR2 HST deployment typology, we recommend RAN4 to send an LS to RAN2. A draft is provided in the appendix of this contribution.Proposal 3: Support introducing a UE capability for FR2 HST Bidirectional deployment, to avoid introducing mandatory requirements which require a dedicated implementation and which cannot be satisfied by a minimum implementation UE. Given that the limitation to 250Km/h does not reflect any expectation on the real world deployment or train speed, do not include a speed limitation in the capability definition.Proposal 4: If a UE capability to support FR2 HST Bidirectional deployment is introduced, introduce Test Case 2b: Uni-directional Scenario B with DPS Scheme 1a, and related Applicability Rule that Test 2b can be skipped if UE supports more than 1 Active TCI State.Proposal 5: If a UE capability to support FR2 HST Bidirectional deployment is introduced, we are open to compromise on Option 1 (9722Hz) for Maximum Doppler Frequency in Bidirectional Deployment scenario.Proposal 6: For Bi-Directional Deployment, support the Deployment scenario included in the WF from R4 #101-e.Proposal 7: On the test procedure issue regarding PDSCH allocation timeline, support Option 4 (which generalizes Option 1 to the Test for UE supporting >1 Active TCI State).Proposal 8: The PDSCH allocation timeline should also consider the input from RRM regarding FR2 TCI switching timeline before we can reach a definitive conclusion on the test procedure.Proposal 9: In line with requirements already included in 38.101-4 for HST deployments, we support Option 1 for SSB and TRS period configuration (respectively 20 and 10 ms). |
| R4-2201877 | Intel | Proposal 1: Define HST-FR2 performance requirements for bi-directional deployment only with 9722 Hz Doppler frequency. Do not define network assistance signalling to indicate TCI state switching type or deployment type (Option 1b).Proposal #2: PDSCH allocation timeline should include:* Bi-directional 1a scheme: THARQ +TMAC Proc +TfirstTRS +TTRS Proc
	+  Test setup should ensure that new SSB is received before new TRS.
* Uni-directional 1b scheme: THARQ +TMAC Proc

Proposal #3: Consider 20ms and 10ms SSB and TRS periodicity receptively. Consider SSB position in the burst as 29.Proposal #4: Define UE feature to support HST-FR2 operation according to the following Table:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Need for the gNB to know if the feature is supported | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Note | Mandatory/Optional |
| x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST3) Support of demodulation processing for FR2 HST  | Yes | UE is not able to meet the enhanced requirements in HST FR2 | Per Band | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |

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## Open issues summary

Last RAN4 meeting agreements in the WF R4-2120775

List of open issues

* Sub-topic 2-1 Network Assistance signalling
	+ Issue 2-1-1: Network assistance signalling to indicate TCI state switching type or deployment type
	+ Issue 2-1-2: LS to RAN2 for Network Assistance signalling
* Sub-topic 2-2: UE capability and Doppler Frequency
	+ Issue 2-2-1: UE capability
	+ Issue 2-2-2: Doppler Frequency for PDSCH requirement in Bi-directional scenario
* Sub-topic 2-3: UE feature list for FR2 HST
	+ Issue 2-3-1: whether additional signalling to indicate UE supporting of demodulation processing for FR2 HST excepting for FR2 UE power class PC6 signalling is needed

### Sub-topic 2-1: Network Assistance signaling

**Issue 2-1-1: Network assistance signalling to indicate TCI state switching type or deployment type**

* Observations
	+ Observation 1(Qualcomm):
		- If the FR2 HST UE is not informed on the deployment type by the network via higher layer signaling, the UE is expected to guess based on direct observations of the network signal. The details of this observations are up to the UE
		- A wrong UE assumption on the Deployment type can have impacts on performance and power consumption.
		- With the agreed Single Panel UE test setup, it’s unclear how a correct UE autonomous identification of the FR2 HST Deployment type used to derive the channel model can be ensured during PDSCH performance testing for FR2 HST
	+ Observation 2(Intel):
		- Conventional UE implementation assumes implementation of SSB based frequency estimation.
		- Network assistance signaling on TCI state switching type or deployment type does not provide reasonable performance or implementation benefits.
* Proposals
	+ Option 1(Intel, Samsung, Huawei, Ericsson): Do not define network assistance signalling to indicate TCI state switching type or deployment type
	+ Option 2 (Qualcomm): To avoid performance and power impact in a real deployment and to ensure proper setup during testing of the PDSCH demodulation requirements, we recommend RAN4 to agree on the introduction of higher layer signaling (ie. System Information, RRC)) to inform the UE of the FR2 HST deployment typology (Uni-directional and Bi-directional scenario).
* Recommended WF
	+ Encourage comments if any.

**Issue 2-1-2: LS to RAN2 for Network Assistance signalling**

* Proposals
	+ Option 1 (Qualcomm): If an agreement is reached on the introduction of higher layer signaling to inform the UE of the FR2 HST deployment typology, we recommend RAN4 to send an LS to RAN2. A draft is provided in the appendix of this contribution.
* Recommended WF
	+ Pending on issue 2-1-1

### Sub-topic 2-2: UE capability and Doppler Frequency

**Issue 2-2-1: UE capability**

* Observation
	+ Observation 1(Qualcomm):
		- We cannot support option 1 (No UE capability for FR2 HST) because a minimum implementation UE is not able to cope with the expected Doppler Jump in FR2 HST Bidirectional deployment with the expected train speed and additional UE processing is required;
* Proposals
	+ Option 1(ZTE, Intel, Samsung, Huawei, Ericsson): Not to define signaling distinguishing UE capability between uni-directional deployment and bi-directional deployment.
	+ Option 2(ZTE): To support UE capability signalling differentiating different speed if the need of different speeds is confirmed.
	+ Option 3(Qualcomm): Support introducing a UE capability for FR2 HST Bidirectional deployment, to avoid introducing mandatory requirements which require a dedicated implementation and which cannot be satisfied by a minimum implementation UE. Given that the limitation to 250Km/h does not reflect any expectation on the real world deployment or train speed, do not include a speed limitation in the capability definition.
* Recommended WF
	+ Encourage comments if any.

**Issue 2-2-2: Doppler Frequency for PDSCH requirement in Bi-directional scenario**

* Observations
	+ Observation 1(Intel)
		- Option 3 contradicts with previous agreement to not take into account any extra UE frequency error margins to derive max supported Doppler frequency.
* Proposals
	+ Option 1(Samsung, Intel, CMCC, Huawei, Ericsson): 9722Hz
	+ Option 2 (Qualcomm): Compromise 9722Hz if a UE capability to support FR2 HST Bidirectional deployment is introduced
* Recommended WF
	+ Encourage comments if any. Pending on Issue 2-2-1

### Sub-topic 2-3: UE feature list for FR2 HST

**Issue 2-3-1: whether additional signalling to indicate UE supporting of demodulation processing for FR2 HST excepting for FR2 UE power class PC6 signalling is needed**

* Proposals
	+ Option 1( Intel, Ericsson): No
		- The PDSCH demodulation requirements defined in Rel-17 WI HST FR2 are only applicable for UE capable of UE power class 6 (High Speed Train Roof-Mounted UE).
		- Define UE feature to support HST-FR2 operation according to the following Table

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Feature group | Components | Need for the gNB to know if the feature is supported | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Note | Mandatory/Optional |
| Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST3) Support of demodulation processing for FR2 HST  | Yes | UE is not able to meet the enhanced requirements in HST FR2 | Per Band | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |

* Recommended WF
	+ Encourage comments if any.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1-1Issue 2-1-2 |
| Intel | Issue 2-1-1We still do not see benefits to provide information on deployment type or TCI state switching type from demodulation perspective. According to our assessments TCI state switching due to Tx beam change happens not so frequently to have impact on UE power consumption due to SSB+TRS tracking. Also, HST FR2 UE is a dedicated product that should be able to operate in different deployments. Therefore, there is no need to signal deployment type.  |

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | Issue 2-2-1:Option 1. We do not see the necessity to define signaling distinguishing UE capability between uni-directional deployment and bi-directional deployment. In our view, whether uni-directional deployment and bi-directional deployment is deployed is up to operator deployment, our preference is that both are supported by the high-speed CPEsIssue 2-2-2:Option 1. |
| Ericsson | Issue 2-1-1Option 1.From UE demodulation test point of view, one transmitter transmits signal by changing the Doppler shift according to the channel model regardless of uni- or bi-directional model. This means UE does not need to tune Rx panel. We should also point out it is for special UE dedicated for HST FR2, i.e., PC6. I think such a UE should be optimized for such an environment.We are not sure how the operators choose the deployment mode if 3GPP introduce the higher layer signaling to indicate the deployment topology information. These two deployment scenarios (bi-directional and uni-directional) are two extreme deployment models in our understanding. In the real deployment, it is not possible to deploy RRH exactly same as like Bi-directional scenario B. Some deployment may be middle of uni-directional like and bi-directional like deployments. In this case which mode operators should signal?  |
| Intel | Issue 2-2-1According to the HST FR2 WID, performance in HST-FR2 deployment should be optimized to support 350km/h at 30GHz carrier frequency. A dedicated UE PC 6 was agreed to be introduced for such operation. It means that this UE should have a dedicated implementation to be able to meet corresponding requirements. We do not assume that conventional UEs will be used in HST-FR2 hence there is no need to define requirements based on conventional implementations. Support Option 1.Issue 2-2-2Support Option 1 that is aligned with a target speed from HST-FR2 WID. |

Sub topic 2-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-3-1 |
| Ericsson | Issus 2-3-1We support to define single UE capability to support the PDSCH demodulation requirements for Rel-17 HST FR2, and which should be connected to FR2 UE power class PC6.  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

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

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

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|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #3: PDSCH requirement

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200743 | Samsung | Simulation results summary |
| R4-2200744 | Samsung | CR work split for Rel-17 FR2 HSTProposal 1: Agree the CR work split table above, interest companies are encouraged for joint contribution. |
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* Uni-directional scenario DPS scheme1b, THARQ +TMAC Proc

Proposal 5: Configure SSB period configuration as 20ms, and 10ms for TRS period configuration Observation 1: Similar performance can be achieved for Uni-directional scenario with A and BObservation 2: About 1 dB performance loss for Bi-directional compared with Uni-directional scenarioProposal 6: MCS 17 with Rank2 is feasible for FR2 HST PDSCH requirement. |
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| R4-2201005 | HuaweiHiSilicon | Proposal 1: For Bi-directional scenario B with DPS scheme 1a, only define 350km/h requirements and do not introduce any UE capability to support 250km/h speed.Proposal 2: For Bi-directional scenario B with DPS scheme 1a, reuse same throughput statistics method as the existing FR1 DPS1a cases but change the TRS receiving and processing time to the SSB receiving and processing time that the first time that new TCI state applied is the slot#n+THARQ +TMAC Proc +TfirstSSB + TSSB proc, where in slot#n TCI state switching MAC CE command is transmitted. |
| R4-2201425 | Ericsson | Proposal 1: Schedule the active TCI switching for PDSCH demodulation test with the channel model assuming the Uni-directional Scenario A as follows:* Switch from RRH #(k-1) to RRH #k at the location of $\left(k-1\right)⋅D\_{s}-D\_{s\\_offset}, k=0,1,2,…$

Proposal 2: RAN4 demodulation requirements do not consider the following period after receiving MAC CE active TCI switching from the throughput statistics:* **D**PS Scheme 1a (UE capable of one active TCI state): THARQ + TMAC proc + TfirstRS + TRS proc
* DPS Scheme 1b (UE capable of two or more active TCI states): THARQ + TMAC proc
	+ THARQ: Number of slots between PDSCH and corresponding HARQ-ACK information
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Proposal 3: No signaling is needed to indicate the deployment topology for FR2 HST UE demodulation requirements. Proposal 4: RAN4 define UE demodulation requirements with transmission schemes DPS 1a and 1b only with the channel model based on Bi-directional Scenario B.

|  |  |  |  |
| --- | --- | --- | --- |
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| 1 | HST-DPS-FR2(derived based on Bi-directional Scenario B) | 1a / 1b according to UE capability of the number of active TCI states.  | V: 350km/hDs: 700msDmin: 150m |

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* Switch from RRH #(k+1) to RRH #k at the location of 2(k+1)⋅1/2 D\_s,k=0,1,2,…
 |
| R4-2201718 | Qualcomm | Observation 1: If the FR2 HST UE is not informed on the deployment type by the network via higher layer signaling, the UE is expected to guess based on direct observations of the network signal. The details of this observations are up to the UE.Observation 2: A wrong UE assumption on the Deployment type can have impacts on performance and power consumption.Observation 3: With the agreed Single Panel UE test setup, it’s unclear how a correct UE autonomous identification of the FR2 HST Deployment type used to derive the channel model can be ensured during PDSCH performance testing for FR2 HST.Observation 4: We cannot support option 1 (No UE capability for FR2 HST) because a minimum implementation UE is not able to cope with the expected Doppler Jump in FR2 HST Bidirectional deployment with the expected train speed and additional UE processing is required;Observation 5: Option 3 does not allow for the UE to receive TRS before resuming throughput performance evaluation and as such should not be considered;Observation 6: Option 1 and 2 seem fundamentally to be the same, but we consider Option 1 to be more immediate and clearer to understand;Proposal 1: To avoid performance and power impact in a real deployment and to ensure proper setup during testing of the PDSCH demodulation requirements, we recommend RAN4 to agree on the introduction of higher layer signaling (ie. System Information, RRC)) to inform the UE of the FR2 HST deployment typology (Uni-directional and Bi-directional scenario). Proposal 2: If an agreement is reached on the introduction of higher layer signaling to inform the UE of the FR2 HST deployment typology, we recommend RAN4 to send an LS to RAN2. A draft is provided in the appendix of this contribution.Proposal 3: Support introducing a UE capability for FR2 HST Bidirectional deployment, to avoid introducing mandatory requirements which require a dedicated implementation and which cannot be satisfied by a minimum implementation UE. Given that the limitation to 250Km/h does not reflect any expectation on the real world deployment or train speed, do not include a speed limitation in the capability definition.Proposal 4: If a UE capability to support FR2 HST Bidirectional deployment is introduced, introduce Test Case 2b: Uni-directional Scenario B with DPS Scheme 1a, and related Applicability Rule that Test 2b can be skipped if UE supports more than 1 Active TCI State.Proposal 5: If a UE capability to support FR2 HST Bidirectional deployment is introduced, we are open to compromise on Option 1 (9722Hz) for Maximum Doppler Frequency in Bidirectional Deployment scenario.Proposal 6: For Bi-Directional Deployment, support the Deployment scenario included in the WF from R4 #101-e.Proposal 7: On the test procedure issue regarding PDSCH allocation timeline, support Option 4 (which generalizes Option 1 to the Test for UE supporting >1 Active TCI State).Proposal 8: The PDSCH allocation timeline should also consider the input from RRM regarding FR2 TCI switching timeline before we can reach a definitive conclusion on the test procedure.Proposal 9: In line with requirements already included in 38.101-4 for HST deployments, we support Option 1 for SSB and TRS period configuration (respectively 20 and 10 ms). |
| R4-2201877 | Intel | Proposal 1: Define HST-FR2 performance requirements for bi-directional deployment only with 9722 Hz Doppler frequency. Do not define network assistance signalling to indicate TCI state switching type or deployment type (Option 1b).Proposal #2: PDSCH allocation timeline should include:* Bi-directional 1a scheme: THARQ +TMAC Proc +TfirstTRS +TTRS Proc
	+  Test setup should ensure that new SSB is received before new TRS.
* Uni-directional 1b scheme: THARQ +TMAC Proc

Proposal #3: Consider 20ms and 10ms SSB and TRS periodicity receptively. Consider SSB position in the burst as 29.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Feature group | Components | Need for the gNB to know if the feature is supported | Consequence if the feature is not supported by the UE | Type(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC) | Note | Mandatory/Optional |
| x-1 | Support of FR2 HST operation | 1) Support of FR2 UE PC62) Support of enhanced RRM requirements for FR2 HST3) Support of demodulation processing for FR2 HST  | Yes | UE is not able to meet the enhanced requirements in HST FR2 | Per Band | FR2 UE power class PC6 signalling is used to indicate support of feature group | Optional with capability signalling |

Proposal #4: Define UE feature to support HST-FR2 operation according to the following Table: |

## Open issues summary

Last RAN4 meeting agreements in the WF R4-2120775

List of open issues

* Sub-topic 3-1 Common setup
	+ Issue 3-1-1: Test cases definition and test applicability rule
	+ Issue 3-1-2: TRS/SSB configuration
* Sub-topic 3-2: PDSCH requirement for Uni-directional scenario
	+ Issue 3-2-1: TCI switching scheduling
	+ Issue 3-2-2: PDSCH allocation time for Uni-directional scenario with DPS scheme 1b
* Sub-topic 3-3: PDSCH requirement for Bi-directional scenario
	+ Issue 3-3-1: TCI switching scheduling
	+ Issue 3-3-2: PDSCH allocation time for Bi-directional scenario with DPS scheme 1a

### Sub-topic 3-1: Common setup

**Issue 3-1-1: Test cases definition and test applicability rule**

* Observation
	+ Observation 1(CMCC):
		- With current applicability agreed in last meeting, even if both case 1 (Uni-directional scenario A with DPS scheme 1b) and case 2 (Bi-directional scenario B with DPS scheme 1a) are tested, the performance of bi-directional scenario A with DPS scheme 1b and the performance of uni-directional scenario B with DPS 1a are not guaranteed.
* Proposals
	+ Option 1(Ericsson): RAN4 define UE demodulation requirements with transmission schemes DPS 1a and 1b only with the channel model based on Bi-directional Scenario B.

|  |  |  |  |
| --- | --- | --- | --- |
| Test number | Channel model and active TCI switching scheduling | DPS Tx scheme | Channel model parameters |
| 1 | HST-DPS-FR2(derived based on Bi-directional Scenario B) | 1a / 1b according to UE capability of the number of active TCI states.  | V: 350km/hDs: 700msDmin: 150m |

* + Option 2 (CMCC): Update applicability rule for defined two cases
		- If UE is capable of more than 1 activated TCI state, UE should pass test both case 1 and case 2, otherwise, UE should only pass test of case 2
		- If UE passes case 1 (uni-directional scenario A with DPS scheme 1b), the performance of uni-directional scenario B with DPS scheme 1b are also guaranteed
	+ Option 3 (Qualcomm) : If a UE capability to support FR2 HST Bidirectional deployment is introduced, introduce additional Test Case 2b with test applicability rule
		- Uni-directional Scenario B with DPS Scheme 1a,
		- Test 2b can be skipped if UE supports more than 1 Active TCI State
	+ Option 4: Keep agreement in the last meeting
		- If UE is capable of more than 1 activated TCI state, UE should pass test both case 1 and case 2, otherwise, UE should only pass test of case 2

|  |  |  |  |
| --- | --- | --- | --- |
| Test number | Channel model and active TCI switching scheduling | DPS Tx scheme | Channel model parameters |
| 1 | HST-DPS-FR2-B (Bi-directional Scenario B) | 1a | v: 350km/hDs: 700msDmin: 150m |
| 2 | HST-DPS-FR2-A (Uni-directional Scenario A) | 1b | v: 350km/hDs: 700mDmin: 10mDs\_offset: 10m |

* Recommended WF
	+ Encourage comments if any.

**Issue 3-1-2: TRS/SSB configuration**

* Proposals
	+ Option 1(Intel, Qualcomm, Huawei, Ericsson, Samsung): 20ms for SSB, and 10ms for TRS
		- Option 1a (Intel): SSB position in the burst as 29
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-2: PDSCH requirement for Uni-directional scenario

**Issue 3-2-1: TCI switching scheduling**

* Proposals
	+ Option 1(Ericsson): Schedule the active TCI switching for PDSCH demodulation test with the channel model assuming the Bi-directional Scenario A as follows
		- **Switch from RRH #(k-1) to RRH #k at the location of** $\left(k-1\right)⋅D\_{s}-D\_{s\\_offset}, k=0,1,2,…$



* Recommended WF
	+ Encourage comments if any.

**Issue 3-2-2: PDSCH allocation time for Uni-directional scenario with DPS scheme 1b**

* Observations
	+ Observation 1 (Qualcomm):
		- Option 3 does not allow for the UE to receive TRS before resuming throughput performance evaluation and as such should not be considered;
		- Option 1 and 2 seem fundamentally to be the same, but we consider Option 1 to be more immediate and clearer to understand;
* Proposals
	+ Option 1(Samsung, Intel, Qualcomm, Huawei, Ericsson): THARQ+TMAC Proc
		- THARQ: Number of slots between PDSCH and corresponding HARQ-ACK information
		- TMAC proc: Number of slots for MAC CE processing
	+ Option 2 (Qualcomm): The PDSCH allocation timeline should also consider the input from RRM regarding FR2 TCI switching timeline before we can reach a definitive conclusion on the test procedure
* Recommended WF
	+ Encourage comments if any.

### Sub-topic 3-3: PDSCH requirement for Bi-directional scenario

**Issue 3-3-1: TCI switching scheduling**

* Proposals
	+ Option 1(Ericsson, Qualcomm): Schedule the active TCI switching for PDSCH demodulation test with the channel model assuming the Bi-directional Scenario B as follows
		- Switch from RRH #(k-1) to RRH #(k+1) at the location of $2k⋅\frac{1}{2}D\_{s}, k=0,1,2,…$
		- Switch from RRH #(k+1) to RRH #k at the location of $2\left(k+1\right)⋅\frac{1}{2}D\_{s}, k=0,1,2,…$



* Recommended WF
	+ Encourage comments if any.

**Issue 3-3-2: PDSCH allocation time for Bi-directional scenario with DPS scheme 1a**

* Proposals
	+ Option 1(Huawei): *T*HARQ+*T*MAC Proc+TfirstSSB+TSSB proc
	+ Option 2(Qualcomm, Samsung): THARQ+TMAC Proc+TfirstSSB + TSSB proc +TfirstTRSafterSSB+ TTRS pro
		- Option 2a (Qualcomm): The PDSCH allocation timeline should also consider the input from RRM regarding FR2 TCI switching timeline before we can reach a definitive conclusion on the test procedure
	+ Option 3 (Intel): THARQ +TMAC Proc +TfirstTRS +TTRS Proc
		- Test setup should ensure that new SSB is received before new TRS
	+ Option 4(Ericsson): *T*HARQ+*T*MAC Proc+TfirstRS+TRS proc := *T*HARQ+*T*MAC Proc+ max(TfirstSSB, TfirstTRS), +TRS proc
		- THARQ: Number of slots between PDSCH and corresponding HARQ-ACK information
		- TMAC proc: Number of slots for MAC CE processing
		- TfirstRS: Larger number of slots to the first SSB transmission and the first TRS transmission after MAC CE command is decoded by the UE, that is, max(TfirstSSB, TfirstTRS)
		- TRS proc: Larger number of slots for SSB processing and TRS processing
* Recommended WF
	+ Encourage comments if any.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CMCC | Issue 3-1-1: Test cases definition and test applicability ruleOption 2 (after further check, we update option 2 as following). We would like to provide detailed consideration on this issue.In last meeting, we have following agreements:

|  |
| --- |
| Agreements in last meeting (R4-2120755)* Number of test cases
	+ Case 1: Uni-directional scenario A with DPS scheme 1b
	+ Case 2: Bi-directional scenario B with DPS scheme 1a
	+ Test applicability rule
		- If UE is capable of more than 1 activated TCI state, UE should pass test both case 1 and case 2, otherwise, UE should only pass test of case 2
 |

With current applicability agreed in last meeting, even if both case 1 (Uni-directional scenario A with DPS scheme 1b) and case 2 (Bi-directional scenario B with DPS scheme 1a) are tested, the performance of uni-directional scenario B with DPS 1b is not guaranteed. Based on above consideration, it is proposed to update the applicability rules as following (the addition parts are highlighted in yellow)

|  |
| --- |
| Updated option 2: Update applicability rule for defined two cases* If UE is capable of more than 1 activated TCI state, UE should pass test both case 1 and case 2, otherwise, UE should only pass test of case 2
* If UE passes case 1 (uni-directional scenario A with DPS scheme 1b), the performance of uni-directional **scenario B** with DPS scheme 1b are also guaranteed
 |

We would like to hear companies’ views on this issue.Issue 3-1-2- |
| Ericsson | Issue 3-1-1Our simulation results show any significant performance difference between Bi-directional Scenario B and Uni-directional Scenario A. So we prefer to define the single test to avoid redundant test cases, that is, Option 1If companies want to define two cases, we are also fine with the last agreement Option 4.Regarding the proposal by CMCC, we want to keep the agreements on the scenarios: Uni-directional Scenario A and Bi-directional Scenario B. Issue 3-1-2Option 1 is fine with us. |
| Intel | Issue 3-1-2Support at least Option 1. We have proposed Option 1a as an alternative how to ensure that SSB is received before TRS after TCI state switching. |

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-2-1Issue 3-2-2- |
| Ericsson | Issue 3-2-1RAN4 should capture such a scheduling in TS38.101-4. Issue 3-2-2We support Option 1. Regarding the TCI switching timeline, we can follow the same approach as FR1 HST-DPS agreed in Rel-16 HST WI. We need to configure CSI-RS for CSI acquisition so that UE should know the next TCI states. |
| Intel | Issue 3-2-1We support Option 1. Similar to HST FR1 test cases the scheduling approach should be captured in table with test case parameters.Issue 3-2-2Support Option 1 that is aligned with TCI state switching delay requirement for MAC-CE based switching with known target TCI state. |

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-2-1Issue 3-3-1 |
| Ericsson | Issue 3-2-1RAN4 should capture such a scheduling in TS38.101-4. Issue 3-3-1Option 4 is a compromised proposal of Option 1 and Option 3, which covers both cases UE receive either SSB or TRS just after the active TCI switching. It looks the Option 2 requires the longest DTX period which requires to receive SSB first, followed by TRS. Considering the SSB periodicity of 20ms and TRS periodicity of 10ms. The different among the options may not be so significant. Since we agreed it is up to UE implementation for time/frequency tracking, RAN4 may choose Option 2 considering the worst case? |
| Intel | Issue 3-2-1We support Option 1. Similar to HST FR1 test cases the scheduling approach should be captured in table with test case parameters.Issue 3-3-1Test setup will determine when each TRS and SSB will be received during the test. In this case we prefer to clearly capture exact interruption time in test description. In order to make correct TCI state switching UE needs both SSB and TRS. SSB will be used for course time/frequency synchronization. Then, TRS is also needed since fine synchronization is required for demodulation of high order modulation. Therefore, we support Option 3 or Option 4. Option 3 looks preferable because there is no need to test engineers to calculate which RS is received first/last.  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2201002(Draft CR on minimum requirements for PDSCH HST-DPS (38.101-4)) | Moderator: Based on guidance of meeting arrangement, the draft CR will be postponed to future RAN4 meeting. |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #4: CR work split for FR2 HST demod

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2200744 | Samsung | CR work split for Rel-17 FR2 HSTProposal 1: Agree the CR work split table above, interest companies are encouraged for joint contribution. |

## Open issues summary

Last RAN4 meeting agreements in the WF R4-2120775

List of open issues

* Sub-topic 4-1: CR work split

### Sub-topic 4-1: CR work split

* Proposals
	+ Option 1: Agree the CR work split table above, interest companies are encouraged for joint contribution.
		- BS demodulation

|  |  |  |
| --- | --- | --- |
| **Section number** | **Section title** | **Responsible company** |
| **TS 38.104** |
|  | *Big CR* | Samsung |
| 11 | Radiated performance requirements |
| 11.2 | Performance requirements for PUSCH |
| 11.2.2 | Requirements for BS type 2-O |
| *11.2.2.x* | *Requirements for PUSCH for high speed train* | *Intel* |
| *11.2.2.y* | *Requirements for UL timing adjustment* | *CATT* |
| 11.4 | Performance requirements for PRACH |
| 11.4.2 | Requirements for BS type 2-O |
| 11.4.2.2 | PRACH detection requirements |
| *11.4.2.2.x* | *Minimum requirements for high speed train* | *Huawei* |
| *Annex A* | *Reference measurement channels* | *Intel* |
| *Annex G.3* | *High speed train condition* | *Nokia* |
| *Annex G.4* | *Moving propagation conditions* | *CATT* |
| **TS 38.141-2** |
|  | *Big CR*  | *Nokia* |
| *4.6* | *Manufacturer's declarations* | *Samsung, Nokia* |
| 8 | Radiated performance requirements |
| 8.1.2 | Applicability rule |
| *8.1.2.4* | *Applicability of PUSCH for high speed train performance requirements* | *Huawei* |
| 8.2 | OTA performance requirements for PUSCH |
| *8.2.4* | *Performance requirements for PUSCH for high speed train* | *Ericsson, Samsung* |
| *8.2.5* | *Performance requirements for UL timing adjustment* | *CATT* |
| 8.4 | OTA performance requirements for PRACH |
| 8.4.1 | PRACH false alarm probability and missed detection |
| *8.4.1.6* | *Test requirement for high speed train* | *Huawei* |
| *Annex A* | *Reference measurement channels* | *Intel* |
| *Annex E* | *OTA measurement system set-up* | *Ericsson* |
| *Annex J.3*  | *High speed train condition* | *Nokia* |
| *Annex J.4* | *Moving propagation conditions* | *CATT* |

* + - UE demodulation

|  |  |  |
| --- | --- | --- |
| **Section number** | **Section title** | **Responsible company** |
| **TS 38.101-4** |
|  | *Big CR* | Samsung |
| 7.11 | *Applicability of requirements* | Intel |
| 7.2.2.2.x | *Minimum requirements for PDSCH HST-DPS* | Huawei |
| A.3.2 | *Reference measurement channels for PDSCH performance requirement*  | Ericsson |
| *B.3* | *High speed Train Scenarios*  | Qualcomm |

* Recommended WF

In the last meeting, the draft CR work split for FR2 HST demod was discussed. Based on current progress for FR2 HST performance part, around 22 CRs work split was expected for both UE and BS side. Based on the guidance about CR handling as

|  |
| --- |
| * + SI/WI RAN4 RF/RRM/demodulation Work Plans, if needed
	+ Rapporteurs are encouraged to provide updated SI/WI RRM work plans to decide on
		- CR/TP work split among contributing companies to avoid duplicate efforts and to encourage sharing the workload and cross-checking CRs
			* CR work split should at least include Big CR split. It is also allowed if companies want to further split the work under each Big CR.
 |

Regarding the CR work split, it is encouraged to companies considering the work load. 2 or 3 CRs per each companies is suggested, if other companies show the same interest with same topic and want to contribute it, joint contribution is appreciated.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

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

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic #1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

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

Notes:

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

## 2nd round

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

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)