**3GPP TSG-RAN WG4 Meeting #94-e R4-20xxxxx**

**Electronic Meeting, Feb.24th - Mar.6th 2020**

**Agenda item:** 8.18

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for RAN4#94e\_#95\_NR\_perf\_enh\_Demod

**Document for:** Information

# Introduction

This email thread discusses the NR Rel-16 UE and BS performance requirements in agenda 8.18.

List of candidate target of email discussion for 1st round and 2nd round:

* 1st round:
	+ Invite UE demodulation experts to review the recommended WF in section 1~5, and provide comments (if any) in section 1.3, 2.3, 3.3, 4.3 and 5.3.
	+ Invite BS demodulation experts to review the recommended WF in section 6~7, and provide comments (if any) in section 6.3 and 7.3.
* 2nd round: TBA

# Topic #1: General issue for UE requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2001445 | Huawei, HiSilicon | Observation 1: Intra-band contiguous CA for FDD, intra-band non-contiguous CA configurations and inter-band CA with maximum 3 and 4 bands introduced from release 16 are not release independent from release 15Observation 2: The following intra-band non-contiguous CA within FR2 are not release independent from release 15* + More than 4 sub-blocks, such as CA\_n261(5O)
	+ 3 sub-blocks with more than 1 CCs within a sub-block, such as CA\_n260(3G)
	+ 4 sub-blocks with more than 1 CC within a sub-block, such as CA\_n260(4G)

Observation 3: Limited inter-band CA configurations between FR1 and FR2, as listed in Table 7.1-1 of TS 38.307, are release independent from release 15Proposal 1: Only the NR UE normal demodulation requirements for those CA configurations that are defined as release independent from release 15 can be release independent from release 15Proposal 2: Discuss the release independence for UE CSI reporting test for NR CA after MarchProposal 3: PMI reporting test for single panel codebook Type I for 16 and 32 Tx ports can be release independent from release 15Proposal 4: Discuss the release independence for PMI reporting test for Rel-15 type II codebook after detailed simulation assumptions finalizedProposal 5: Define demodulation requirements for LTE TDD – NR coexistence to be release independent from release 15 only for Band n90 |

## Open issues summary

### Sub-topic 1-1: Release independent issue

**Issue 1-1: release independent issue**

* *Agreement in RAN4 #93 (R4-1915856, ad-hoc minutes)*
	+ *Release independent aspect*
		- *RAN4 to discuss what NR UE demodulation and CSI reporting requirements are release independent from Release 15 onward.*
			* *UE demodulation and CSI reporting test for NR CA*
			* *PMI reporting test with Tx ports more than 8*
			* *LTE-NR co-existence scenario*
* Proposals
	+ Option 1 (Huawei):
		- Only the NR UE normal demodulation requirements for those CA configurations that are defined as release independent from release 15 can be release independent from release 15
		- Discuss the release independence for UE CSI reporting test for NR CA after March
		- PMI reporting test for single panel codebook Type I for 16 and 32 Tx ports can be release independent from release 15
		- Discuss the release independence for PMI reporting test for Rel-15 type II codebook after detailed simulation assumptions finalized
		- Define demodulation requirements for LTE TDD - NR coexistence to be release independent from release 15 only for Band n90
* Recommended WF
	+ FFS based on the inputs from more companies

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | **Issue 1-1: release independent issue**Normal CA requirements will be defined in generic manner and will be tested only for supported CA configurations. Therefore, based on our understanding, Rel-15 UE will be automatically tested for CA configurations that are defined as release independent from Rel-15.We think that requirements Rel-15 Type II codebook also can be considered as release independent, because this feature is supported from Rel-15 and it is not clear how simulation assumption affects decision on release independency.Other bullets from Option 1 are fine for us |

## 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:* |

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: UE CA PDSCH requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000136 | China Telecom | Rank and MCS for FR2Proposal 1: For FR2, use rank 2 and MCS 10.Tx antenna numberProposal 2: For FR1 and FR2, use 2Tx antennas.TDD-FDD CA and TDD-TDD CA with different SCSsProposal 3: For FDD 15 kHz + TDD 30 kHz CA and TDD 15 kHz + TDD 30 kHz CA, define requirements for 15kHz SCS Pcell and 30kHz SCS Pcell. For FDD 15 kHz + TDD 15 kHz CA, define requirements for FDD 15 kHz Pcell and TDD 15 kHz Pcell.Proposal 4: Summary of proposed HARQ process number for NR FDD 15 kHz + TDD 30 kHz CA, FDD 15 kHz + TDD 15 kHz CA and TDD 15 kHz + TDD 30 kHz CA.Table 3: Summary of proposed HARQ process number for NR CA

|  |  |
| --- | --- |
| NR CA | HARQ process number |
| FDD 15 kHz + TDD 30 kHz CA | FDD PCell | 4 for FDD CC; 8 for TDD CC |
| TDD PCell | 8 for TDD CC; 8 for FDD CC |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell | 4 for FDD CC; 8 for TDD CC |
| TDD PCell | 8 for TDD CC; 8 for FDD CC |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz SCS PCell | 8 for 15 kHz CC; 12 for 30 kHz CC |
| 30kHz SCS PCell | 8 for 30 kHz CC; 8 for 15 kHz CC |

Observation 1: The link-level performance difference at 70% throughput is negligible for round-trip time of 10 slots and 20 slots.Proposal 5: Apply the same single carrier requirement for Pcell and Scell in CA with the same duplex mode and SCS, CA with different duplex modes, CA with the same duplex mode and different SCSs.Test applicabilityProposal 6: If Pcell in both carriers are supported, in the test, configure TDD cell as Pcell in TDD-FDD CA, configure 15 kHz SCS cell as Pcell in TDD 15+30kHz SCS CA.Proposal 7: Reuse the LTE approach for CA capability categorization, i.e., define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.Proposal 8: Test all the supported CA capabilities, including intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.Proposal 9: Selection of CA configuration(s) and CBW combination:For FR1, for each supported CA duplex mode and each supported CA capability,* Step 1: Select the CA configuration(s) satisfying the following conditions:
	+ For each CC, single carrier performance requirement is specified for any one of the supported SCS(s).
	+ For each CC, the supported maximum modulation order is not lower than 16 QAM.
	+ For each CC, the supported maximum number of MIMO layers is not lower than 2.
	+ For each band, the supported max data rate (calculated according to 4.1.2 of TS 38.306) is not lower than the date rate corresponding to using 2-layer and MCS 13 on the largest (aggregated) channel bandwidth on the band.
* Step 2: Select any one of the CA configuration(s) with the largest aggregated CA bandwidth among the selected the CA configuration(s) based on step 1.

For FR2, for each supported CA duplex mode and each supported CA capability, * Step 1: Select the CA configuration(s) satisfying the following conditions:
	+ For each CC, single carrier performance requirement is specified for any one of the supported SCS(s)
	+ For each CC, the supported maximum modulation order is not lower than 16 QAM
	+ For each CC, the supported maximum number of MIMO layers is not lower than 2
	+ For each band, the supported max data rate (calculated according to 4.1.2 of TS 38.306) is not lower than the date rate corresponding to using 2-layer and MCS 10 on the largest (aggregated) channel bandwidth on the band.
* Step 2: Calculate the largest aggregated CA bandwidth for the selected the CA configuration(s) based on step 1, denoted as CBWlargest.
* Step 3: Calculate the maximum aggregated channel bandwidth that can be testable in the test system, denoted as CBWtestable.
* Step 4:
	+ If CBWlargest <= CBWtestable, select any one of the CA configuration(s) with the largest aggregated CA bandwidth among the selected the CA configuration(s) based on step 1.
	+ If CBWlargest > CBWtestable, select any one of the CA configuration(s) with the aggregated channel bandwidth no smaller than CBWtestable among the selected the CA configuration(s) based on step 1.

Spec structureProposal 10: In the demod spec, not list all the possible CA bandwidth combinations, but just give the procedure to select the CA configuration for testing. |
| R4-2000137 | China Telecom | Initial simulation results for FR1 FDD Normal CA scenarios |
| R4-2000359 | Intel Corporation | Proposal 1: Use Rank 1 MCS13 for FR2 NR Normal CA requirements.Proposal 2: Consider the following HARQ process configuration for TDD-FDD CA and TDD-TDD CA with different SCSs:* PCell FDD 15kHz + SCell TDD 15kHz: PCell – 4, SCell – 4
* PCell TDD 15kHz + SCell FDD 15kHz: PCell – 8, SCell – 8
* PCell FDD 15kHz + SCell TDD 30kHz: PCell – 4, SCell – 8
* PCell TDD 30kHz + SCell FDD 15kHz: PCell – 8, SCell – 8
* PCell TDD 15kHz + SCell TDD 30kHz: PCell – 8, SCell – 16
* PCell TDD 30kHz + SCell TDD 15kHz: PCell – 8, SCell – 8

Proposal 3: Reuse single carrier FDD and TDD requirements for FDD-TDD CA and TDD CA with different SCSs and define requirements for the following scenarios: PCell FDD 15kHz + SCell TDD 15kHz, PCell FDD 15kHz + SCell TDD 30kHz and PCell TDD 30kHz + SCell TDD 15kHz.Proposal 4: Align categorizing of CA capabilities for NR Normal CA requirements with RF specifications. Use references to sections with CA configurations descriptions in RF specifications (for example, 5.2A and 5.5A) for definition of CA capabilities to avoid regular maintenance of TS 38.101-4.Proposal 5: Consider the following CA capabilities for NR Normal CA testing: Intra-band contiguous CA, Intra-band non-contiguous CA and Inter-band CA with the largest number of bandsProposal 6: Use the following approach for selection of CA configuration for NR FR1 Normal CA testing:* Step 1: Select CA configurations with maximum number of CCs, on which UE capability field supportedSubCarrierSpacingDL is equal to SCSreq, among all supported CA configurations
* Step 2: Select CA configurations with maximum number of CCs, on which UE capability field maxNumberMIMO-LayersPDSCH is higher or equal to νLayersreq, among all the selected CA configurations from Step 1
* Step 3: Select any one of CA configurations, which contain CBW combination with the largest data rate not exceeding DataRatereq, among all the selected CA configurations from Step 2.

Proposal 7: Use the following approach for selection of CA configuration for NR FR2 Normal CA testing:* Step 1: Select CA configurations, which contain CBW combinations with SNRTEmax higher or equal to SNRreq, among all supported CA configurations
* Step 2: Select CA configurations with maximum number of CCs, on which UE capability field supportedSubCarrierSpacingDL is equal to SCSreq, among all the selected CA configurations from Step 1
* Step 3: Select CA configurations with maximum number of CCs, on which UE capability field maxNumberMIMO-LayersPDSCH is higher or equal to νLayersreq, among all the selected CA configurations from Step 2
* Step 4: Select any one of CA configurations, which contain CBW combination with the largest data rate not exceeding DataRatereq and aggregated bandwidth with SNRTEmax higher or equal to SNRreq, among all the selected CA configurations from Step 3.
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| R4-2000360 | Intel Corporation | Alignment and impairment simulation results for FR1 Normal CA scenarios and alignment simulation results for FR2 Normal CA scenarios. |
| R4-2000361 | Intel Corporation | Summary of Normal CA simulation results (FR1 15 kHz FDD and TDD) |
| R4-2000362 | Intel Corporation | Summary of Normal CA simulation results (FR1 30 kHz TDD) |
| R4-2000363 | Intel Corporation | Summary of Normal CA simulation results (FR2) |
| R4-2000647 | CMCC | Proposal 1: It is proposed to define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.Proposal 2: Test all the supported CA capabilities, including intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bandsProposal 3: Test the largest aggregated CA bandwidth combination for the following cases:* FDD 15KHz+TDD 15KHz (only in case UE does not support FDD 15KHz+TDD 15KHz)
* FDD 15KHz+FDD 15KHz
* TDD 30KHz+TDD 30KHz
* FDD 15KHz+TDD 30KHz
* TDD 15KHz+TDD 30KHz
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| R4-2000952 | NTT DOCOMO, INC. | Proposal 1: Introduce mechanism to diverge CA tests to FR1 and FR2. For instance, CA tests are performed for all of FR1 CA, FR2 CA and FR1&FR2 CA. Proposal 2: For categorizing of CA categories, we prefer following options.* Option 1: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.
* Option 3: Test all the supported CA capabilities, including intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands

Proposal 3: Applicability of the CA test is designed using following alternatives.* Alt. 1: Maximum number of CCs
* Alt. 2: Maximum number of bands
* Alt. 3: Maximum aggregated channel bandwidth
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| R4-2001354 | Ericsson | Proposal 1: MCS10 with rank 2 for the PDSCH demodulation requirements with CA in FR2. |
| R4-2001419 | Qualcomm Incorporated | Proposal 1: For TDD 30kHz + FDD 15kHz CA, follow the HARQ timelines as in Figure 2-1 with number of HARQ processes as 8 for both carriers when TDD carrier is PCC, and 4 for FDD, 8 for TDD when FDD carrier is PCC.Proposal 2: For TDD 30kHz + TDD 15kHz CA, follow the HARQ timelines as in Figure 2-2 with number of HARQ processes as 6 for TDD 15kHz, 8 for TDD 30kHz when TDD 30kHz carrier is PCC, and 6 for TDD 15kHz, 10 for TDD 30kHz when TDD 15kHz carrier is PCC.Proposal 3: For TDD 15kHz + FDD 15kHz CA, follow the HARQ timelines as in Figure 2-3 with number of HARQ processes as 6 for TDD 15kHz, 8 for FDD 15kHz when TDD 15kHz carrier is PCC, and 4 for both carriers when FDD 15kHz carrier is PCC.Proposal 4: Use 6 HARQ processes for defining TDD 15kHz requirements.Proposal 5: Evaluate the single carrier performance for following cases to decide whether the same single carrier requirements can be reused regardless of which CC is PCC or SCC:* FDD 15kHz with 4 and 8 HARQ processes
* TDD 15kHz with 4 and 6 HARQ processes
* TDD 30kHz with 8 and 10 HARQ processes

Observation 1: Based on preliminary results, number of HARQ processes does not change the performance significantly.Proposal 6: Use MCS 10, Rank 2 for defining FR2 CA normal demodulation requirements.Proposal 7: If testable SNR is lower than the requirement SNR for FR2 CA, that test case will be skipped. |
| R4-2001444 | Qualcomm Incorporated | Simulation results for NR CA |
| R4-2001446 | Huawei, HiSilicon | Observation 1: For FR2 TDD 120 kHz, the performance of rank 1 with MCS 13 is better than that of rank 2 with MCS 10.Proposal 1: Choose Rank 1 MCS13 for FR2 NR CA normal performance requirements. |
| R4-2001447 | Huawei, HiSilicon | Observation 1: There is up to 0.69dB difference for FDD 15 kHz SCS PCell with 4 HARQ process and SCell with 8 HARQ process for 2Rx for FDD 15 kHz + TDD 30 kHz CA.Observation 2: Same performance requirements can be defined for TDD 30 kHz PCell and SCell for FDD 15 kHz + TDD 30 kHz CA scenario.Observation 3: Very minor difference between FR1 TDD 15 kHz PCell with 8 HARQ processes and SCell with 12 HARQ processes for both 2Rx and 4Rx for TDD 15 kHz + TDD 30 kHz CA.Observation 4: Very minor difference between FR1 TDD 30 kHz PCell with 8 HARQ processes and SCell with 6 HARQ processes for both 2Rx and 4Rx for TDD 15 kHz + TDD 30 kHz CA.Observation 5: Same performance requirements can be foreseen for FDD 15kHz PCell and SCell, TDD 15kHz SCS PCell and SCell for FDD 15 kHz + TDD 15 kHz CA scenario.Proposal 1: Define same performance requirements for TDD 30 kHz PCell&SCell as corresponding single carrier requirements for FDD 15 kHz + TDD 30 kHz CA.Proposal 2: Define same performance requirements for TDD 15 kHz PCell&SCell and TDD 30 kHz PCell&SCell as corresponding single carrier requirements for TDD 15 kHz + TDD 30 kHz CA.Proposal 3: Define same performance requirements for FDD 15 kHz PCell&SCell and TDD 15 kHz PCell&SCell as corresponding single carrier requirements for FDD 15 kHz + TDD 15 kHz CA.Proposal 4: * + Define the same performance requirements as single CC for CA as per CC
	+ Specify the test applicability that
		- The performance requirements are applicable for CC that acted as PCell or SCell
		- The test coverage can be considered fulfilled if UE passes one of scenario with one of the CC as PCell as per the real testing request

Proposal 5:* Categorizing of CA capabilities: option 2, i.e. define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA as per the different frequency range FR1, FR2 and FR1+FR2 for supported CA duplex mode
* Testing of different CA capabilities, CA configurations and CBW combinations:
	+ For each duplex mode and different CA capabilities of intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA
		- Select the supported largest SCS if the performance requirements defined for one CA capability with more than one SCS
		- Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination
		- If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs
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| R4-2001448 | Huawei, HiSilicon | Proposal 1: Number of HARQ process and K1 for FDD 15kHz PCell + TDD 30kHz SCell: * FDD 15kHz PCell: same as single carrier case, i.e. 4 HARQ processes with K1 ={2}
* TDD 30kHz SCell: 8 HARQ processes with K1={2}

Proposal 2: Number of HARQ process and K1 for TDD 30kHz PCell + FDD 15kHz SCell: * TDD 30kHz PCell: same as single carrier case, i.e. 8 HARQ processes with K1={8,7,6,5,5,4,3,2}
* FDD 15kHz SCell: 8 HARQ processes with K1 ={7,6,4,11,9,7,6,4}

Proposal 3: Number of HARQ process and K1 for TDD 15kHz PCell + TDD 30kHz SCell: * TDD 15kHz PCell: same as single carrier case, i.e. 8 HARQ processes with K1 ={4,3,2,6}
* TDD 30kHz SCell: 12 HARQ processes with K1={4,4,3,3,2,2,6,6}

Proposal 4: Number of HARQ process and K1 for TDD 30kHz PCell + TDD 15kHz SCell: * TDD 30kHz PCell: same as single carrier case, i.e. 8 HARQ processes with K1 ={8,7,6,5,5,4,3,2}
* TDD 15kHz SCell: 6 HARQ processes with K1={7,5,4,11}

Proposal 5: Number of HARQ process and K1 for FDD 15kHz PCell + TDD 15kHz SCell: * FDD 15kHz PCell: same as single carrier case, i.e. 4 HARQ processes with K1=2
* TDD 15kHz SCell: 4 HARQ processes with K1=2

Proposal 6: Number of HARQ process and K1 for TDD 15kHz PCell +FDD 15kHz SCell: * TDD 15kHz PCell: same as single carrier case, i.e. 8 HARQ processes with K1={4,3,2,6}
* FDD 15kHz SCell: 8 HARQ processes with K1={4,3,2,6,5}
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## Open issues summary

### Sub-topic 2-1: Rank and MCS

**Issue 2-1: Rank and MCS for FR2**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Option 1: rank 2 and MCS 10*
	+ *Option 2: rank 1 and MCS 13*
	+ *Down-select to one option*
* Proposals
	+ Option 1: rank 2 and MCS 10 (China Telecom, Ericsson, Qualcomm)
		- Qualcomm: If testable SNR is lower than the requirement SNR for FR2 CA, that test case will be skipped.
	+ Option 2: rank 1 and MCS 13 (Intel, Huawei)
* Recommended WF
	+ Define requirements for both options, and conduct test for one of the two options with the following rule:
		- If the testable SNR is not lower than the required SNR for rank 2 and MCS 10, rank 2 and MCS 10 will be used.
		- If the testable SNR is lower than the required SNR for rank 2 and MCS 10, rank 1 and MCS 13 will be used.
		- In the test, all the CCs will be configured the same rank and MCS.

### Sub-topic 2-2: Tx antenna number

**Issue 2-2: Tx antenna number**

* Proposals
	+ Option 1: For FR1 and FR2, use 2Tx antennas (China Telecom)
		- *Note:* The number of Tx antennas has not been mentioned in the previous WFs.
* Recommended WF
	+ Option 1

### Sub-topic 2-3: Pcell configuration

**Issue 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *FDD 15 kHz + TDD 30 kHz CA and FDD 15 kHz + TDD 15 kHz CA*
		- *FFS whether requirements will be defined for FDD PCell and TDD Pcell*
			* *If Pcell in both carriers are supported, the performance for FDD Pcell and FDD Scell is similar and the performance for TDD Pcell and TDD Scell is similar, FFS which one is used for the tests.*
	+ *TDD 15 kHz + TDD 30 kHz CA*
		- *FFS whether requirements will be defined for 15 kHz PCell and 30 kHz Pcell*
			* *If Pcell in both carriers are supported, the performance for 15kHz Pcell and 15 kHz Scell is similar and the performance for 30 kHz Pcell and 30 kHz Scell is similar, FFS which one is used for the tests.*
* Proposals
	+ For performance requirements
		- Option 1 (China Telecom, Huawei):
			* For CA with different SCSs, define requirements for both 15kHz Pcell and 30kHz Pcell.
			* For FDD + TDD CA with 15 kHz SCS, define requirements for both FDD 15 kHz Pcell and TDD 15 kHz Pcell.
				+ *Note (China Telecom):* In TS 38.306, different capabilities are defined for Pcell on larger SCS (i.e., *diffNumerologyWithinPUCCH- GroupLargerSCS*) and Pcell on smaller SCS (i.e., *diffNumerologyWithinPUCCH-GroupSmallerSCS*), where Pcell is the cell carrying PUCCH; and there is no capability defined for NR TDD Pcell and FDD Pcell.
		- Option 2 (Intel):
			* Define requirements for the following scenarios: PCell FDD 15kHz + SCell TDD 15kHz, PCell FDD 15kHz + SCell TDD 30kHz and PCell TDD 30kHz + SCell TDD 15kHz.
	+ For test applicability
		- Option 1: The test coverage can be considered fulfilled if UE passes one of scenario with one of the CC as PCell as per the real testing request (Huawei)
		- Option 2: If Pcell in both carriers are supported, in the test, configure TDD cell as Pcell in TDD-FDD CA, configure 15 kHz SCS cell as Pcell in TDD 15+30kHz SCS CA. (China Telecom)
* Recommended WF
	+ For performance requirements, select option 1:
		- For CA with different SCSs, define requirements for both 15kHz Pcell and 30kHz Pcell.
		- For FDD + TDD CA with 15 kHz SCS, define requirements for both FDD 15 kHz Pcell and TDD 15 kHz Pcell.
	+ For test applicability, further discuss the following options:
		- Option 1: The test coverage can be considered fulfilled if UE passes one of scenario with *one of the CC as PCell* as per the real testing request
		- Option 2: If Pcell in both carriers are supported, configure *TDD cell as Pcell* in TDD-FDD CA, configure *15 kHz SCS cell as Pcell* in TDD 15+30kHz SCS CA.
		- Option 3: If Pcell in both carriers are supported, configure *FDD cell as Pcell* in TDD-FDD CA, configure *30 kHz SCS cell as Pcell* in TDD 15+30kHz SCS CA.

### Sub-topic 2-4: HARQ process number

**Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *FDD 15 kHz + TDD 30 kHz CA and FDD 15 kHz + TDD 15 kHz CA*
		- *HARQ process number for FDD 15 kHz + TDD 30 kHz CA*
			* *Pcell: 4 for FDD and [8 or 10] for TDD*
			* *Scell: FFS*
	+ *TDD 15 kHz + TDD 30 kHz CA*
		- *HARQ process number: FFS*
* Proposals
	+ Summary of proposals on HARQ process number

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| HARQ process number | CCs with the *same* duplex mode & SCS with Pcell | CCs with *different* duplex mode / SCS with Pcell |
| CTC | Intel | QC2 | HW | CTC | Intel1 | QC2 | HW |
| FDD 15 kHz + TDD 30 kHz CA | FDD PCell | 4 | 4 | 4 | 4 | 8 | 8 | 8 | 8 |
| TDD PCell | 8 | 8 | 8 | 8 | 8 | 8 | 8 | 8 |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell | 4 | 4 | 4 | 4 | 8 | 4 | 4 | 4 |
| TDD PCell | 8 | 8 | 6 | 8 | 8 | 8 | 8 | 8 |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell | 8 | 8 | 6 | 8 | 12 | 16 | 10 | 12 |
| 30kHz PCell | 8 | 8 | 8 | 8 | 8 | 8 | 6 | 6 |
| *Note 1:* Intel proposes to schedule the initial transmission and retransmission on the same type of TDD slots.*Note 2*: Qualcomm proposes to use 6 HARQ processes for defining TDD 15kHz requirements. |

* + Proposals on K1 (Huawei)

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| --- | --- | --- |
| K1 | CCs with the *same* duplex mode & SCS with Pcell | CCs with *different* duplex mode / SCS with Pcell |
| FDD 15 kHz + TDD 30 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {8,7,6,5,5,4,3,2} | {7,6,4,11,9,7,6,4} |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | {4,3,2,6} | {4,3,2,6,5} |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell | {4,3,2,6} | {4,4,3,3,2,2,6,6} |
| 30kHz PCell | {8,7,6,5,5,4,3,2} | {7,5,4,11} |

* Recommended WF
	+ The HARQ process number for Pcell is same with that for single carrier test.
	+ Initial transmission and retransmission are scheduled on the same type of TDD slot, i.e., DL slot or special slot.
	+ Companies to check if the following HARQ process numbers are feasible:
		- For TDD 15 kHz + TDD 30 kHz CA with 15 kHz Pcell, companies to provide preference on whether to use 12 or 16 processes

|  |  |  |
| --- | --- | --- |
| HARQ process number | CCs with the *same* duplex mode & SCS with Pcell | CCs with *different* duplex mode / SCS with Pcell |
| FDD 15 kHz + TDD 30 kHz CA | FDD PCell | 4 | 8 |
| TDD PCell | 8 | 8 |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell | 4 | 4 |
| TDD PCell | 8 | 8 |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell | 8 | 12 or 161 |
| 30kHz PCell | 8 | 8 |
| Note 1: * If different RTTs (10 or 20 slots) are allowed for different HARQ processes, 12 HARQ processes will be used, as seen in Figure 4 of China Telecom’s paper in R4-2000136.
* If the same RTT (20 slots) is used for all the HARQ processes, 16 HARQ processes will be used.
 |

* + Decide on K1 values after the HARQ process numbers are agreed.

### Sub-topic 2-5: Single carrier performance

**Issue 2-5: Single carrier performance for TDD-FDD CA and TDD-TDD CA with different SCSs**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Performance requirements:*
		- *Further discuss whether single carrier requirements from FDD and TDD CA with the same SCS can be reused.*
		- *Companies are encouraged to bring performance analysis in the next meeting*
* Summary of simulation observations

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Intel | CTC | QC | HW |
| FDD 15 kHz | Similar for {4, 8} processes |  | Similar for {4, 8} processes | up to 0.69dB difference |
| TDD 15 kHz | Similar for {4, 8} processes |  |  | Similar for {8,12} processes |
| TDD 30 kHz | Similar for {8,16} processes | Similar for {8,16} processes |  | Similar for {8,6} processes |

* Proposals
	+ Option 1: Reuse single carrier FDD and TDD requirements for FDD-TDD CA and TDD CA with different SCSs (Intel, China Telecom)
	+ Option 2: Evaluate the single carrier performance for following cases to decide whether the same single carrier requirements can be reused regardless of which CC is PCC or SCC (Qualcomm)
		- FDD 15kHz with 4 and 8 HARQ processes
		- TDD 15kHz with 4 and 6 HARQ processes
		- TDD 30kHz with 8 and 10 HARQ processes
	+ Option 3 (Huawei):
		- Define same performance requirements for TDD 30 kHz PCell&SCell as corresponding single carrier requirements for FDD 15 kHz + TDD 30 kHz CA.
		- Define same performance requirements for TDD 15 kHz PCell&SCell and TDD 30 kHz PCell&SCell as corresponding single carrier requirements for TDD 15 kHz + TDD 30 kHz CA.
		- Define same performance requirements for FDD 15 kHz PCell&SCell and TDD 15 kHz PCell&SCell as corresponding single carrier requirements for FDD 15 kHz + TDD 15 kHz CA.
* Recommended WF
	+ Further evaluate the single carrier performance with different numbers of HARQ processes
		- To align the simulation setup, use the HARQ process numbers and K1 values agreed in sub-topic 2-4.

### Sub-topic 2-6: FR and numerology in each CA duplex mode

**Issue 2-6-1: FR1 and FR2 CA**

* Proposals
	+ Option 1: Introduce mechanism to diverge CA tests to FR1 and FR2. For instance, CA tests are performed for all of FR1 CA, FR2 CA and FR1&FR2 CA. (DCM)
		- DCM: If we simply choose the tested band combinations with based on the largest aggregated channel bandwidth (or number of CCs), UE tends to perform CA tests using FR2 bands.
* Recommended WF
	+ Encourage feedback on the above proposal
	+ Provide recommended WF later based on the feedback

**Issue 2-6-2: Numerology in each CA duplex mode**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Test applicability for different CA duplex mode*
		- *Test all the supported CA duplex mode*
* Proposals
	+ Option 1: For each duplex mode, the same numerology and different numerologies in different CCs should be tested (CMCC)
		- Same numerology for each duplex mode combination
			* FDD 15KHz+TDD 15KHz (only in case UE does not support FDD 15KHz+TDD 15KHz)
			* FDD 15KHz+FDD 15KHz
			* TDD 30KHz+TDD 30KHz
		- Different numerologies for each duplex mode combination
			* FDD 15KHz+TDD 30KHz
			* TDD 15KHz+TDD 30KHz
* Recommended WF
	+ Encourage feedback on the above proposal
	+ Provide recommended WF later based on the feedback

### Sub-topic 2-7: Categorizing of CA capabilities

**Issue 2-7: Categorizing of CA capabilities**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Option 1: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.*
	+ *Option 2: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA*
	+ *Other options are not precluded.*
	+ *Companies to bring proposals on the demod spec structure for CA, with the motivation to minimize future maintenance.*
* Proposals
	+ Option 1: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands. (China Telecom, Intel, CMCC, DCM)
		- Intel: Align categorizing of CA capabilities for NR Normal CA requirements with RF specifications. Use references to sections with CA configurations descriptions in RF specifications (for example, 5.2A and 5.5A) for definition of CA capabilities to avoid regular maintenance of TS 38.101-4.
		- China Telecom: in the demod spec, not list all the possible CA bandwidth combinations, but just give the procedure to select the CA configuration for testing.
	+ Option 2: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA (Huawei)
* Recommended WF
	+ Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands.
		- Whether to test each of the supported capabilities will be discussed separately.
	+ Use references to sections in RF specifications for definition of CA capabilities and configurations to avoid regular maintenance of TS 38.101-4.

### Sub-topic 2-8: Test of different CA capabilities

**Issue 2-8: Test of different CA capabilities**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Option 1: Test intra-band contiguous CA, Intra-band non-contiguous CA and Inter-band CA with the largest number of bands*
	+ *Option 2: Test intra-band contiguous CA, Intra-band non-contiguous CA and Inter-band CA with the largest aggregated CBW*
	+ *Option 3: Test all the supported CA capabilities, including intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands*
	+ *Option 4: Any one of the supported CA capabilities*
	+ *Other options are not precluded.*
* Proposals
	+ Option 1: Test intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with the largest number of bands (Intel)
	+ Option 2: Test intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA (Huawei)
	+ Option 3: Test all the supported CA capabilities, including intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands (China Telecom, CMCC, DCM)
* Recommended WF
	+ FFS based on the 1st round email discussion.

### Sub-topic 2-9: Selection of CA configuration(s) and CBW combination

**Issue 2-9: Selection of CA configuration(s) and CBW combination**

* *Agreement in RAN4 #93 (R4-1915861, WF)*
	+ *Further discuss by taking into account:*
		- *The supportedSubCarrierSpacingDL, maxNumberMIMO-LayersPDSCH and supportedModulationOrderDL are reported for each CC and scalingFactor are reported per band for FR1 and FR2.*
		- *The testable SNR for FR2.*
* Proposals
	+ Option 1: Test the largest aggregated CA bandwidth combination (CMCC, DCM)
	+ Option 2: Maximum number of CCs (DCM)
	+ Option 3: Maximum number of bands (DCM)
	+ Option 4 (China Telecom):

For FR1, for each supported CA duplex mode and each supported CA capability,

* Step 1: Select the CA configuration(s) satisfying the following conditions:
	+ For each CC, single carrier performance requirement is specified for any one of the supported SCS(s).
	+ For each CC, the supported maximum modulation order is not lower than 16 QAM.
	+ For each CC, the supported maximum number of MIMO layers is not lower than 2.
	+ For each band, the supported max data rate (calculated according to 4.1.2 of TS 38.306) is not lower than the date rate corresponding to using 2-layer and MCS 13 on the largest (aggregated) channel bandwidth on the band.
* Step 2: Select any one of the CA configuration(s) with the largest aggregated CA bandwidth among the selected the CA configuration(s) based on step 1.

For FR2, for each supported CA duplex mode and each supported CA capability,

* Step 1: Select the CA configuration(s) satisfying the following conditions:
	+ For each CC, single carrier performance requirement is specified for any one of the supported SCS(s)
	+ For each CC, the supported maximum modulation order is not lower than 16 QAM
	+ For each CC, the supported maximum number of MIMO layers is not lower than 2
	+ For each band, the supported max data rate (calculated according to 4.1.2 of TS 38.306) is not lower than the date rate corresponding to using 2-layer and MCS 10 on the largest (aggregated) channel bandwidth on the band.
* Step 2: Calculate the largest aggregated CA bandwidth for the selected the CA configuration(s) based on step 1, denoted as CBWlargest.
* Step 3: Calculate the maximum aggregated channel bandwidth that can be testable in the test system, denoted as CBWtestable.
* Step 4:
	+ If CBWlargest <= CBWtestable, select any one of the CA configuration(s) with the largest aggregated CA bandwidth among the selected the CA configuration(s) based on step 1.
	+ If CBWlargest > CBWtestable, select any one of the CA configuration(s) with the aggregated channel bandwidth no smaller than CBWtestable among the selected the CA configuration(s) based on step 1.
	+ Option 5 (Intel)

Use the following approach for selection of CA configuration for NR FR1 Normal CA testing:

* Step 1: Select CA configurations with maximum number of CCs, on which UE capability field supportedSubCarrierSpacingDL is equal to SCSreq, among all supported CA configurations
* Step 2: Select CA configurations with maximum number of CCs, on which UE capability field maxNumberMIMO-LayersPDSCH is higher or equal to νLayersreq, among all the selected CA configurations from Step 1
* Step 3: Select any one of CA configurations, which contain CBW combination with the largest data rate not exceeding DataRatereq, among all the selected CA configurations from Step 2.

Use the following approach for selection of CA configuration for NR FR2 Normal CA testing:

* Step 1: Select CA configurations, which contain CBW combinations with SNRTEmax higher or equal to SNRreq, among all supported CA configurations
* Step 2: Select CA configurations with maximum number of CCs, on which UE capability field supportedSubCarrierSpacingDL is equal to SCSreq, among all the selected CA configurations from Step 1
* Step 3: Select CA configurations with maximum number of CCs, on which UE capability field maxNumberMIMO-LayersPDSCH is higher or equal to νLayersreq, among all the selected CA configurations from Step 2
* Step 4: Select any one of CA configurations, which contain CBW combination with the largest data rate not exceeding DataRatereq and aggregated bandwidth with SNRTEmax higher or equal to SNRreq, among all the selected CA configurations from Step 3.
	+ Option 6 (HW):
* For each duplex mode and different CA capabilities of intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA
	+ Select the supported largest SCS if the performance requirements defined for one CA capability with more than one SCS
	+ Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination
	+ If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs
* Recommended WF
	+ Further discuss in RAN4 #94bis f2f meeting.

### Sub-topic 2-10: Simulation result summary

**Issue 2-10: Summary and calibration of simulation results**

* Summary
	+ R4-2000361 Summary of Normal CA simulation results (FR1 15 kHz FDD and TDD)
	+ R4-2000362 Summary of Normal CA simulation results (FR1 30 kHz TDD)
	+ R4-2000363 Summary of Normal CA simulation results (FR2)
* Recommended WF
	+ Companies to add their results in the summary
	+ Calibrate the results from different companies

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | **Issue 2-1: Rank and MCS for FR2**We are fine to define requirements for both options. However, from selection point of view we suggest to take FRC which results in the highest testable Data Rate:* Step 1: Select CA configurations and CBW for testing of Rank 1 MCS 13
* Step 2: Select CA configurations and CBW for testing of Rank 2 MCS 10
* Step 3: Calculate Data Rate for selected configuration for both FRC
* Step 4: Select FRC which leads to the highest Data Rate

**Issue 2-2: Tx antenna number**Agree with Option 1.**Issue 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs**Agree with the recommended WF for requirements definition. As for test applicability, if UE supports any PCell configuration then we suggest to consider scenarios with less number of HARQ processes. Therefore, our preference is Option 3.**Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs**Agree with the recommended WF. As for number of HARQ processes for TDD 15 kHz + TDD 30 kHz CA (12 or 16), we need more time to check and suggest to discuss this in the 2nd round**Issue 2-5: Single carrier performance for TDD-FDD CA and TDD-TDD CA with different SCSs**Agree with the recommended WF.**Issue 2-6-1: FR1 and FR2 CA**Based on our understanding, taking into account that we discuss simulation assumptions for FR1 and FR2 separately, we are going to define separate requirements for FR1 and FR2. UE should pass both type of CA requirements (i.e. FR1 and FR2) in case UE supports them.**Issue 2-6-2: Numerology in each CA duplex mode**We suggest the following set of scenarios to reduce the number of tests and have sufficient coverage* Test #1: FDD 15 kHz + FDD 15 kHz
* Test #2: TDD 15 kHz + TDD 30 kHz, in case UE supports different SCS on different carriers for TDD-TDD CA, otherwise TDD 30 kHz + TDD 30 kHz
* Test #3: FDD 15 kHz + TDD 30 kHz, in case UE supports different SCS on different carriers for FDD-TDD CA, otherwise FDD 15 kHz + TDD 15 kHz

**Issue 2-7: Categorizing of CA capabilities**Agree with recommended WF.**Issue 2-8: Test of different CA capabilities**We suggest not to test inter-band CA with different number of bands, because testing of UE with support N CCs for inter-band CA with number of band M < N leads to testing of mixed CA scenarios (i.e. intra-band + inter-band). Same time, we are going to have dedicated test for intra-band scenario and testing of mixed CA scenarios looks redundant.**Issue 2-9: Selection of CA configuration(s) and CBW combination**Agree with recommended WF |

## 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: UE PMI reporting requirements with larger number of Tx ports

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000138 | China Telecom | Proposal 1: Introduce subband PMI test requirements for 16 Tx ports.Observation 1: Based on the current simulation assumptions, the performance difference between subband PMI and wideband PMI reporting is marginal in both codebook mode 1 and mode 2. Proposal 2: Further investigate the simulation assumptions such as beam steering model, channel model and subband size, so as to find appropriate test parameters for subband PMI reporting.Proposal 3: For the location of NZP CSI-RS, select either option 1 or option 2.Proposal 4: For type II codebook, use (N1, N2) = (4, 2) for 16 Tx ports, and (N1, N2) = (4, 4) for 32 Tx ports.Proposal 5: For type II codebook, use MCS 20 and rank 2.Proposal 6: For type II codebook, use XP High for MIMO correlation. |
| R4-2000139 | China Telecom | Initial simulation results for 32 Tx ports FDD wideband test. |
| R4-2000300 | Samsung | Observation 1: The gain of subband compared with wideband for SNR point at 90% is not significant for both 16 Tx and 32 Tx port with follow PMI. |
| R4-2000301 | Samsung | Observation1: As for Type II, it achieves significant gain compared to Type I codebook, the gain is about 9dB and 6.6dB for rank1 and rank 2 at SNR point at 90% of peak throughput, respectively. Observation2: The gap of Type II between following PMI and random PMI is extremely high than Type I codebook caseObservation3: SNR point at 90% of peak throughput is lower than before due to the more accurate channel compression for Type II.Observation4: The TDL-A channel model has small delay spread which lacks of channel selectivity in frequency domain, there is no obvious performance difference between ‘SubbandAmplitude=OFF’ and ‘SubbandSmplitude=ON’ in the current cases, consequently, other channel model with high delay spread can be considered if RAN4 agreed to configure ‘SubbandSmplitude=ON’. Proposal1: Under beam steering model with dual-cluster beams, there is larger performance gap between Type II codebook and Type I –single Panel codebook, RAN4 should define new test cases for Type II codebook.Proposal 2: Regarding test metric, relative throughput ratio between following PMI with Type II codebook and following PMI with Type I codebook can considered as a candidate option. |
| R4-2000302 | Samsung | Proposal 1: For NR Type II codebook construction, using below configurations* Number of ports: 16 Tx ports with (N1, N2) = (4,2) and (O1, O2) = (4,4)
* L (numberOfBeams): 2
* Npsk (phaseAlphabetSize) : FFS for beam combining coefficient (phase) set size, Npsk =4 can be taken for initial simulation purpose
* subbandAmplitude: FFS for 'true' or 'false'

Proposal 2: Reusing beam steering approach with dual-cluster beams as as specified in B.2.3B.4A of TS 36.101* Relative power ratio among two beams can be fixed as 1 (p =1)

Proposal 3: For test metric, several approaches can be further considered: * Alt1 : TP ratio between following PMI under Type II codebook and following PMI under Type-I single panel codebook
* Alt2: TP ratio between following PMI and rand PMI

Proposal 4: below parameters can be used as starting point for initial summation purpose:* MCS and rank: 16QAM ½, rank2
* MIMO correlation: XP High
* Channel model: TDLA30-5
 |
| R4-2000374 | Intel Corporation | Observation #1: Subband PMI test cases weren’t introduced in Rel-15Proposal #1: Introduce test cases for subband PMI with 16TX ports |
| R4-2001476 | Huawei, HiSilicon | In this contribution, we provide our simulation results for particular subband PMI test cases for comparison and then we also give our ideal and impairment simulation results for 16Tx and 32Tx wideband PMI tests for alignment.  |
| R4-2001477 | Huawei, HiSilicon | Observation 1: The performance of Subband PMI has tiny gain compared to Wideband PMIProposal 1: Not to define Subband performance requirement for PMI testProposal 2: For NZP CSI-RS in Type I codebook requirements, consider (l0, l1) = (5,7) for 32 Tx ports |
| R4-2001478 | Huawei, HiSilicon | Proposal 1: (N1, N2) = (4, 2) and (O1, O2) = (4, 4) for 16 Tx portsProposal 2: (N1, N2) = (4, 4) and (O1, O2) = (4, 4) for 32 Tx portsProposal 3: Use MCS 20 and Rank = 2Proposal 4: Use Relative throughput ratio between following PMI with Type II codebook and following PMI with Type I codebook as Test metricProposal 5: MIMO correlation: XP HighProposal 6: Channel model: TDLA30-5 |
| R4-2001733 | Ericsson | Observation 1: PMI reporting throughput curves do not differ between wideband and Subband PMI reporting. |
| R4-2001734 | Ericsson | Summary of simulation results of NR UE CSI with 16, and 32Tx antennas |
| R4-2002041 | Qualcomm Incorporated | Proposal 1: Define subband Type -I PMI reporting requirements for 16 Tx ports.Proposal 2: Use option 2 for NZP CSI-RS location. |

## Open issues summary

### Sub-topic 3-1: NZP CSI-RS for type I

**Issue 3-1: location of NZP CSI-RS for type I single-panel codebook**

* *Agreement in RAN4 #93 (R4-1915858, WF)*
	+ *First subcarrier index and first symbol location for NZP CSI-RS*
		- *Option 1*
			* *(k0, k1, k2, k3) = (2, 4, 6, 8), l0 = 5 for 16 Tx ports, and (k0, k1, k2, k3) = (2, 4, 6, 8), (l0, l1) = (5, 7) for 32 Tx ports.*
		- *Option 2*
			* *(k0, k1, k2, k3) = (2, 4, 6, 8), l0 = 5 for 16 Tx ports, and (k0, k1, k2, k3) = (2, 4, 6, 8), (l0, l1) = (5, 12) for 32 Tx ports.*
		- *Down-select to one option in the next meeting.*
* Proposals
	+ Option 1: (k0, k1, k2, k3) = (2, 4, 6, 8), l0 = 5 for 16 Tx ports, and (k0, k1, k2, k3) = (2, 4, 6, 8), (l0, l1) = (5, 7) for 32 Tx ports. (China Telecom, Huawei)
	+ Option 2: (k0, k1, k2, k3) = (2, 4, 6, 8), l0 = 5 for 16 Tx ports, and (k0, k1, k2, k3) = (2, 4, 6, 8), (l0, l1) = (5, 12) for 32 Tx ports. (China Telecom, Qualcomm)
		- Qualcomm: option 1 may collide with DMRS in realistic scenarios
* Recommended WF
	+ Confirmthere is no performance difference for the two options.
	+ Encourage more inputs and select one option based on majority companies’ view.

### Sub-topic 3-2: Subband PMI for type I

**Issue 3-2: whether to introduce subband PMI test for type I single-panel codebook**

* *Agreement in RAN4 #93 (R4-1915858, WF)*
	+ *subband PMI requirements for 16 Tx ports*
		- *If subband PMI test for 16 Tx ports will be introduced, only 32 Tx ports will be covered in wideband PMI test.*
		- *If subband PMI test for 16 Tx ports will not be introduced, both 16 and 32 Tx ports will be covered in wideband PMI test.*
		- *Decide whether to define subband requirements based on the simulation results.*
		- *Companies are encouraged to run simulation for the following 4 cases. Consider the following priority if no time to run simulation for all 4 cases.*
			* *Priority for simulation: Follow subband PMI, Random subband PMI > Follow wideband PMI, Random wideband PMI*
			* *For subband/wideband gain comparison, run all tests with channel model TDLC300-5*
* Summary of simulation observations
	+ China Telecom: Based on the current simulation assumptions, the performance difference between subband PMI and wideband PMI reporting is marginal in both codebook mode 1 and mode 2.
	+ Samsung: The gain of subband compared with wideband for SNR point at 90% is not significant for both 16 Tx and 32 Tx port with follow PMI.
	+ Intel: The results with subband PMI aren’t significantly better than that with wideband PMI.
	+ Huawei: The performance of subband PMI has tiny gain compared to Wideband PMI.
	+ Ericsson: PMI reporting throughput curves do not differ between wideband and Subband PMI reporting.
* Proposals
	+ Option 1: Introduce subband PMI requirements for 16 Tx ports (China Telecom, Intel, Qualcomm)
		- China Telecom: Further investigate the simulation assumptions such as beam steering model, channel model and subband size, so as to find appropriate test parameters for subband PMI reporting.
		- Intel: Subband PMI test cases weren’t introduced in Rel-15.
	+ Option 2: Not introduce subband PMI requirements for 16 Tx ports (Huawei)
* Recommended WF
	+ FFS based on the 1st round email discussion.

### Sub-topic 3-3: Simulation result summary for type I

**Issue 3-3: Summary and calibration of simulation results for type I codebook**

* Summary
	+ R4-2001734 Summary of simulation results of NR UE CSI with 16, and 32Tx antennas
* Recommended WF
	+ Companies to add their results in the summary
	+ Calibrate the results from different companies

### Sub-topic 3-4: Codebook construction for type II

**Issue 3-4-1: Codebook construction for type II 16 Tx ports**

* Proposals
	+ Option 1: (N1, N2) = (4, 2) and (O1, O2) = (4,4) (Samsung, China Telecom, Huawei)
* Recommended WF
	+ Option 1

**Issue 3-4-2: Codebook construction for type II 32 Tx ports**

* Proposals
	+ Option 1: (N1, N2) = (4, 4) and (O1, O2) = (4, 4) (China Telecom, Huawei)
* Recommended WF
	+ Option 1

**Issue 3-4-3: L, Npsk  and subbandAmplitude for type II codebook construction**

* Proposals
	+ L (numberOfBeams)
		- Option 1: 2 (Samsung)
	+ Npsk (phaseAlphabetSize)
		- Option 1: FFS for beam combining coefficient (phase) set size, Npsk =4 can be taken for initial simulation purpose (Samsung)
	+ subbandAmplitude:
		- Option 1: FFS for 'true' or 'false' (Samsung)
			* Samsung: The TDL-A channel model has small delay spread which lacks of channel selectivity in frequency domain, there is no obvious performance difference between ‘SubbandAmplitude=OFF’ and ‘SubbandSmplitude=ON’ in the current cases, consequently, other channel model with high delay spread can be considered if RAN4 agreed to configure ‘SubbandSmplitude=ON’.
* Recommended WF
	+ Encourage feedback on the above proposals.

### Sub-topic 3-5: Beam steering model for type II

**Issue 3-5: Beam steering model for type II codebook**

* Proposals
	+ Option 1 (Samsung):
		- Reusing beam steering approach with dual-cluster beams as as specified in B.2.3B.4A of TS 36.101
			* Relative power ratio among two beams can be fixed as 1 (p =1)
* Recommended WF
	+ Encourage feedback on the above proposal

### Sub-topic 3-6: MCS and rank for type II

**Issue 3-6: MCS and rank for type II codebook**

* Proposals
	+ Option 1: MCS 13 (16QAM ½), rank2 (Samsung)
	+ Option 2: MCS 20, rank 2 (China Telecom, Huawei)
* Recommended WF
	+ FFS based on the 1st round email discussion

### Sub-topic 3-7: Channel model for type II

**Issue 3-7: Channel model for type II codebook**

* Proposals
	+ Option 1: TDLA30-5 (Samsung, Huawei)
* Recommended WF
	+ Use option 1 as baseline

### Sub-topic 3-8: MIMO correlation for type II

**Issue 3-8: MIMO correlation for type II codebook**

* Proposals
	+ Option 1: XP High (Samsung, China Telecom, Huawei)
* Recommended WF
	+ Use option 1 as baseline

### Sub-topic 3-9: Test metric for type II

**Issue 3-9: Test metric for type II codebook**

* Proposals
	+ Option 1: TP ratio between following PMI with Type II codebook and following PMI with Type-I single panel codebook (Samsung, Huawei)
	+ Option 2: TP ratio between following PMI and rand PMI (Samsung)
* Recommended WF
	+ FFS based on the 1st round email discussion

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 3-1: Given that there should not be a performance difference we can check the different configurations with 1 test case and decide in next meeting regarding CSI-RS configuration. If no performance difference, we can configure with option 2.Issue 3-2: We haven’t seen any performance gains from subband PMI compared to Wideband PMI. Other companies’ have seen small gains, therefore we are fine with introducing subband PMI tests with 16Tx ports. Also, from a functionality point of view it is good to cover subband PMI testing as well.Issue 3-4-1: We are ok with Option 1.Issue 3-4-2: We are ok with Option 1.Issue 3-4-3: We have not seen large gains when using more number of beams, 2 could be used as baseline but no need to preclude other options if companies’ see a gain. Npsk we are fine to set it to 4. SubbandAmplitude we are ok have it set to falseIssue 3-5: We are ok with beam steering model as baseline but would also not preclude modification/other option for coming meetings.Issue 3-6: Given the larger antenna arrays with 16, and 32Tx ports compared to Rel-15 PMI tests we don’t think that Option 1 should be relevant for Type II given that we already employ higher MCS for NR\_Enh\_Perf Type I PMI tests. Option 2 is OK with us.Issue 3-7: We can use TDLA30-5 as baseline, but would not preclude other options in this meeting when we only have simulations from few companies.Issue 3-8, 3-9: If we want to compare Type I codebook with Type II codebook using High antenna correlation will not see that big of gain, therefore if relative gain Type II/Type I is employed the performance will be marginal, and therefore not represent a good test of Type II codebook. Also generally using a relative throughput metric does not imply good performance; if demodulation performance is bad for both Type I, and Type II PMI reporting but performance is slightly better for Type II. the test conducted might look good at a glance, but will not showcase good overall performance. Therefore, a need for performance metrics which also to some extent takes absolute throughput into account would better ensure performance. We think that absolute metrics better capture performance requirements, or a combination of relative, and absolute performance could be employed. |
| Samsung | Issue 3-1: Prefer option 2: either option 1 and option 2 has no impact on the performanceIssue 3-2:Prefer option 1: Introduce subband PMI requirements for 16 Tx portsSubband PMI is very essential feature for NR. Similar with LTE FeMIMO WI, RAN4 has verified the gain and define the related requirement for subband PMI. From the test coverage perspective, we prefer to introduce the subband PMI requirements at this stage, although the related gain is not very significant. Based on the current summary results, we obverse the divergent results of each company, we prefer to further check the simulation assumption Issue 3-3: We have already added Samsung’s results, considering the divergent results of each company, we prefer to further align.Issue 3-4-1:We prefer option 1Issue 3-4-2:We are ok with recommended WF.Issue 3-4-3:We prefer option 1 with considering L=2 beam for reducing the complexity and providing the comparable performance compared with LTE. Meanwhile, The existing beam-steer model with specified in LTE can be reused as the baseline. Regarding subbandAmplitude, we show there is no obvious performance different between ON and OFF under TDLA30-5 channel, the delay spread is small which lacks of channel selectivity. At this stage, in order to facilitate the progress, we prefer to SubbandAmplitude=OFF. And if other high delay spread channel condition considered, we prefer to SubbandAmplitude=ONIssue 3-5: We prefer option 1, we prefer to use the same beam steering model with LTE to reduce the complexity.Issue 3-6:We are ok with recommend WFIssue 3-7: We are ok with recommend WF as option 1 is baseline. Issue 3-8:We are ok with recommend WF, XP high can be considered as the baseline. We have done some investigation and simulation with XP high condition, the gain compared with type I codebook is not significant. Some initial study from other company show the gain with medium or lower condition. At this stage, we suggest to not preclude other condition, such as XP medium. Issue 3-9:We are fine with recommend WFRegarding the test metric, the relative gain or absolute should depend on the related MCS. As shown in our company contribution, the SNR point at 90% TP is very low based on following PMI and random PMI metric for type II, and the ratio is remarkable, while the SNR point is reasonable with following PMI with type II and following PMI with type I. In this stage, considering only our company provide the result with type II, we prefer to keep both two options, and decide the relative gain and absolute base on simulation results, if the SNR point and ratio at 90%TP is reasonable, we prefer to use option 1 as the baseline.Meanwhile, there is also similar discussion with NR eMIMO with type II enhancement. In order to verify the gain of type II enhancement, the test metric of TP ratio between following PMI with Type II codebook enhancement and following PMI with Rel-15 Type-II codebook is more reasonable. |
| Intel | **Issue 3-1: Location of NZP CSI-RS for type I single-panel codebook**Option 2. The CSI-RS position doesn’t impact performance, but it its better to avoid potential collision with DMRS**Issue 3-2: Whether to introduce subband PMI test for type I single-panel codebook**Option 1. It is beneficial to introduce requirements for SB PMI which is likely to be used in the network. It is not an optional feature in Rel-15 **Issue 3-8: MIMO correlation for type II codebook**LTE requirements for Advanced codebook (i.e. rather same as Type II) are defined for XP Medium. Therefore, we suggest to consider this option as one of candidate for further discussion.**Issue 3-9: Test metric for type II codebook**We prefer Option 2, because this is baseline metric for PMI requirements in NR. Option 1 will lead to rather complicated test design. Based on our understanding, purpose of this test is to check correct Type II reporting, not to check performance benefits vs Type I. Same time, test metric for Advanced codebook LTE requirements is different from baseline PMI metric (i.e. follow vs random). Test metric for LTE Advanced CSI is TP ration between “follow PMI and RPI (relative power indicator)” and “follow PMI and fixed RPI”. Similar test metric can be considered as one of the option for further discussion. |

## 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:* |

*Suggestion on WF/LS assignment*

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

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: UE LTE-NR co-existence requirements for TDD

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000364 | Intel Corporation | Definition of LTE-NR coexistence requirements for TDD mode1. Added requirements in applicability section
2. Introduced LTE-NR coexistence requirements for TDD mode
3. Added new FRCs for LTE-NR coexistence requirements
 |
| R4-2001861 | Qualcomm Incorporated | Simulation results for LTE-NR coexistence tests for TDD |

## Open issues summary

### Sub-topic 4-1: Simulation result

**Issue 4-1: Summary and calibration of simulation results**

* *In RAN4 #93, the simulation results were summarized in R4-1915862*
* Proposal
	+ Qualcomm provides updated simulation results in R4-2001861
* Recommended WF
	+ Revise the summary to update Qualcomm’s simulation results
	+ Calibrate the results from different companies

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 4-1: Others: |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000364, Intel | 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:* |

*Suggestion on WF/LS assignment*

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

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #5: UE FR1 CA power imbalance requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000140 | China Telecom | Propose 1: Reuse the following parameters from LTE CA power imbalance test:* Propagation condition: static channel without external noise
* Modulation order: 64QAM
* Rank: rank1
* HARQ: no retransmission, RV version 0
* Throughput test point: 85% of maximum throughput
* Measurement cell: weaker cell only

Propose 2: Define requirements for 15 kHz SCS FDD+FDD CA, 30 kHz SCS TDD+TDD CA with TDD pattern of DDDSU + DDSUU.Propose 3: Use PDSCH mapping type A, and DMRS type 1 with 1 additional DMRS.Propose 4: Define requirements for 5+5 MHz bandwidth for FDD+FDD CA, 10+10 MHz bandwidth for TDD+TDD CA, with the following test applicability:* The test is done for any one of the supported bandwidth combination, by using performance requirement for 5+5 MHz FDD+FDD CA or 10+10 MHz TDD+TDD CA.
* The tested PRBs shall be placed in the highest part for the CC with lower carrier frequency, and placed in the lowest part for the CC with higher carrier frequency.
 |
| R4-2000365 | Intel Corporation | Proposal 1: Reuse the following LTE CA requirements configuration for NR CA requirements with power imbalance:* Propagation conditions: Static channel without external noise
* FRC: 64QAM with Rank 2 for tested CC
* HARQ: No retransmission, RV version 0
* Reference value Fraction of Maximum Throughput: 85%

Proposal 2: Define NR CA requirements with power imbalance for FDD with 15 kHz SCS and TDD with 30 kHz SCS.Proposal 3: Further discuss one of the following options for CBW combinations selection for NR CA requirements with power imbalance:* Option 1: Choose one or several fixed CBW combination(s)
* Option 2: Define generic methodology for selection of CBW combination among all CBW combinations in supported CA configurations.
 |
| R4-2000953 | NTT DOCOMO, INC. | Proposal 1: For power imbalance test for intra-band NR-CA, the following test parameters are applied:

|  |  |
| --- | --- |
| Parameters | Value |
| Duplex mode | Case #1: FDD+FDD CA w/ 15kHz SCSCase #2: TDD+TDD CA w/ 30kHz SCS (TDD pattern: 7DS2U) |
| RB allocation | Full allocation |
| PDSCH configurations | Mapping type: Type AK0: 0PRB bundling size: WB |
| PDSCH DMRS configurations | DMRS type: Type 1Number of additional DMRS: 1 (i.e. 1+1) |
| Modulation order | 64QAM (Code rate is FFS) |
| Transmission rank | Rank 1 |
| Max number of HARQ transmission | 1 (RV = {0}) |
| PDCCH allocation | Symbol #0 |
| MIMO configuration | 2x2 / 2x4 MIMO |
| Propagation condition | Static propagation conditionNo external noise sources are applied |
| Precoding configuration | SP Type I, Random per slot with PRB bundling granularity |

Proposal 2: For power imbalance test for intra-band NR-CA, the following test methodology is applied: * + Reference testing point: 85%ile throughput
	+ Measurement cell: Weaker cell only

Proposal 3: As CA configuration for power imbalance requirement, specify the following CA configurations. FFS necessity of further down selection.* 50+60, 50+80, 50+100, 60+60, 60+80, 60+100, 80+80 and 80+100 MHz
* Further discuss after Rel-16 core spec is finalized.

Observation: For intra-band EN-DC scenario in FR1, UE may suffer significant power imbalance between LTE and NR carriers even in co-located scenario if beam pattern is different between LTE and NR.* Maximally 25 dB power imbalance is observed in system evaluation.

Proposal 4: Power imbalance requirement should be introduced to ensure correct UE implementation in intra-band contiguous and non-contiguous EN-DC scenario in FR1.Proposal 5: For test setup, NR carrier has lower power of 6dB than LTE carrier, and only throughput NR carrier is tested. |

## Open issues summary

### Sub-topic 5-1: Duplex, SCS and TDD pattern

**Issue 5-1-1: Duplex** **and SCS**

* Proposal
	+ Option 1 (DCM, China Telecom, Intel):
		- FDD+FDD CA with 15kHz SCS
		- TDD+TDD CA with 30kHz SCS
* Recommended WF
	+ Option 1

**Issue 5-1-2: TDD pattern for 30 kHz SCS**

* Proposal
	+ Option 1: 7DS2U (DCM)
	+ Option 2: DDDSU + DDSUU (China Telecom)
* Recommended WF
	+ FFS based on the inputs from more companies

### Sub-topic 5-2: Channel bandwidth combination

**Issue 5-2: Channel bandwidth combination**

* Proposal
	+ Option 1: Specify the following CA configurations. FFS necessity of further down selection (DCM)
		- 50+60, 50+80, 50+100, 60+60, 60+80, 60+100, 80+80 and 80+100 MHz
		- Further discuss after Rel-16 core spec is finalized.
	+ Option 2: Define requirements for 5+5 MHz bandwidth for FDD+FDD CA, 10+10 MHz bandwidth for TDD+TDD CA, with the following test applicability (China Telecom)
		- The test is done for any one of the supported bandwidth combination, by using performance requirement for 5+5 MHz FDD+FDD CA or 10+10 MHz TDD+TDD CA.
		- The tested PRBs shall be placed in the highest part for the CC with lower carrier frequency, and placed in the lowest part for the CC with higher carrier frequency.



* + Option 3: Further discuss one of the following options for CBW combinations selection for NR CA requirements with power imbalance (Intel)
		- Option 3A: Choose one or several fixed CBW combination(s)
		- Option 3B: Define generic methodology for selection of CBW combination among all CBW combinations in supported CA configurations.
* Recommended WF
	+ Companies to review the three options listed above
	+ FFS based on the inputs from more companies

### Sub-topic 5-3: Propagation condition and MIMO configuration

**Issue 5-3-1: Propagation condition**

* Proposal
	+ Option 1: Static channel without external noise (DCM, China Telecom, Intel)
* Recommended WF
	+ Option 1

**Issue 5-3-2: MIMO configuration**

* Proposal
	+ Option 1: 2x2 and 2x4 (DCM)
* Recommended WF
	+ Companies to check the option 1 from DCM

### Sub-topic 5-4: MCS and rank

**Issue 5-4-1: Modulation order**

* Proposal
	+ Option 1: 64QAM (DCM, China Telecom, Intel)
* Recommended WF
	+ Option 1

**Issue 5-4-2: Code rate**

* Proposal
	+ Option 1: FFS (DCM)
* Recommended WF
	+ FFS

**Issue 5-4-3: Rank**

* Proposal
	+ Option 1: Rank 1 (DCM, China Telecom)
	+ Option 2: Rank 2 (Intel)
* Recommended WF
	+ Select one option based on the inputs from more companies

### Sub-topic 5-5: PDSCH configuration

**Issue 5-5-1: PDSCH RB allocation**

* Proposal
	+ Option 1: Full allocation (DCM)
	+ Option 2: 25 PRBs for 15kHz FDD, 24 PRBs for 30kHz TDD (China Telecom)
		- There are 25 PRBs for 5MHz CBW with 15kHz SCS, and 24 PRBs for 10MHz CBW with 30kHz SCS
* Recommended WF
	+ FFS based on the inputs from more companies

**Issue 5-5-2: PDSCH Mapping type and K0**

* Proposal
	+ Mapping type
		- Option 1: Type A (DCM, China Telecom)
	+ K0
		- Option 1: 0 (DCM)
* Recommended WF
	+ Mapping type: Type A
	+ K0: 0

**Issue 5-5-3: PRB bundling size and Precoding configuration**

* Proposal
	+ PRB bundling size
		- Option 1: WB (DCM)
	+ Precoding configuration
		- Option 1: SP Type I, Random per slot with PRB bundling granularity (DCM)
* Recommended WF
	+ FFS based on the inputs from more companies

**Issue 5-5-4: Number of HARQ transmission**

* Proposal
	+ Option 1: No retransmission, RV version 0 (DCM, China Telecom, Intel)
* Recommended WF
	+ Option 1

### Sub-topic 5-6: PDSCH DMRS configurations

**Issue 5-6: PDSCH DMRS configurations**

* Proposal
	+ Option 1: DMRS type 1, with 1 additional DMRS (DCM, China Telecom)
* Recommended WF
	+ Option 1

### Sub-topic 5-7: PDCCH allocation

**Issue 5-7: PDCCH allocation**

* Proposal
	+ Option 1: Symbol #0 (DCM)
* Recommended WF
	+ FFS based on the inputs from more companies

### Sub-topic 5-8: Test metric

**Issue 5-8-1: Test point**

* Proposal
	+ Option 1: 85% of maximum throughput (DCM, China Telecom, Intel)
* Recommended WF
	+ Use Option 1 as baseline

**Issue 5-8-2: Measurement cell**

* Proposal
	+ Option 1: Weaker cell only (DCM, China Telecom)
* Recommended WF
	+ Use Option 1 as baseline

### Sub-topic 5-9: Power imbalance requirements for EN-DC

**Issue 5-9: Power imbalance requirements for EN-DC**

* Proposal on whether to define power imbalance requirement for FR1intra-band EN-DC
	+ Option 1: Yes. Power imbalance requirement should be introduced to ensure correct UE implementation in intra-band contiguous and non-contiguous EN-DC scenario in FR1. (DCM)
		- For intra-band EN-DC scenario in FR1, UE may suffer significant power imbalance between LTE and NR carriers even in co-located scenario if beam pattern is different between LTE and NR.
			* Maximally 25 dB power imbalance is observed in system evaluation.
		- For test setup, NR carrier has lower power of 6dB than LTE carrier, and only throughput NR carrier is tested.
* Recommended WF
	+ Companies to provide feedback on DCM’s proposal
	+ Decision to be made in RAN plenary meeting

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Intel | **Issue 5-1-2: TDD pattern for 30 kHz SCS**We prefer Option 1, because this is baseline for most of defined requirements.**Issue 5-2: Channel bandwidth combination**Selection of fixed set of CBW combinations may lead to situation that some UEs will not be tested, because supported CA configurations does not include these CBW combinations. Therefore, we think that generic methodology for selection of CBW combination among all CBW combinations in supported CA configurations can be considered (Option 3B).**Issue 5-3-2: MIMO configuration**Agree with Option 1.**Issue 5-4-2: Code rate**Same MCS as for PDSCH demodulation requirements (i.e. MCS19, 64QAM with 0.5 code rate) can be considered as one of the options.**Issue 5-4-3: Rank**Option 1 is also fine for us.**Issue 5-5-1: PDSCH RB allocation**This topic depends on outcome of Issue 5-2. Therefore, we suggest to discuss it later.**Issue 5-5-2: PDSCH Mapping type and K0**Agree with Recommended WF.**Issue 5-5-3: PRB bundling size and Precoding configuration**We suggest to consider baseline assumption on PRB bundling from PDSCH requirements, i.e. 2 PRBs.**Issue 5-7: PDCCH allocation**We suggest to consider baseline assumption from FR1 PDSCH requirements, i.e. PDCCH with 2 symbols (#0 and #1)**Issue 5-9: Power imbalance requirements for EN-DC**Taking into account limited timelines and number of open issues, we suggest to focus on scenarios which are part of WID. |

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #6: BS 30% TP test point

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000141 | China Telecom | Proposal 1: Define FR2 requirements for both DM-RS 1+1 and 1+0, and for with and without PT-RS. Conduct tests based on Rel-15 test applicability. |
| R4-2000299 | Samsung | Proposal 1: Define the 30% TP requirement only with 1 DMRS and PTRS enabled configuration in FR2. |
| R4-2000403 | Ericsson | Proposal 1: Taking only DM-RS 1+1 configuration for FR2 30% throughput test cases.Proposal 2: Taking both with and without PT-RS requirements for FR2 30% throughput test cases. |
| R4-2000614 | CATT | Proposal 1: Choose Option 3: 1+1 and 1+0 for FR2.Proposal 2: Choose Option 2: without PTRS. |
| R4-2000615 | CATT | CR for TS38.104: Introducing PUSCH performance requirements at 30% throughput testing point |
| R4-2000616 | CATT | CR for TS38.141-1: Introducing PUSCH performance requirements at 30% throughput testing point |
| R4-2000617 | CATT | CR for TS38.141-2: Introducing PUSCH performance requirements at 30% throughput testing point |
| R4-2000811 | ZTE Wistron Telecom AB | Consider DMRS and PTRS together and adopt either “DMRS 1+1 without PTRS” or “DMRS 1+0 with PTRS” for defining FR2 BS demodulation requirements for 30% throughput testing points. |
| R4-2000812 | ZTE Wistron Telecom AB | Simulation results for NR PUSCH with 30% throughput |
| R4-2001194 | NTT DOCOMO, INC. | Proposal 1: For FR2 additional DM-RS configuration, RAN4 adopts option 1 (i.e., 1+1 and 1+0).Proposal 2: For FR2 PT-RS configuration, RAN4 adopts option 1 (i.e., with and without PT-RS).Proposal 3: Add the 30% TP test case with RBs for minimum channel bandwidth to the table for * + - * 5/10/20MHz for 15kHz SCS
			* 10/20/40/100MHz for 30kHz SCS
			* 50/100MHz for 60kHz SCS
			* 50/100/200MHz for 120kHz
 |
| R4-2001449 | Huawei, HiSilicon | Proposal 1: Define FR2 PUSCH performance requirements for 30% TP with DM-RS 1+1 and without PT-RS configuration.Proposal 2: Introduce PUSCH performance requirements with 30% TP based on the test configurations in Table 2-1 |
| R4-2001692 | Nokia, Nokia Shanghai Bell | DM-RS configuration1. The difference between FR2 DM-RS addPos={pos0, pos1} is a slight SNR degradation of less than 1dB for the 30%TPUT test point, with addPos=pos0. The absolute TPUT of DM-RS 1+0 is higher than DM-RS 1+1.

PT-RS configurationthe 30%TPUT test point. DM-RS configuration 1+0 and 1+1 are similarly impacted.1. RAN4 to only define requirements with FR2 PT-RS deactivated.
 |

## Open issues summary

### Sub-topic 6-1: FR2 DM-RS

**Issue 6-1: FR2 DM-RS configuration**

* *Agreement in RAN4 #93 (RAN4 #93 Chairman notes)*
	+ *FR2 DM-RS configuration*
		- *Option 1: 1+1 and 1+0*
		- *Option 2: 1+1*
		- *Option 3: 1+0*
* Proposal
	+ Option 1: 1+1 and 1+0 (China Telecom, CATT, DCM)
		- Conduct tests based on Rel-15 test applicability.
	+ Option 2: 1+1 (Ericsson, ZTE, Huawei)
	+ Option 3: 1+0 (Samsung, ZTE)
* Recommended WF
	+ Define requirements for DM-RS 1+1 and 1+0, and conduct tests based on Rel-15 test applicability.
		- Companies can provide simulation results for their interested cases.

### Sub-topic 6-2: FR2 PT-RS

**Issue 6-2: FR2 PT-RS configuration**

* *Agreement in RAN4 #93 (RAN4 #93 Chairman notes)*
	+ *FR2 PT-RS configuration*
		- *Option 1: with and without PT-RS*
		- *Option 2: with PT-RS*
		- *Option 3: without PT-RS*
* Proposal
	+ Option 1: with and without PT-RS, and conduct tests based on Rel-15 test applicability (China Telecom, Ericsson, DCM)
		- Conduct tests based on Rel-15 test applicability.
	+ Option 2: with PT-RS (Samsung, ZTE)
	+ Option 3: without PT-RS (CATT, ZTE, Huawei, Nokia)
* Recommended WF
	+ Define requirements for with and without PT-RS, and conduct tests based on Rel-15 test applicability.
		- Companies can provide simulation results for their interested cases.

### Sub-topic 6-3: Channel bandwidth

**Issue 6-3: channel bandwidth**

* *Agreement in RAN4 #92bis (R4-1912669, ad-hoc minutes)*
	+ *Bandwidth/SCS: the minimal channel bandwidth per SCS (5MHz CBW/15kHz SCS, 10MHz CBW/30kHz SCS, 50MHz CBW/60kHz SCS, 50MHz CBW/120kHz SCS)*
* Proposal
	+ Proposal 1: Add the 30% TP test case with RBs for minimum channel bandwidth to the table for (DCM)
		- 5/10/20MHz for 15kHz SCS
		- 10/20/40/100MHz for 30kHz SCS
		- 50/100MHz for 60kHz SCS
		- 50/100/200MHz for 120kHz
* Recommended WF
	+ Companies to check if the proposal 1 from DCM is agreeable.
	+ If the proposal 1 is not agreeable, keep the agreement made in RAN4 #92bis.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 6-1: Issue 6-2:Issue 6-3:Others: |
| Nokia, Nokia Shanghai Bell | 6-1: Nokia can agree to the proposed WF (define requirements for DM-RS 1+1 and 1+0, and conduct tests based on Rel-15 test applicability).6-2: Nokia can agree to the proposed WF (define requirements for with and without PT-RS, and conduct tests based on Rel-15 test applicability).6-3: Nokia proposes to stay with the previous agreement.While we see the issue of a non-expert reader not knowing what to do in case of not declaring to support the smallest CBW, an expert-reader will know about the applicability rules for this case. |
| Ericsson | Issue 6-1: We support the recommended WF Issue 6-2: We support the recommended WFIssue 6-3: We don’t think there is necessary to introduce separate requirements for all these BW and SCS combinations. However, assuming that the intention is to write the *same* requirement based on the minimum number of PRBs into each individual table, in order to ensure that there is always an applicable 30% test, this is OK. We would also be open if there are other suggestions on how to ensure that the applicability rule always makes the 30% throughput requirement applicable for all BS channel bandwidths. |
| Samsung | Issue 6-1Prefer option 2 and recommend WFIssue 6-2Prefer option 2 and recommend WFIssue 6-3Prefer to keep the agreement in RAN4#92b. Since one of test purpose for 30%TP is to verify the performance with cell edge UE. To guarantee the certain of link budget performance, only small number of RB will be scheduled |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR number** | **Comments collection** |
| R4-2000615, CATT |  Ericsson: PT-RS option should not be disabled in FR2 table if we agree the recommended WF. |
| Company B |
|  |
| R4-2000616, CATT |  Ericsson: same comments as R4-2000615 |
| Company B |
|  |
| R4-2000617, CATT |  Ericsson: same comments as R4-2000615 |
| 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #7: BS additional FR2 requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2000142 (not available) | China Telecom | Summary of ideal and impairment results for FR2 PUSCH 2T2R MCS12 |
| R4-2000799 | ZTE Wistron Telecom AB | CR for 38.104: new FRC tables for FR2 PUSCH 2T2R MCS12 |
| R4-2000800 | ZTE Wistron Telecom AB | CR for 38.141-2: new FRC tables for FR2 PUSCH 2T2R MCS12 |
| R4-2001693 | Nokia, Nokia Shanghai Bell | CR for 38.104: Performance requirements for FR2 PUSCH 2T2R 16QAM |
| R4-2001694 | Nokia, Nokia Shanghai Bell | CR for 38.141-2: Radiated test requirements for FR2 PUSCH 2T2R 16QAM |

## Open issues summary

### Sub-topic 7-1: Simulation result summary

**Issue 7-1: Summary of simulation results**

* *In RAN4 #93, the simulation results were summarized in R4-1913188.*
* In this meeting, no new simulation results are provided.
* Recommended WF
	+ Derive performance requirements based on the summary in R4-1913188.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 7-1: Others: |
| Nokia, Nokia Shanghai Bell | 7-1: Nokia's CRs are based on R4-1913188, as mentioned in the summary of changes of the CR (see R4-2001693 and R4-2001694). Hence the current numbers are proposed to be considered as final.The current CRs also do not carry square brackets, which we think is fine due to no simulation results being provided, but we hope for comments to the CRs on this matter. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2000799, ZTE |  Ericsson: There is a typo in table title and should be “2 transmission layers”, others are OK. |
| Company B |
|  |
| R4-2000800, ZTE |  Ericsson: There is a typo in table title and should be “2 transmission layers”, others are OK. |
| Company B |
|  |
| R4-2001693, Nokia | Nokia: MCC has informed us of a cover sheet error. A new T-doc number is required. |
|  Ericsson: Tables are OK and need further confirm the value. |
|  |
| R4-2001694, Nokia | Nokia: MCC has informed us of a cover sheet error. A new T-doc number is required. |
|  Ericsson: Tables are OK and need further confirm the value. |
|  |

## 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:* |

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation**  |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |