**3GPP TSG-RAN WG4 Meeting #94-e draft R4-2002524**

**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:
	+ Focus on the WFs and CR revisions in the 2nd round.
	+ For the WFs, check if the tentative agreements in the summary of 1st round are agreeable, and try to make down-selection on candidate options if possible. 5 sub-threads on WFs:
	+ RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002390 (UE release independent aspect, led by Huawei)
	+ RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002391 (UE CA demod, led by Intel)
	+ RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002393 (UE PMI reporting, led by Ericsson and Samsung)
	+ RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002396 (UE power imbalance, led by NTT DOCOMO)
	+ RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002397 (BS 30% TP, led by NTT DOCOMO)
	+ Discuss the following CR revisions in the main thread of RAN4#94e\_#95\_NR\_perf\_enh\_Demod:
	+ R4-2002427 CR to TS 38.101-4: LTE-NR coexistence requirements for TDD mode (R16) Intel Corporation
	+ R4-2002398 CR for TS38.104: Introducing PUSCH performance requirements at 30% throughput testing point CATT
	+ R4-2002399 CR for TS38.141-1: Introducing PUSCH performance requirements at 30% throughput testing point CATT
	+ R4-2002400 CR for TS38.141-2: Introducing PUSCH performance requirements at 30% throughput testing point CATT
	+ R4-2002401 CR for 38.104: new FRC tables for FR2 PUSCH 2T2R MCS12 ZTE Wistron Telecom AB
	+ R4-2002402 CR for 38.141-2: new FRC tables for FR2 PUSCH 2T2R MCS12 ZTE Wistron Telecom AB
	+ R4-2002403 CR for 38.104: Performance requirements for FR2 PUSCH 2T2R 16QAM Nokia, Nokia Shanghai Bell
	+ R4-2002404 CR for 38.141-2: Radiated test requirements for FR2 PUSCH 2T2R 16QAM Nokia, Nokia Shanghai Bell

# Topic #1: General issue for UE requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **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 |
| DOCOMO | **Issue 1-1: release independent issue**Generally, we think Rel. 15 core features can be designed as release independent. 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. |
| CMCC | **Issue 1-1: release independent issue**We think the requirements for Rel-15 features can be release independent. For LTE TDD-NR coexistence, TDD n48 for spectrum sharing is also under discussion. So we may not need to restrict only for band n90. Generally, the requirements can be applied to the TDD bands supporting spectrum sharing in Rel-15. |
| Huawei | Issue 1-1: which band combinations are release independent from Release 15, they are captured in TS 38.307, not all CA configurations defined in Rel-16 core specification TS 38.101-1/2/3 are release independent now. more work is needed for TS 38.307 if RAN4 wants to defined all CA configurations are release independent from Release 15. |
| Qualcomm | Issue 1-1: We are ok with first 4 bullets of Option 1. For fifth bullet, we don’t understand why LTE TDD -NR coexistence tests need to be limited to only band n90. There are multiple bands in Rel-15 where we can have LTE-NR coexistence for TDD. |

## 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:** Issue 1-1: release independent issue
	+ CA normal demodulation requirements
		- The requirements for those CA configurations that are defined as release independent from release 15 can be release independent from release 15.
	+ PMI reporting requirements for single panel Type I codebook
		- The requirements for 16 and 32 Tx ports can be release independent from release 15.

*Candidate options:** Issue 1-1: release independent issue
	+ Demodulation requirements for TDD LTE - NR coexistence
		- Option 1: Release independent from release 15 only for Band n90 (Huawei)
		- Option 2: Release independent from release 15 for the TDD bands supporting spectrum sharing in Rel-15. (CMCC, Qualcomm)
		- CMCC: TDD n48 for spectrum sharing is also under discussion.
	+ PMI reporting requirements for Rel-15 type II codebook
		- Option 1: Discuss the release independence after detailed simulation assumptions finalized (Huawei)
		- Option 2: Release independent from Rel-15 since it is Rel-15 core feature (Intel, DCM, CMCC)
	+ CA CQI reporting requirements
		- Option 1: Discuss the release independence after March (Huawei)
		- Option 2: Release independent from Rel-15 since it is Rel-15 core feature (DMC, CMCC)

*Recommendations for 2nd round:*Further discuss the candidate options above. |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on release independent aspect for UE demodulation and CSI reporting requirements | Huawei, HiSilicon |

### 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

**R4-2002390 Way forward on release independent aspect for UE demodulation and CSI reporting requirements**

 *Type: other For: Approval
 Source: Huawei*

**Abstract:**

**Discussion:**

*Moderator’s note: The WF is discussed in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002390 (led by Huawei).*

**Recommendation:** The document was agreeable

## Summary on 2nd round

*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”* |
| R4-2002390, WF | *agreeable* |

# Topic #2: UE CA PDSCH requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **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}
 |

## 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

|  |  |  |
| --- | --- | --- |
| 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)

|  |  |  |
| --- | --- | --- |
| 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 |
| DOCOMO | **Issue 2-1: Rank and MCS for FR2**We are fine with the recommended WF.**Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs**We propose following values.

|  |  |  |
| --- | --- | --- |
| 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 | 6 | 8 |
| TDD PCell |  | 8 |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell |  |  |
| TDD PCell |  |  |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell |  |  |
| 30kHz PCell |  |  |
|  |

**Issue 2-6-1: FR1 and FR2 CA**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. We need to consider 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.**Issue 2-7: Categorizing of CA capabilities**Option 1**Issue 2-8: Test of different CA capabilities**Option 3 |
| CMCC | **Issue 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs**For performance requirements, OK with the recommended WF. For test applicability, we prefer option 2.**Issue 2-6-1: FR1 and FR2 CA**Agree with the otpin1, FR1 and FR2 CA should be considered separately.**Issue 2-6-2: Numerology in each CA duplex mode**TDD 30KHz+TDD 30KHz is very typical configuration for NR TDD deployment. We support option 1.**Issue 2-7: Categorizing of CA capabilities**We support option 1. The specifrication structure in the recommenede WF can be further discussed. Agree with the otpin1, FR1 and FR2 CA should be considered separately.**Issue 2-8: Test of different CA capabilities**We support option 3. |
| Qualcomm | Issue 2-1: We prefer Option 1. Based on simulation results collected so far, it seems that MCS10, Rank2 is within testable SNR.Issue 2-2: Option 1 is ok.Issue 2-3: In principle, we are ok with recommended WF for performance requirements. We should still verify that performance doesn’t vary much for different number of HARQ processes after we have finalized the number of HARQ processes for each cell. Regarding test applicability, we are ok with Option 1 and Option 3 as we don’t see much value in unnecessarily testing the UE with higher number of HARQ processes (which is the case with TDD PCell) when performance will be similar.Issue 2-4: We don’t agree with the recommended WF. Our provided HARQ timelines are not considered in proposed HARQ numbers. We propose to include 6 HARQ processes for TDD 15kHz in general and also our proposal for HARQ processes for TDD 15kHz + TDD 30kHz case. The intention is to minimize the number of HARQ processes wherever possible so that UE is not strained for memory unnecessarily.Issue 2-5: In principle, we are ok with Option 1. We proposed Option 2 to make sure that performance is similar in all cases before we agree with Option 1. We are ok with recommended WF.Issue 2-6-1: We are Ok with testing FR1 CA and FR2 CA separately. FR1+FR2 CA can’t be tested, so we should remove that option.Issue 2-6-2: We are Ok with Option 1. However, there is a typo in the first bullet of same numerology. It should be “FDD 15KHz+TDD 15KHz (only in case UE does not support FDD 15KHz+TDD 30KHz)”Issue 2-7: We prefer to define capabilities with the largest number of bands instead of different number of bands. Alternatively, we can define an applicability rule to test only the largest number of bands.Issue 2-8: We are ok with Option 1.Issue 2-9: We are ok with recommended WF. |
| China Telecom | Issue 2-1: Rank and MCS for FR2For the two options, there is no obvious majority view, and it is difficult to choose one of them. The recommended WF will not increase the test case number. Moreover, for FR2, the number of SCS & CBW combinations for simulation is 4, so the additional simulation workload is not significant. So we agree with recommended WF. Issue 2-2: Tx antenna numberAgree to add the missing test parameter.Issue 2-3: Pcell configurationAgree with the recommended WF. Performance requirements can be defined for both, and test shall be conducted for one of them. For the test applicability, option 2 is preferred.Issue 2-4: HARQ process numberAgree with the recommended WF. For TDD 15 kHz + TDD 30 kHz CA with 15 kHz Pcell, either 12 or 16 processes is ok for us.Issue 2-5: Single carrier performanceBased on our simulation results, it is feasible to reuse single carrier FDD and TDD requirements for FDD-TDD CA and TDD CA with different SCSs.But ok with the recommended WF to ensure different companies have the same simulation observations.Issue 2-6-1: FR1 and FR2 CAIn our understanding, with different test methods (conducted or OTA), the demod tests are performed for FR1 CCs and FR2 CCs separately. Issue 2-6-2: Numerology in each CA duplex modeOk with the Option 1.Issue 2-7: Categorizing of CA capabilitiesAgree with the recommended WF.Aligning the categorization of CA capabilities with RF specifications is very helpful for the maintenance of TS 38.101-4.Issue 2-8: Test of different CA capabilitiesSupport option 3. |
| Huawei | Issue 2-1: We prefer Option 2. Considering the impairment margin and additional margin 0.5dB on top of averaged impairment results, the results for Rank 2 and MCS 10 is near to the untestable SNR point, it is meaningful to define a feasible requirements at current stage if such choice exist.Issue 2-2: Option 1 is fine for us.Issue 2-3: From our simulation results, similar performance requirements for either FDD PCell or TDD PCell, either TDD 15 kHz PCell or TDD 30 kHz PCell, i.e. one set of requirements can be defined for them, the main difference should be the number of HARQ process, operators may have different deployment request, from specification drafting point of view, we do not need to limit it and keep both, but with test applicability that 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.Issue 2-4: PCell: we prefer to use the same number of HARQ process for PCell as that for single carrier test; SCell: RAN4 already agreed not to cover 16 HARQ processes for NR CA in WF R4-1912832, also 12 HARQ process is feasible. As per Figure 7. SCell HARQ timing for PCell TDD 15kHz + SCell TDD 30kHz in R4-2000359 (Intel) as if the analyzed number of HARQ process is 12? Please correct us if any misunderstanding.Issue 2-5: We are ok with Option 1.Issue 2-6-1: Basically we agree with test the CA as per FR1, FR2, for each frequency range, select the band combination for testing based on the largest aggregated channel bandwidth.Issue 2-6-2: We are wondering if all the duplex mode combinations listed in Option 1 are mandatory to support for one UE, i.e. corresponding test applicability needs to be defined or not? Would like to hear other companies’ view on this.Issue 2-7: We are not clear about how to define the different capabilities for intra-band contiguous CA, NC-CA and inter-band CA with different number of bands, is it same as LTE section 8.1.2.2 with different number of DL CCs, , in that case, still heavy specification maintenance burden. Draft specification structure is welcome to give more intuitive view. |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#2** | *Tentative agreements:** Issue 2-2: Tx antenna number
	+ For FR1 and FR2, use 2Tx antennas
* Issue 2-5: Single carrier performance for TDD-FDD CA and TDD-TDD CA with different SCSs
	+ 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.
* Issue 2-6-1: FR1 and FR2 CA
	+ Group understanding is that FR1 CA and FR2 CA are tested separately

*Candidate options:** Issue 2-1: Rank and MCS for FR2:
	+ Option 1: rank 2 and MCS 10 (QC)
	+ Option 2: rank 1 and MCS 13 (HW)
	+ Option 3: Define requirements for both option 1 and option 2, and conduct test for one of the two options with the following rule (Intel, DCM, CTC)
		- Option 3a (CTC):
		- 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.
		- Option 3b: suggest to take FRC which results in the highest testable Data Rate (Intel)
		- 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 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs
	+ For performance requirements, the following proposal can be agreed after RAN4 confirmed that the same single carrier performance can be applied with different Pcell configurations (i.e., one set of requirements can be applied for different Pcell)
		- 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 (QC, HW)
		- 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. (scenarios with larger number of HARQ processes) (CMCC, CTC)
		- 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. (scenarios with less number of HARQ processes) (Intel, QC)
* Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs
	+ Option 1 (Intel, CTC, [HW]):
		- 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.
		- Use the following HARQ process numbers:

|  |  |  |
| --- | --- | --- |
| 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.
 |

* + - For TDD 15 kHz + TDD 30 kHz CA with 15 kHz Pcell in the above table
		- Option 1a: 12 processes (HW)
		- Option 1b: 16 processes
		- Decide on K1 values after the HARQ process numbers are agreed.
	+ Option 2 (QC):

|  |  |  |
| --- | --- | --- |
| 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 | 6 | 8 |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell | 6 | 10 |
| 30kHz PCell | 8 | 6 |

* + Option 3 (DCM)

|  |  |  |
| --- | --- | --- |
| 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 | 6 | 8 |
| TDD PCell |  | 8 |
| FDD 15 kHz + TDD 15 kHz CA | FDD PCell |  |  |
| TDD PCell |  |  |
| TDD 15 kHz + TDD 30 kHz CA | 15kHz PCell |  |  |
| 30kHz PCell |  |  |

* Issue 2-6-2: Numerology in each CA duplex mode
	+ Option 1: For each duplex mode, the same numerology and different numerologies in different CCs should be tested (CMCC, QC, CTC)
		- Same numerology for each duplex mode combination
		- FDD 15KHz+TDD 15KHz (only in case UE does not support FDD 15KHz+TDD 30KHz)
		- FDD 15KHz+FDD 15KHz
		- TDD 30KHz+TDD 30KHz
		- Different numerologies for each duplex mode combination
		- FDD 15KHz+TDD 30KHz
		- TDD 15KHz+TDD 30KHz
	+ Option 2: define appropriate test applicability for the list in option 1 (Intel, HW)
		- Option 2a: suggest the following set of scenarios to reduce the number of tests and have sufficient coverage (Intel)
		- 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
	+ Categorizing of CA capabilities
		- Option 1: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with different numbers of bands. (Intel, CMCC, DCM, CTC, [QC])
		- QC: ok with option 1 if we can define an applicability rule to test only the largest number of bands for inter-band CA.
		- Option 2: Define different capabilities for intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA (Huawei)
	+ Spec structure
		- Option 1: Use references to sections in RF specifications for definition of CA capabilities and configurations to avoid regular maintenance of TS 38.101-4. (Intel, CTC)
		- Option 2: Further discuss (CMCC, HW)
* Issue 2-8: Test of different CA capabilities
	+ Option 1: Test intra-band contiguous CA, intra-band non-contiguous CA and inter-band CA with the largest number of bands (Intel, QC)
	+ 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 (CTC, CMCC, DCM)

*Recommendations for 2nd round:*Further discuss the candidate options above. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on PDSCH CA normal demodulation requirements | Intel Corporation |
| #2 | Simulation assumptions for NR normal CA UE performance requirements | Intel Corporation |

### 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

**R4-2002391 Way forward on PDSCH CA normal demodulation requirements**

 *Type: other For: Approval
 Source: Intel*

**Abstract:**

**Discussion:**

*Moderator’s note: The WF and the corresponding simulation assumptions are discussed in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002391 (led by Intel).*

[Intel] I suggest to focus on the following issues:

* Issue 2-1: Rank and MCS for FR2 (Page 2)
* Issue 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs (Page 3)
* Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs (Page 4)

Other topics related to Test applicability rule can be discussed in the next RAN4 meeting.

Please let me know if you are fine with such procedure or prefer to discuss all open issues.

[CTC] We support this procedure. We should prioritize issues impacting the simulation campaign.

[Intel] Also, I would like to express our view on the following open issues:

* Issue 2-1: Rank and MCS for FR2 (Page 2)
	+ Based on our understanding, Option 3 (define for both FRCs and select) is rather compromised solution which allows to test Rank 2 MCS 10, where it is feasible, otherwise test Rank 1 MCS13. Therefore, we would like to check with proponents of Option 1 and 2 if Option 3 is acceptable compromise solution.

[CTC] We share the same view, since the debate is on whether rank 2 MCS 10 can be tested in large CA channel BW and with commercial test system.

In RAN4 #93, it was also agreed to take the testable SNR for FR2 into account when selecting CA configuration(s) and CBW combination.

In addition, option 3 does not bring high simulation workload, with 4 companies already provided results for both rank 1 and rank 2.

***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.*

[QC] Regarding MCS/Rank for FR2 CA, I am a bit confused about the whole discussion. Earlier, we had decided to choose MCS/Rank based on testability limit and based on simulation results, it seems that MCS10, Rank2 is within testable limit of 10dB assuming 2dB margin. So, what is the motivation behind discussing Option 2 and Option 3? Are we expecting more than 2dB margin from the simulation results provided or is it something else? If it is about the margin, we would suggest to use some lower MCS (say MCS 9) with Rank 2 instead of having this compromised Option 3 because MCS 9, Rank 2 will still provide higher throughput compared to MCS 13, Rank 1. We don’t need to make a decision now, but I just wanted to understand the motivation.

[Intel] Our preference is Rank 1 option, because it allows to test larger CBW combination than Rank 2 option and, therefore, rather beneficial for bands with significant limit on testable SNR point. Same time, based on discussion no consensus was reached on selection between two options. Therefore, there was suggestion from China Telecom to combine both options and test one or another FRC depending on test conditions. This option based on our understanding is good compromised solution which we can consider for future discussion.

[Intel] Issue 2-3: Pcell configuration for TDD-FDD CA and TDD-TDD CA with different SCSs (Page 3)

* + At current stage we have the following potential WF: define requirements for all scenarios and take one scenarios during the testing (for example PCell FDD of PCell TDD for TDD-FDD CA). Same time, based on our review of UE capability, there is no signaling on whether UE supports one or another type of PCell. Therefore, based on our understanding, Options 2 and 3 are just converted to testing of certain scenarios and other scenarios will not be tested. Taking into account such understanding, definition of requirements for all scenarios is not required for Options 2 and 3, because some scenarios will not be tested. Therefore, we would like to check other companies view on this issue.

[CTC] By checking 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.

So, we would propose to define requirements for different Pcell configurations.

[Intel] As for Pcell configuration, we’ve added the following clarification, marked in red:

|  |
| --- |
| * Pcell configuration
	+ For performance requirements, the following proposal can be agreed after RAN4 confirmed that the same single carrier performance can be applied with different Pcell configurations and if applicability rules will be defined in a way that there is no scenarios which will never be tested (i.e. one Pcell configuration will be covered by one group of UEs and another Pcell configuration will be covered by another group of UEs)
		- For CA with different SCSs, define requirements for both 15kHz Pcell and 30kHz Pcell.
		- For FDD + TDD CA with 15 kHz SCS, FFS whether to define requirements for both FDD 15 kHz Pcell and TDD 15 kHz Pcell.
 |

Using such clarification allows to avoid situation that we will define requirements for different Pcell configuration and define applicability rules, which preclude testing of one PCell configuration. For example, based on our understanding, UEs don’t have any capability on support of FDD PCell or TDD PCell operation for TDD-FDD CA with same SCS and always support all scenarios. If we define applicability rule as: “If Pcell in both carriers are supported, configure *TDD cell as Pcell* in TDD-FDD CA” then scenarios with FDD PCell will not be tested. Therefore, definition of requirements, which will not be tested, probably, is not needed. We suggest to give companies more time to think on what set of requirements and what kind of applicability rules should be defined to ensure that all requirements can be tested under certain conditions.

[CTC] I understand your point. It would be also ok to add FFS for FDD + TDD CA with 15 kHz SCS.

[QC] We are ok with this clarification. I hope that this clarification still doesn’t stop us from defining same requirements for different number of HARQ processes, for example, we may want to define the same requirement for TDD 30kHz with 8 and 16 HARQ processes.

[Intel] Our additional note on applicability is not related to question whether we use same or different requirements for scenarios with different number of HARQ processes. Our intention is to avoid the situation that we define requirements for multiple PCell configuration and applicability rules and some scenarios will never be tested, because applicability rules do not allow testing of some scenarios. (more detailed description is in this e-mail thread below).

[Intel] Issue 2-4: HARQ process number for TDD-FDD CA and TDD-TDD CA with different SCSs (Page 4)

* Based on our calculations, HARQ timing for PCell is same as for Single Carrier. Therefore, we suggest to reuse previous agreements on Single Carrier:
	+ FDD 15 kHz: 4
	+ TDD 15 kHz: 8
	+ TDD 30 kHz: 8
* As for HARQ process number for SCell, at current stage we have only question related to option “10 processes” for TDD 15 kHz (PCell) + TDD 30 kHz (SCell). Based on our understanding, such option is only possible if we don’t take into account potential BS delay from ACK/NACK reception to retransmission generation, because in this case, retransmission for HARQ #6 is scheduled right after UL slot which carries ACK/NACK feedback for slot with this HARQ index. Therefore, we think that “10 processes” is not feasible for TDD 15 kHz (PCell) + TDD 30 kHz (SCell), taking into account that previously we assumed BS processing delay equal to UE processing delay.

[CTC] From Figure 2-2 of QC’s paper in R4- 2001419, in our understanding, the 10 processes are realized with ACK/NACK transmitted on the special slot.

By comparing the proposals from different companies, the following aspects need to be discussed:

* a) Whether the HARQ timing for PCell is same as for Single Carrier?
	+ Yes in Intel, Huawei and CTC’s paper
	+ No in QC’s paper
* b) Whether initial transmission and retransmission are scheduled on the same type of TDD slot, i.e., DL slot or special slot?
	+ Yes in Intel and CTC’s paper
	+ No in QC and Huawei’s paper
* c) Whether the UL symbols in special slot can be used for carrying PUCCH?
	+ Yes in QC’s paper
	+ No in Intel, Huawei and CTC’s paper

Can we first discuss and align views on the three aspects?

[QC] Regarding your question on 10 HARQ processes, we are sending UL on S slot for HARQ#6 to meet the timeline as shown in our paper R4-2001419. As of now, we would like to keep the WF as it is.. listing all the options since everything seems controversial to resolve in less than a day.

**Recommendation:** The document was agreeable**.**

**R4-2002392 Simulation assumptions for NR normal CA UE performance requirements**

 *Type: other For: Approval
 Source: Intel*

**Abstract:**

**Discussion:**

*Moderator’s note: The simulation assumptions are discussed together with the WF in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002391 (led by Intel).*

**Recommendation:** The document was agreeable**.**

## Summary on 2nd round

*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”* |
| R4-2002391, WF | *agreeable* |
| R4-2002392, Simulation assumptions | *agreeable* |

# 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. |
| Qualcomm | Issue 3-1: We prefer Option 2. We are ok with either option and we do not expect any performance difference.Issue 3-2: We are ok with Option 1 to cover this feature.Issue 3-4-1/2: Ok with option1 for both 16 and 32Tx ports. However, we suggest to discuss whether we need to define the requirements for both 16 and 32 Tx ports or only one of them. Our preference will be to down-select.Issue 3-4-3: We are ok with L = 2. For other parameters, we would like to keep it open and decide based on simulation results in the next meeting. So, we should also list Npsk = 8 in the options.Issue 3-5: We are ok with Option 1.Issue 3-6: We should decide this based on simulation results. Other options should not be excluded at this early stage.Issue 3-7: Ok with Option 1.Issue 3-8: Ok with Option 1.Issue 3-9: We prefer to use Option 2 since we don’t want to couple two scenarios in one test. We already have a separate test case for Type I single panel codebook and we can compare the ratios compared to random PMI for both tests if we want to evaluate whether there are gains are not. Also. depending on UE implementation, throughput ratio for Option 1 could vary a lot compared to Option 2. |
| China Telecom | Issue 3-2: Subband PMI for type ISupport option 1, but need to find new test scenarios where subband PMI can show gain over wideband PMI.  |
| Huawei | Issue 3-1: Since no performance difference has been observed between two options, ether option 1 or 2 is ok for us. Issue 3-2: We encourage companies to follow the instructions listed in the approved Way forward. Based on the approved WF R4-1915858 in last meeting in Reno, there is an instruction on page 3 saying:

|  |
| --- |
| * + **Decide whether to define subband requirements based on the simulation results.**
 |

Now we can see results provided by interested companies in this meeting are all showing that no gain has been observed. Thus, if we are agreed to follow the instructions in WF, then no subband requirements should be introduced. Based on our understanding, there are plenty of important features and we are not able to cover them all, not to mention covering one of them with no performance gain for performance requirements. Considering the time limit issue and we are going to start discussing the details of Type II PMI test, further investigation on finding other simulation assumptions seems time consuming and not reasonable. I believe we are not going to keep on testing with different combination of parameters until we finally get the gain, are we? Issue 3-3: Simulation results from Huawei has been added into the summary for alignmentIssue 3-5: We prefer to use option 1 as baseline.Issue 3-6: We prefer to at least align with Type I test cases. We support option 2. Issue 3-7, 3-8: We support using High XP and TDLC30-5 as baseline and do some initial simulations. Other options are still welcome  |

## 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**  |
| **Topic #3** | *Tentative agreements:** Issue 3-1: location of NZP CSI-RS for type I single-panel codebook
	+ (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.
* Issue 3-4-1: Codebook construction for type II 16 Tx ports
	+ (N1, N2) = (4, 2) and (O1, O2) = (4,4)
* Issue 3-4-2: Codebook construction for type II 32 Tx ports
	+ (N1, N2) = (4, 4) and (O1, O2) = (4, 4)
* Issue 3-5: Beam steering model for type II codebook
	+ Option 1:
		- 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)
	+ Use option 1 as baseline, and not preclude modification/other option for coming meetings.
* Issue 3-7: Channel model for type II codebook
	+ Option 1: TDLA30-5
	+ Use option 1 as baseline, and not preclude other options

*Candidate options:** Issue 3-2: whether to introduce subband PMI test for type I single-panel codebook
	+ Option 1: Introduce subband PMI requirements for 16 Tx ports (China Telecom, Intel, Qualcomm, Samsung)
	+ Option 2: Not introduce subband PMI requirements for 16 Tx ports (Huawei)
* Issue 3-3: Summary and calibration of simulation results for type I codebook
	+ Samsung: considering the divergent results of each company, we prefer to further align.
* Issue 3-4-2A (**new identified issue**): Number of Tx ports for defining type II performance requirements
	+ Option 1: 16 and 32 Tx ports
	+ Option 2: select 16 or 32 Tx ports (QC)
* Issue 3-4-3: L, Npsk and subbandAmplitude for type II codebook construction
	+ L (numberOfBeams)
		- Option 1: 2 (Samsung, QC, E///)
		- Other options are not precluded
	+ Npsk (phaseAlphabetSize)
		- Option 1: Npsk =4 (Samsung, E///)
		- Option 2: Npsk = 8 (QC)
		- Other options are not precluded
	+ subbandAmplitude:
		- Option 1: fasle (E///, Samsung)
		- Option 2: true
		- keep open till the next meeting
* Issue 3-6: MCS and rank for type II codebook
	+ Option 1: MCS 13 (16QAM ½), rank2 (Samsung)
	+ Option 2: MCS 20, rank 2 (China Telecom, Huawei, E///)
	+ Other options are not precluded
* Issue 3-8: MIMO correlation for type II codebook
	+ Option 1: XP High (Samsung, China Telecom, Huawei, Qualcomm)
	+ Option 2: XP Medium (Intel, Samsung)
	+ Other options are not precluded
* Issue 3-9: Test metric for type II codebook
	+ Option 1: TP ratio between following PMI with Type II codebook and following PMI with Type-I single panel codebook (Samsung, Huawei, [E///])
	+ Option 2: TP ratio between following PMI and rand PMI (Samsung, Intel, Qualcomm)
	+ Other options are not precluded

*Recommendations for 2nd round:*Further discuss the candidate options above. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on PMI reporting requirements for Tx ports larger than 8 and up to 32 | Ericsson, Samsung |
| #2 | Simulation assumptions for NR PMI reporting requirements for more than 8 Tx ports | Ericsson |

### 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

**R4-2002393 Way forward on PMI reporting requirements for Tx ports larger than 8 and up to 32**

 *Type: other For: Approval
 Source: Ericsson，Samsung*

**Abstract:**

**Discussion:**

*Moderator’s note: The WF and the corresponding simulation assumptions are discussed in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002393(led by Ericsson and Samsung).*

NZP-CSI-RS configuration for Single panel type I 32Tx ports

[China Telecom] In the contributions and 1st round discussion, 5 companies (Samsung, Intel, Qualcomm, China Telecom, Huawei) expect no performance difference for the two options.

Does Ericsson want to check it in the next meeting, or can we go with option 2? 

[Ericsson]: We are ok with option 2.

[Huawei] We are fine with the option2

Test parameters for 16 Tx ports

[China Telecom] In my understanding, we do not need to discuss these parameters again for 16 Tx. If we look at the agreed WF in R4-1912834 in RAN4 #92bis, the agreed duplex mode and  Rx antenna number apply for both 16 and 32 Tx ports.

[Intel] For Test parameters with 16TX ports on Slide #4, we support to have the same Duplex types and RX port assumptions as for 32TX.

[Ericsson]: Yes I will remove yellow markings, but I just wanted to confirm aligned view on 16Tx port configuration.

Codebook construction for Type II

[Samsung]: Only 16 Tx port is prefered with option 1. As mentioned, type II codebook is similar with LTE eFD-MIMO Advanced codebook with multi-beam linear combinations, only 16 Tx requirement is specifed.

Meanwhile, for single panel codebook requirement, we have already defined the requirement with both 16 and 32 Tx port.

For 32Tx, the number of support codebook size and parameters in type II codebook is more, which will increase test complexity. For functionality verification, 16Tx port should be enough.

[Ericsson]: One observation regarding 32 port transmission. In eMIMO WI if we agree on relative gain metric to: (Rel-16 Type II / Rel-15 Type II) performance we will still need to configure 32 port transmission.

[Huawei] As mentioned in Samsung’s comments, we agree that 32Tx port requirement can be covered in Type I codebook based test cases rather than covered in both Type I and Type II. So we support option 1

N\_psk

[Samsung]: This value is design to indicate the Phase Coefficients, with quantized to N\_PSK levels (RRC configured) or 4 levels(fixed)

If no RRC configured signalling, the default value should be 4. Since the performance different between 4 and 8 is very small, we still prefer option 1 to reduce the test effort and make progress.

[Ericsson]: We are also fine with Option 1: 4, but would like to get input from more companies. Removed “other options not precluded” since N\_psk can only be set to {4,8}

MIMO correlation for Type II Codebook

[Samsung]: As observed in our initial results, the gain of type II is not obvious under XP high condition. At this stage, we suggest to keep two options and check the gain by simulation results, then decide the more appropriate channel condition

[Ericsson]: We also prefer to keep it open. We’d expect better Type II performance with XP medium correlation, and thus would like to keep the options open and encourage companies to simulate with different options.

Test metric for type II codebook

[Samsung]: We are fine with option 2, using the existing test metric, considering if the potential relative gain is not obvious with option 1.

[Ericsson]: We would like to explore different options and evaluate test metrics

[Huawei] We are fine to use option 2 as the test metric to make prograss

[Huawei] To other Type II parameters listed in pages but not mentioned here, we think adding sentence of “other options are not precluded”, like the way it has been done now, is a good way for leaving some times for interested companies to do the investigation and bring their views maybe in the next meeting.

**Recommendation:** The document was agreeable**.**

**R4-2002394 Simulation assumptions for NR PMI reporting requirements for more than 8 Tx ports**

 *Type: other For: Approval
 Source: Ericsson*

**Abstract:**

**Discussion:**

*Moderator’s note: The simulation assumptions are discussed together with the WF in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002393 (led by Ericsson and Samsung).*

**Recommendation:** The document was agreeable**.**

## Summary on 2nd round

*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”* |
| R4-2002393, WF | *Agreeable* |
| R4-2002394, Simulation assumptions | *Agreeable* |

# 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** |
|  |  |

### 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** |
| #1 | Summary of simulation results for LTE-NR coexistence for TDD | Huawei, HiSilicon |

### 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**  |
| R4-2000364, Intel | No comments received in the first round discussion, encourage companies to double check in the second round. If still no comment, recommend to agree it. No revision tdoc number needed. |

## Discussion on 2nd round

**R4-2002395 Summary of simulation results for LTE-NR coexistence for TDD**

 *Type: other For: Information
 Source: Huawei, HiSilicon*

**Abstract:**

**Discussion:**

*Moderator’s note: Recommend to derive the tentative requirements in [] based on the results in the summary.*

**Recommendation:** The document was noted**.**

**R4-2002427 CR to TS 38.101-4: LTE-NR coexistence requirements for TDD mode (R16)**

 *Type: CR For: Agreement
 38.101-4 v15.4.0 CR-0035 Cat: B (Rel-16)

 Source: Intel Corporation*

**Discussion:**

**Recommendation:** The document was agreeable**.**

## Summary on 2nd round

*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”* |
| R4-2002427, CR | *agreeable* |

# 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. |
| DOCOMO | **Issue 5-1-2: TDD pattern for 30 kHz SCS**Option 1: 7D1S2U (S=6d4g4u)**Issue 5-2: Channel bandwidth combination**We should strive for generic method for covering CBW combinations (option 1 and 3B).**Issue 5-5-1: PDSCH RB allocation**Full allocation. But we can discuss after BW is determined.**Issue 5-9: Power imbalance requirements for EN-DC**We need this requirement, since power imbalance occurs when beam/precoding pattern is different between LTE and NR. Similar requirement as intra-band contiguous is to be introduced. |
| CMCC | **Issue 5-1-1: Duplex** **and SCS**Support option 1**Issue 5-1-2: TDD pattern for 30 kHz SCS**Support option 1**Issue 5-3-2: MIMO configuration**Support option 1 |
| Qualcomm | Issue 5-1-1: Ok with Option 1Issue 5-1-2: Ok with Option 1 as that has been the default config so far.Issue 5-2: Ok with Option 3.Issue 5-3-1: Ok with Option 1.Issue 5-3-2: If we choose Rank1 (as it was in LTE), then these should be 1x2 and 1x4 to avoid any precoding issue, similar to SDR tests.Issue 5-4-1: Ok with Option 1.Issue 5-4-2: Ok to keep it FFS for now.Issue 5-4-3: Ok with Option 1, which is same as LTE.Issue 5-5-1: Ok with Option 1.Issue 5-5-2: Ok with recommended WF.Issue 5-5-3: We prefer to keep it open for this meeting and add PRB bundling size of 2 as another option.Issue 5-5-4: Ok with Option 1.Issue 5-6: Ok with Option 1.Issue 5-7: For lower BWs, it may not be possible to contain PDCCH within 1 symbol. We prefer to use 2 PDCCH symbols.Issue 5-8-1: Ok with Option 1.Issue 5-8-2: Ok with Option 1.Issue 5-9: We are Ok to define requirements for intra-band contiguous EN-DC with 6dB power imbalance between LTE and NR carrier. Whether to define the requirements for intra-band non-contiguous EN-DC can be discussed further. |
| China Telecom | Issue 5-3-2: MIMO configurationOK with option 1.Issue 5-5-3: PRB bundling size and Precoding configurationOk with option 1 for PRB bundling size and precoding configuration.Issue 5-7: PDCCH allocationOK with option 1. |
| Huawei | Issue 5-1-2: Support option 1Issue 5-2: More discussion is needed on how to select the channel bandwidth combinationIssue 5-4-3: Support Option 1Issue 5-7: Prefer to same as the existing casesIssue 5-9: It is out of the 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.*

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#5** | *Tentative agreements:** Issue 5-1-1: Duplex and SCS
	+ FDD+FDD CA with 15kHz SCS
	+ TDD+TDD CA with 30kHz SCS
* Issue 5-3-1: Propagation condition
	+ Static channel without external noise
* Issue 5-4-1: Modulation order
	+ 64QAM
* Issue 5-4-3: Rank
	+ Rank 1
* Issue 5-5-2: PDSCH Mapping type and K0
	+ Mapping type: Type A
	+ K0: 0
* Issue 5-5-4: Number of HARQ transmission
	+ No retransmission, RV version 0
* Issue 5-6: PDSCH DMRS configurations
	+ DMRS type 1, with 1 additional DMRS
* Issue 5-8-1: Test point
	+ 85% of maximum throughput
* Issue 5-8-2: Measurement cell
	+ Weaker cell only

*Candidate options:** Issue 5-1-2: TDD pattern for 30 kHz SCS
	+ Option 1: 7DS2U (DCM, Intel, CMCC, Qualcomm, HW)
		- DCM: S=6:4:4
	+ Option 2: DDDSU + DDSUU (China Telecom)
* Issue 5-2: Channel bandwidth combination
	+ 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, Qualcomm)
		- 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. (Intel, DCM)
	+ Other options are not precluded
* Issue 5-3-2: MIMO configuration
	+ Option 1: 2x2 and 2x4 (DCM, Intel, CMCC, CTC)
	+ Option 2: 1x2 and 1x4 (QC)
		- QC: If we choose Rank1 (as it was in LTE), then these should be 1x2 and 1x4 to avoid any precoding issue, similar to SDR tests.
* Issue 5-4-2: Code rate
	+ Option 1: MCS19, 64QAM with 0.5 code rate (Intel)
	+ Option 2: FFS (DCM, QC)
* Issue 5-5-1: PDSCH RB allocation
	+ Option 1: Full allocation (DCM, QC)
	+ 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
	+ Other options are not precluded
* Issue 5-5-3: PRB bundling size
	+ Option 1: WB (DCM, CTC)
	+ Option 2: 2 PRBs (Intel)
	+ Keep open in this meeting (QC)
* Issue 5-7: PDCCH allocation
	+ Option 1: Symbol #0 (DCM, CTC)
	+ Option 2: 2 symbols (#0 and #1) (Intel, QC, HW)
* Issue 5-9: 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)
		- NR carrier has lower power of 6dB than LTE carrier, and only throughput NR carrier is tested.
	+ Option 2: No (Intel, HW)
	+ Option 3: Define requirements for intra-band contiguous EN-DC with 6dB power imbalance between LTE and NR carrier. Whether to define the requirements for intra-band non-contiguous EN-DC can be discussed further. (QC)

*Recommendations for 2nd round:*Further discuss the candidate options above. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on UE FR1 CA power imbalance requirements | NTT DOCOMO |

### 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

**R4-2002396 Way forward on UE FR1 CA power imbalance requirements**

 *Type: other For: Approval
 Source: NTT DoCoMo*

**Abstract:**

**Discussion:**

*Moderator’s note: The WF is discussed in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002396 (led by NTT DoCoMo).*

[Intel] Page 2: Option 3A for CBW is rather same to Option 1. Therefore we suggest to combine these options.

[DCM] we are OK with this page.

[Intel] Page 3: We can keep this slide. Same time, I assume that this should be RAN decision, not RAN4.

[DCM] As agreed In R4-1910052, “FFS: whether to introduce FR1 EN-DC PDSCH demodulation performance requirement with power imbalance, i.e. 6dB power imbalance between LTE and NR carriers.”

Thus, we should discuss this in RAN4 rather in RAN.

[Intel] This topic is not a part of objectives of this WID. Therefore, based on normal procedure, RAN4 should not spend time on discussion of topics which are out of scope.

[Huawei] I assume it is just for information, not mandate that RAN4 should discuss it in next meeting before RAN agrees to add it into the WID.

[DCM] Regarding slide#3, we understand your point regarding objective in WID.  We are OK to revise the objective of WID in RAN#87.

[Intel] Page 4: Number of PRBs for Option 2 is missing for PRB bundling configuration

[DCM] we are OK with this page. Sorry for my mistake.

In terms of Duplex mode of TDD, we prefer to add DDDSUUDDDD (shifted 7D1S2U) or use this pattern instead of 7D1S2U.

DDDSUUDDDD is typical deployment for operator.

[Intel] Page 5: We didn’t discuss details of EN-DC requirements. We suggest to come back to this topic if it will be agreed to include EN-DC scenario in this WID.

[DCM] As mentioned in Page 3, we would like to discuss this topic in RAN4. In this sense, we like to include the sentence below.

- For power imbalance test for FR1 non-contiguous EN-DC (if introduced), following parameters are applied:

[Intel] Based on our understanding, WF usually contains proposals from papers, submitted by companies, or from discussions during the meeting. Same time, for this meeting we didn’t find any paper with proposals with simulation assumptions for EN-DC requirements and this topic was not discussed as a part of this e-mail thread. Therefore, we suggest to remove this page. The latest version of WF, corrected by Huawei, is fine for us. HW:

[Huawei] No need to keep it before agreement made for discussion this part for details.

**Recommendation:** The document was agreeable**.**

## Summary on 2nd round

*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”* |
| R4-2002396 WF | *agreeable* |

# 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** |
| 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 |
| NTT DOCOMO | Issue 6-1: We support Option 1 and recommended WF.Issue 6-2: We support Option 1 and recommended WF.Issue 6-3: This proposal follows agreement in RAN4 #92bis. Our intention is to avoid missing this test when BS vendors declare other than minimum CBW (i.e., 5MHz for 15kHz, 10MHz for 30kHz or 50MHz for 60/120kHz) as a maximum supported CBW. |
| CATT | **Issue 6-1: FR2 DM-RS configuration**CATT supports the recommended WF.**Issue 6-2: FR2 PT-RS configuration**CATT supports the recommended WF.**Issue 6-3: channel bandwidth**CATT prefers to keep the previous agreement in RAN4#92bis meeting.Others: CATT volunteers to provide simulation result template for BS 30% TP test point if necessary. |
| China Telecom | Issue 6-1: FR2 DM-RSAs agree in RAN4 #93, we aim to finalize all the test requirements in this meeting (seen in RAN4 Chairman notes).Agree with the recommended WF. The problem of selecting one option is that some BS may not support the selected configuration.Issue 6-2: FR2 PT-RSAs agree in RAN4 #93, we aim to finalize all the test requirements in this meeting (seen in RAN4 Chairman notes).Agree with the recommended WF. The problem of selecting one option is that some BS may not support the selected configuration.Issue 6-3: channel bandwidthNo strong view. |
| Huawei | Issue 6-1: From the proposals and further feedback from Samsung, almost all BS vendors are ok with Option 2 of 1+1, considering the allocated symbol length is 10 and 14, to ensure the better performance, we would like to know the motivation to use DM-RS 1+0. We prefer Option 2.Issue 6-2: We would like to propose if Option 3 is acceptable for company if we take majority’s view.Issue 6-3: Prefer to keep the previous agreement. |

### 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. |
| NTT DOCOMO: As commented on Issue 6-3, we prefer to add the requirements with 30% TP metric to all requirement tables. It would be noted that the number of RB is equivalent to minimum CBW per SCS. |
| CATT: The CR will be revised based on agreements. |
| China Telecom: PT-RS option should not be disabled in FR2 table if we agree the recommended WF. |
| R4-2000616, CATT |  Ericsson: same comments as R4-2000615 |
| NTT DOCOMO: Same comment as R4-2000615 |
| CATT: same comments as R4-2000615. |
| China Telecom: 1) PT-RS option should not be disabled in FR2 table if we agree the recommended WF.2) In RAN4 #92bis ad-hoc (see minutes in R4-1912722), the following applicability rule was agreed, which is different from the Rel-15 applicability and need to be captured in the CR.RAN4 #92bis agreement:*SCS: Only test the lowest supported SCS for each frequency range*38.141: Applicability of requirements for different subcarrier spacings*Unless otherwise stated, PUSCH requirement tests shall apply only for each subcarrier spacing declared to be supported (see D.7 in table 4.6-1).* |
| R4-2000617, CATT | Ericsson: same comments as R4-2000615 |
| NTT DOCOMO: Same comment as R4-2000615 |
| CATT: same comments as R4-2000615. |
| China Telecom: same comments as R4-2000616 |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |
| **Sub-topic #6** | *Candidate options:** Issue 6-1: FR2 DM-RS configuration
	+ Option 1: Define requirements for DM-RS 1+1 and 1+0, and conduct tests based on Rel-15 test applicability. (Nokia, Ericsson, DCM, CATT, CTC, Samsung)
		- Companies can provide simulation results for their interested cases.
	+ Option 2: 1+1 (ZTE, Huawei, Samsung)
	+ Option 3: 1+0 (ZTE)
* Issue 6-2: FR2 PT-RS configuration
	+ Option 1: Define requirements for with and without PT-RS, and conduct tests based on Rel-15 test applicability. (Samsung, Nokia, DCM, CATT, China Telecom, Ericsson)
		- Companies can provide simulation results for their interested cases.
	+ Option 2: with PT-RS (Samsung, ZTE)
	+ Option 3: without PT-RS (CATT, ZTE, Huawei, Nokia)
* Issue 6-3: channel bandwidth
	+ Option 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
	+ Option 2: keep the agreement made in RAN4 #92bis (Nokia, [E///], Samsung, CATT, HW)
	+ *Bandwidth/SCS: the minimal channel bandwidth per SCS (5MHz CBW/15kHz SCS, 10MHz CBW/30kHz SCS, 50MHz CBW/60kHz SCS, 50MHz CBW/120kHz SCS)*

*Recommendations for 2nd round:*Further discuss the candidate options above. |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title**  | **Assigned Company,****WF or LS lead** |
| #1 | Way forward on PUSCH demodulation requirements for 30% throughput | NTT DOCOMO |

### 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”* |
| R4-2000615, CATT | *to be revised* |
| R4-2000616, CATT | *to be revised* |
| R4-2000617, CATT | *to be revised* |

## Discussion on 2nd round

**R4-2002397 Way forward on PUSCH demodulation requirements for 30% throughput**

 *Type: other For: Approval
 Source: NTT DoCoMo*

**Abstract:**

**Discussion:**

*Moderator’s note: The WF is discussed in sub-thread* *RAN4#94e\_#95\_NR\_perf\_enh\_Demod – draft WF R4-2002397 (led by NTT DoCoMo).*

Issue 6-1: FR2 DM-RS configuration

* Option 1: Define requirements for DM-RS 1+1 and 1+0, and conduct tests based on Rel-15 test applicability. (Nokia, Ericsson, DCM, CATT, CTC, Samsung)
	+ Companies can provide simulation results for their interested cases.
* Option 2: 1+1 (ZTE, Huawei, Samsung)
* Option 3: 1+0 (ZTE)

Tentative Agreement:

* 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.

[China Telecom] As agreed in RAN4 #93, we aim to finalize all the test requirements in this meeting.

We support the tentative agreement. The problem of selecting one option is that some BS may not support the selected configuration.

[Nokia]: We also support the tentative agreement. The tables already exist in 38.141-2 for both DM-RS configurations and the applicability rules are already in place, so the additional specification effort will be low.

[Ericsson]: We agree with tentative agreements. BS can choose requirements based on supported configuration.

[DCM]: Thanks for the discussion. We agree with tentative agreement. If there are no other concerns, we can conclude with the tentative agreement.

Issue 6-2: FR2 PT-RS configuration

* Option 1: Define requirements for with and without PT-RS, and conduct tests based on Rel-15 test applicability. (Samsung, Nokia, DCM, CATT, China Telecom, Ericsson)
	+ Companies can provide simulation results for their interested cases.
* Option 2: with PT-RS (Samsung, ZTE)
* Option 3: without PT-RS (CATT, ZTE, Huawei, Nokia)

Tentative Agreement:

* 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.

[China Telecom] Same comment as for DM-RS configuration:

As agreed in RAN4 #93, we aim to finalize all the test requirements in this meeting.

We support the tentative agreement. The problem of selecting one option is that some BS may not support the selected configuration.

[Nokia]: Currently 38.141-2 (Table 8.2.1.4.2-1, and the requirement tables) only have PT-RS configured for MCS 16 and 64. We should follow this template and not introduce PT-RS off for our MCS 2. (MCS 2 agreed in R4-1912722.) Otherwise we will have the unexplainable situation of having FR2 requirements for 30%TPUT and not 70%TPUT.
Remark: We should probably fix Table 8.2.1.4.2-1 to define PT-RS on **and off** in type O-2... We will prepare a CR for next meeting.

[China Telecom 2] We agreed to use MCS 2 in RAN4 #92bis in R4-1912669, and then agreed to use MCS 16 instead in RAN4 #93 in R4-1915804.

Checking the agreements in ad-hoc minutes of different meetings seems not convenient. It is good we have a WF on the parameter in this meeting.

[Ericsson]: We agree with tentative agreements. BS can choose requirements based on supported configuration.

[Nokia2]: True, we had overlooked the second update of our decision. So there is no unexplainable test case issue. Hence, we can agree to the WF.

[DCM]: Thanks for the discussion. We agree with tentative agreement. If there are no other concerns, we can conclude with the tentative agreement.

Issue 6-3: channel bandwidth

* Option 1: Add the 30% TP test cases with RBs for the minimum channel bandwidth per SCS (i.e., 25RB for 15kHz SCS, 24RB for 30kHz SCS, 66RB for 60kHz SCS, 32RB for 120kHz SCS, which are agreed in #92bis) to all tables for CP-OFDM (i.e., Table 8.2.1.2-1 – 8.2.1.2-14, Table 11.2.2.1.2-1 - 11.2.2.1.2-5 in TS 38.104, and corresponding Tables in TS38.141-1/2) (DCM)
* Option 2: Add the 30% TP test cases with RBs for the minimum channel bandwidth per SCS (i.e., 25RB for 15kHz SCS, 24RB for 30kHz SCS, 66RB for 60kHz SCS, 32RB for 120kHz SCS, which are agreed in #92bis) to only tables for the minimum channel bandwidth per SCS for CP-OFDM (i.e., Table 8.2.1.2-1, 8.2.1.2-4, 8.2.1.2-8, 8.2.1.2-11, Table 11.2.2.1.2-1, 11.2.2.1.2-3 in TS 38.104, and corresponding Tables in TS 38.141-1/2)

Tentative Agreement:

* 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.

[DCM]: Based on our original intention, we clarified our proposal and updated candidate options. Please share your preferable option.

[China Telecom] Thanks DCM for clarifying the proposal. With this clarification and Rel-15 test applicability on channel bandwidth, I could think option 1 and 2 are the same from the test coverage point of view.

It is worth noting that with the Rel-15 test applicability, Rel-15 DFT-s-OFDM PUSCH requirements are only defined for minimal BW per SCS, i.e., the above option 2.

[Nokia:] We agree with CTC in saying that the test coverage is the same for both options. Our preference is as in round 1, the skilled reader will know how to apply the current applicability rules correctly. However, our preference is only slight and would like to hear comments from further companies.

[Ericsson] Regarding there is no essential difference between two options, we think it would be good to use Option 1 to interpret the “hidden” information in the application rules to a clear requirements table for readers to look up. Not all of our readers are skilled, and a serious technical specification could also be user-friendly.

[Nokia:] OK. Nokia supports both options then. We have no preference for when the 30%TPUT CRs are adapted to the agreements in this meeting. There is no time pressure in this WI.

[DCM]: Let me clarify the motivation of Option 1. In Rel-15, both DFT-s-OFDM and CP-OFDM PUSCH requirements were introduced. For DFT-s-OFDM, as commented by CTC, only the requirements for the minimum channel bandwidth per SCS are defined and only tables for the minimum channel bandwidth per SCS exist. It means any BS declaring to support DFT-s-OFDM will refer to the table of the minimum channel bandwidth. E.g., A BS declaring to support 80MHz CBW and 30kHz SCS will refer to the table of 10MHz CBW and 30kHz SCS according to the applicability rule.

On the other hand, for CP-OFDM, we have multiple tables with different sets of channel bandwidth and SCS. A BS declaring to support larger channel bandwidth does not refer to the table of the minimum channel bandwidth.

e.g., A BS declaring to support 80MHz CBW and 30kHz SCS will refer to the table of 40MHz CBW and 30kHz SCS according to the applicability rule. Then such a BS might miss the requirement in the table of 10MHz CBW and 30kHz SCS if Option 2.

To avoid such unnecessary omissions and confusion, we proposed option 1.

[China Telecom 3] Just share my understanding of the Rel-15 applicability: A BS declaring to support 80MHz CBW and 30kHz SCS, the requirements for CP-PUSCH with 40MHz and DFT PUSCH with 10MHz will apply.

But we are fine with option 1.

[Huawei] We prefer Option 2. The Option 1 will make the specification reduplicated, specification reader usually first take look at those performance requirements and then try to understand the related applicability rule during testing, and they had thought there are different performance requirements for different bandwidths per SCS defined for 30% TP, but after double checking by spending much time, reader realizes that the requirements are actually same finally. If company think there is any confusion about the test applicability rule for 30% TP test case, more clarification can be added.

[Huawei] I noticed the latest version for this WF in the draft box: Draft R4-2002397\_Way forward on PUSCH demodulation requirements for 30percent throughput\_v2, are not correctly capture our comments on how to capture the performance requirements in the specification, i.e. Issue 6-3: channel bandwidth. We cannot agree this version, I am not sure if there is other version that I missed.

[DCM]: In our understanding, the same approach is used in the LTE specification. Are you having such a problem in LTE?

We think different approach from LTE is more confusing.

[DCM]: Another option is to agree on CRs with Option 2, and keep discussion on whether to add the requirements to all tables or not in next meeting. Or postpone CRs to next meeting.

[Huawei] I personally think that all companies had a constructive discussion on the topic about NR PUSCH 30% TP, tried to compromise as much as possible, after this meeting, we finalized all open issues that is a great progress. Now the only left open issue is about the CR drafting, sorry I cannot download the CRs shared by CATT in the draft box, and the specification structure. As you said the existing LTE structure has no problem, I agree with you that we should try to follow LTE as much as possible to learn good experience, but it does not mean we need to follow LTE for everything, now NR have more bandwidths and SCS, many more tables than LTE (LTE only has 6 tables for 6 bandwidth types, but NR has 14 tables for different bandwidth and SCS), if we try to insert the same content to every tables, it is effort and time consuming either from the CR drafting or specification reading, I really did not figure out any benefit to do so.

Only 4 tables are created for DFT-s-OFDM with the less number of RB to adapt to all possible supporting bandwidth in the real testing, it is a good example that we can follow for PUSCH 30% TP test cases, so I did not find any issues to use Option 2.

I did not have any intention to try to avoid to test some test cases, just from specification drafting point of view. If I made any misunderstanding to you, I am sorry for that.

***Agreements:***

Slide #3 regarding FR2 DM-RS configuration and Slide #4 regarding FR2 PT-RS configuration of the WF R4-2002397 are agreed.

**Recommendation:** The document was Noted

**R4-2002398 CR for TS38.104: Introducing PUSCH performance requirements at 30% throughput testing point**

 *Type: CR For: Agreement
 38.104 v16.2.0 CR-0130 Cat: B (Rel-16)

 Source: CATT*

**Discussion:**

[Huawei] Your CR is drafted based the Option 1 in the WF, actually we have not reached agreement on Option 1 or Option 2.

By following your CR, the requirements for PUSCH 30% TP defined with the lowest channel bandwidth, if you insert them into all other channel bandwidth tables, how to understand the requirements table for certain bandwidth (all others are defined as per bandwidth, but the newly inserted one is not actually based on bandwidth and is based on smallest number of PRB) and the corresponding test applicability rule for different bandwidth. In a word, everything is defined based on the bandwidth, but this is based on the specific number of PRB, the existing applicability rules cannot be applied.

8.1.2.1.2 Applicability of requirements for different channel bandwidths

For each subcarrier spacing declared to be supported, the tests for a specific channel bandwidth shall apply only if the BS supports it (see D.14 in table 4.6-1).=> e.g. 40MHz

Unless otherwise stated, for each subcarrier spacing declared to be supported, the tests shall be done only for the widest supported channel bandwidth. (e.g. 40MHz) If performance requirement is not specified for this widest supported channel bandwidth, the tests shall be done by using performance requirement for the closest channel bandwidth lower than this widest supported bandwidth; the tested PRBs shall then be centered in this widest supported channel bandwidth.

As per Option 1, the 30% TP requirements is specified in the table for 40MHz CBW, i.e. the performance requirements are specified, so this test applicability rule for different channel bandwidth cannot be applied. All other cases in this table for 40MHz CBW are defined with full bandwidth and can be tested directly, now how to test this 30% TP cases that is not full bandwidth, no any specification.

For Option 2: the 30% TP cases are only captured in the table for 5MHz CBW for example, but BS can find the 70% requirements defined for the supported 40MHz CBW, BS does not need to find other closet lower bandwidth, so the 30% cases will be missed. If you want to BS test those 30% TP cases, additional test applicability rule is needed.

Based on the above initial analysis, I think that we need more analysis on how to capture the requirements for 30% TP, maybe separate table as defined for DFT-s-OFDM, but additional specific test applicability rule needs to be defined to request BS to test those cases for 30% TP besides those for 70% TP.

I am not sure if I missed anything, other comments are welcome.

[E///]: I think Tricia made a good point that the requirements of PUSCH 30% Thp is defined at the minimum PRBs not the full bandwidth. I think it would be better to use a separate tables for all 30% Thp requirements and also add a separate paragraph in bandwidth application rule like in SCS application rule. Or we just modify the application rule also works?

**Recommendation:** The document was Noted

**R4-2002399 CR for TS38.141-1: Introducing PUSCH performance requirements at 30% throughput testing point**

 *Type: CR For: Agreement
 38.141-1 v16.2.0 CR-0088 Cat: B (Rel-16)

 Source: CATT*

**Discussion:**

**Recommendation:** The document was Noted

**R4-2002400 CR for TS38.141-2: Introducing PUSCH performance requirements at 30% throughput testing point**

 *Type: CR For: Agreement
 38.141-2 v16.2.0 CR-0107 Cat: B (Rel-16)

 Source: CATT*

**Discussion:**

**Recommendation:** The document was Noted

## Summary on 2nd round

*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”* |
| R4-2002397, WF | With one comment unaddressed, it is recommended to note the WF, and capture the following the agreements in RAN4 Chairman notes:***Agreements:***Slide #3 regarding FR2 DM-RS configuration and Slide #4 regarding FR2 PT-RS configuration of the WF R4-2002397 are agreed. |

# 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** |
| 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. |
| China Telecom: 1) On NOTE 1 in Table A.7-2: change “*Additional DM-RS position = pos0* with *l0*= 0” to “*Additional DM-RS position = pos1* with *l0*= 0 and *l* =8”2) Editorial comments: the table title should be in “TH” format. |
|  |
| R4-2000800, ZTE | Ericsson: There is a typo in table title and should be “2 transmission layers”, others are OK. |
| China Telecom: Same comment as 2000799 |
|  |
| 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. |
| China Telecom: 1) In my understanding, in Rel-15, some test cases with MCS 16 DMRS 1+0 were removed since 70% TP cannot be achieved. Now for MCS 12, 70% TP can be achieved, so we need to add back these cases in Rel-16.2) Suggest to put [] on the required numbers for the time being, and remove the [] later with a new CR. (Give companies more time to double check) |
| 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. |
| China Telecom: 1) In my understanding, in Rel-15, some test cases with MCS 16 DMRS 1+0 were removed since 70% TP cannot be achieved. Now for MCS 12, 70% TP can be achieved, so we need to add back these cases in Rel-16.2) Suggest to put [] on the required numbers for the time being, and remove the [] later with a new CR. (Give companies more time to double check)3) A typo in Table 8.2.1.5.2-3, correct 14.2 to 15.0.4) A typo in Table 8.2.1.5.2-5, correct the second “G-FR2-A7-5” to “G-FR2-A7-10”. |

## 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:*Derive performance requirements based on the summary in R4-1913188. |

*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”* |
| R4-2000799, ZTE | *to be revised* |
| R4-2000800, ZTE | *to be revised* |
| R4-2001693, Nokia | *to be revised* |
| R4-2001694, Nokia | *to be revised* |

## Discussion on 2nd round

**R4-2002401 CR for 38.104: new FRC tables for FR2 PUSCH 2T2R MCS12**

 *Type: CR For: Agreement
 38.104 v16.2.0 CR-0136 Cat: C (Rel-16)

 Source: ZTE Wistron Telecom AB*

**Discussion:**

CTC: one editorial comment on 38.104 FRC CR: add “and” in note 1 of Table A.7-2: i.e., *pos1* with *l0* = 0 and *l* = 8

**Recommendation:** The document was agreeable**.**

**R4-2002402 CR for 38.141-2: new FRC tables for FR2 PUSCH 2T2R MCS12**

 *Type: CR For: Agreement
 38.141-2 v16.2.0 CR-0116 Cat: C (Rel-16)

 Source: ZTE Wistron Telecom AB*

**Discussion:**

**Recommendation:** The document was agreeable**.**

**R4-2002403 CR for 38.104: Performance requirements for FR2 PUSCH 2T2R 16QAM**

 *Type: CR For: Agreement
 38.104 v16.2.0 CR-0159 Cat: C (Rel-16)

 Source: Nokia, Nokia Shanghai Bell*

**Abstract:**

SNR of performance requirements for FR2 PUSCH 2T2R 16QAM, in section 11 is unachievable. Implement previously agreed changes to rectify.

**Discussion:**

**Recommendation:** The document was agreeable**.**

**R4-2002404 CR for 38.141-2: Radiated test requirements for FR2 PUSCH 2T2R 16QAM**

 *Type: CR For: Agreement
 38.141-2 v16.2.0 CR-0132 Cat: C (Rel-16)

 Source: Nokia, Nokia Shanghai Bell*

**Abstract:**

SNR of performance requirements for FR2 PUSCH 2T2R 16QAM, in section 8 is unachievable. Implement previously agreed changes to rectify.

**Discussion:**

CTC: seems a typo in Table 8.2.1.5.2-2 of 38.141-2 CR, correct 17.7 to 15.7.

**Recommendation:** The document was agreeable**.**

## Summary on 2nd round

*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”* |
| R4-2002401, CR | *agreeable* |
| R4-2002402, CR | *agreeable* |
| R4-2002403, CR | *agreeable* |
| R4-2002404, CR | *agreeable* |