**3GPP TSG-RAN WG4 Meeting # 109 R4-232xxxx**

**Chicago, USA, Nov., 13 – 17, 2023**

**Agenda item:** 8.3.4

**Source:** Moderator (Huawei, HiSilicon)

**Title:** Topic summary for [109][316] RF\_FR1\_enh2\_Demod

**Document for:** Information

# Introduction

This paper provides the summary for the contributions submitted under the following agendas:

8.3.3 Demodulation and CSI requirements

8.3.3.1 8Rx UE demodulation and CSI

8.3.3.1.1 General aspects

8.3.3.1.2 PDSCH requirements

8.3.3.1.3 SDR requirements

8.3.3.1.4 CQI reporting requirements

8.3.3.2 4Tx BS demodulation

The main open issues for this topics:

* CA performance requirements for 8Rx: PDSCH, SDR, CQI
* Draft CRs review for UE 8Rx performance requirements and BS 4Tx performance requirements.

# Topic #1: General parts

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2318043**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318043.zip) | Discussion on 8Rx general demodulation aspects | Nokia, Nokia Shanghai Bell | [**Proposal 1:** RAN4 shall extend Table 5.1.1.7.2-1 to include tests cases in new Clause 5.2A.4.1.](#_Toc149819122)[**Proposal 2:** RAN4 shall include applicability rules for CA demodulation requirements with different number of Rx antenna ports indicating the number of ports to be connected for various bands and UE declaration within a new clause 5.1.1.7.5 with the following wording:](#_Toc149819123)Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.3.1 are applied.Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, 8 out of the 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration. |
| [**R4-2318671**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318671.zip) | Further Discussion on General Aspects of 8Rx Requirements in FR1 | Apple | **Proposal #1:** RAN4 to extend Table 5.1.1.7.2-1 to include tests cases in new Clause 5.2A.4.1, with the corresponding changes in Table 5.1.1.7.2-1 (Applicability and test rules for CA UE demodulation tests).**Proposal #2:** RAN4 to approve include applicability rules for CA demodulation requirements for different number of Rx antenna ports following the text in the previous RAN4#108bis WF. **Observation #1:** Current work in this work item has heavily leveraged the precedent of LTE 8Rx discussion, including applicability rules and how demodulation requirements have been defined based on previous requirements.**Observation #2:** Under current 8Rx applicability rules, an 8Rx UE is still subject to provide 2Rx and 4Rx functionality for proper conformance testing, in addition to 8Rx functionality.**Observation #3:** Under current PDSCH performance requirements, the antenna correlation for 8Rx is chosen to be ULA Low. Even though the WI assumes a CPE type of device, this may impose severe restrictions to potential small form factor 8Rx UEs that may be manufactured in the future, and such low antenna correlation may not be always achieved in practice.**Proposal #3:** RAN4 to discuss during the last session of this WI how to improve the technical fundamentals of the specification of 8Rx requirements based on Observations #1 to #3. |
| [**R4-2319227**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319227.zip) | Left open issues on general aspects for 8Rx in FR1 | Ericsson | **Proposal 1:** For FR1 8Rx CA applicability rules of demodulation performance requirements, extend Table 5.1.1.7.2-1 to include tests cases in new Clause 5.2A.4.1. **Proposal 2:** For CA with different numbers of DL component carriers, consider the applicability rules for PDSCH as follow.a. Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.3.1 are applied.b. Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.c. Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, all 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.d. For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration. |
| [**R4-2319332**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319332.zip) | discussion on 8Rx general aspects requirements | Samsung | **Proposal 1:** For FR1 8Rx CA applicability rules of demodulation performance requirements, extend 38.101-4 Table 5.1.1.7.2-1 to include Tests cases in new Clause 5.2A.4.1 for 8Rx CA.**Proposal 2:** For FR1 8Rx CA applicability rules and antenna connection of demodulation performance requirements, below requirements should be specified.Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.3.1 are applied.Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, all 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.**Proposal 3:** For FR1 8Rx CA applicability rules requirements should be specified for UE could support 8Rx+8Rx CA but do not support rank 8, rank 2 related test cases should be applied instead of rank 8 test cases. |
| [**R4-2319390**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319390.zip) | Discussion on PDSCH CA requirements for UE with 8Rx | China Telecom | **Proposal 1:** Decide the test applicability rules for 8Rx CA demodulation requirements and extend Table 5.1.1.7.2-1 to include Tests cases in new Clause 5.2A.4.1.**Proposal 2:** Support option 1 as an reasonable extension of the existing test applicability rule for different number of Rx antenna for 2/4Rx CA requirements in 5.1.1.7.3 in TS38.101-4. |
| [**R4-2319534**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319534.zip) | Discussion on 8Rx UE demodulation requirements for CA | ZTE Corporation | **Proposal 1.** For 8Rx CA applicable rules, propose to exend Table 5.1.1.7.2-1 to include Tests cases in new Clause 5.2A.4.1 for 8Rx CA reuqirements, as shown in following table.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Tests | CA capability where the tests apply | CA configuration from the selected CA capability where the tests apply | CA Bandwidth combination to be tested in priority order | PCell CC configuration |
| Test 6 in Clause 5.2A.2.1, 5.2A.3.1 and 5.2A.4.1 | CA\_C, CA\_N, CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |

**Proposal 2.** For Applicability rules for different number of RX antenna ports for CA demodulation requirements, propose to consider the following daclaration for 8Rx CA.* Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.
* Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.3.1 are applied.
* Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, all 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.
* For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.
 |
| [**R4-2320189**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320189.zip) | Discussions on remain issues on 8Rx PDSCH requirements | Huawei, HiSilicon | Observation 1: If we apply the existing criteria to 8Rx UE, it’s possible that 8Rx band is not included in the selected band combination, which can lead to the situation that 8Rx UE is tested without 8Rx band.Proposal 1: The existing applicability rules for CA test should be updated to guarantee that at one 8Rx CC is selected for testing.**Observation 2:** Performance test of 2Rx/4Rx CC in hybrid Rx CA combination is outside the WI scopeProposal 2: If 8Rx UE supports both hybrid Rx band combination (4Rx+8Rx) and 8Rx+8Rx band combination, 8Rx+8Rx should be selected for testing.**Proposal 3:** Use the existing applicability rules listed in Table 2-1:Proposal 4: Confirm Option 1 as antenna connection rules for 8Rx UE CA test.  |

## Open issues summary

### Sub-topic 1-1 Applicability rules for CA

**Issue 1-1-1: Test applicability rules**

*Background: In WF R4-2316914, RAN4 agreed to define the following 8Rx CA demodulation performance tests:*

* + *Rank 8 for 8Rx+8Rx, Rank 2 for 2Rx+8Rx and 4Rx+8Rx*
		- *Rank 8 + Rank 8 for 8Rx+8Rx for UE supporting Rank 8 for 8Rx*
		- *Rank 2 + Rank 2 for 4Rx+8Rx*
		- *Rank 2 + Rank 2 for 2Rx+8Rx*
* Proposals
	+ Option 1: If a 8Rx capable UE supports both hybrid Rx band combination (4Rx+8Rx, 2Rx+8Rx) with Rank 2 and 8Rx+8Rx band combination with Rank 8, CA test for 8Rx+8Rx with Rank 8 should be selected for testing, otherwise Rank 2 CA test should be applied (Huawei, Samsung)
	+ Other option.
* Recommended WF
	+ Option 1 is agreeable?

**Issue 1-1-2: Applicability rules for CA configurations selection**

**Moderator observation:**

As per the proposals from all interesting companies, all companies are fine to extend

Table 5.1.1.7.2-1 in TS 38.101-4 to include new 8Rx CA tests to be defined in section 5.2A.4.1

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tests** | **CA capability where the tests apply** | **CA configuration from the selected CA capability where the tests apply** | **CA Bandwidth combination to be tested in priority order** | **PCell CC configuration** |
| Test 1 in Clause 5.2A.2.1, 5.2A.3.1 and 5.2A.4.1 | CA\_C, CA\_N, CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 2 in Clause 5.2A.2.1, 5.2A.3.1 and 5.2A.4.1 | CA\_C, CA\_N, CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 3 in Clause 5.2A.2.1, 5.2A.3.1 and 5.2A.4.1 | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | TDD CC if supported, otherwise FDD CC |
| Test 4 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 2) | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | Any of CCs |
| Test 5 in Clause 5.2A.2.1 and 5.2A.3.1 (NOTE 3) | CA\_AX | Table 5.1.1.7.2-2 | Largest aggregated CA bandwidth combination | 15 kHz CC if supported, otherwise 30 kHz CC |
| NOTE 1: In case CA\_AX with different number of X is supported then one or two CA configurations are selected based on procedure from Table 5.1.1.7.2-2.NOTE 2: These scenarios are only tested for UEs which are not verified with Test 3 in Clause 5.2A.2.1 and 5.2A.3.1.NOTE 3: These scenarios are only tested for UEs which are not verified with Test 2 in Clause 5.2A.2.1 and 5.2A.3.1. |

But for the selection of CA configurations, whether to directly reuse the rules defined in Table 5.1.1.7.2-2, there are different views.

* **Proposals for the selection of CA configurations**
	+ Option 1 (Nokia, Apple, Ericsson, Samsung, CTC, ZTE)
		- Reuse Table 5.1.1.7.2-2 in TS 38.101-4.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CA capability | Step 1 | Step 2 | Step 3 | Step 4 |
| CA\_C or CA\_N | Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | N/A | N/A |
| CA\_AX | Select the CA configurations with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | Select the CA configurations with the largest number of bands and with the maximum number of CCs, for which the supported maximum number of MIMO layers is not lower than 2. | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 3. |
| NOTE 1: For CA\_AX capability, if CA configuration from step 2 is CA configuration with the largest number of bands then Step 3 and Step 4 are skipped. Otherwise, the two CA configurations selected from Step 2 and Step 4 are used for testing.NOTE 2: Maximum supported data rate for Step 2 and Step 4 is calculated based clause 4.1.2 of TS 38.306 [14].NOTE 3: Tested data rate for Step 2 and Step 4 is calculated based on the equation $DataRate=10^{-3}\sum\_{j=1}^{J}TBS\_{j}2^{μ\_{j}}$ and FRCs used in the test. |

* + Option 2 (Huawei)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CA capability | Step 1 | Step 2 | Step 3 | Step 4 |
| CA\_C or CA\_N | If the UE support CA configuration that for each CC, supported maximum number of Rx and maximum number of MIMO layers is 8:* Select the CA configurations with the maximum number of CCs, for which the supported maximum number of Rx and MIMO layers is 8.

Otherwise:* Select the CA configurations with the maximum number of CCs, conditioned that at least for one CC the supported maximum number of Rx is 8 and for each CC the supported maximum number of MIMO layers is not lower than 2
 | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | N/A | N/A |
| CA\_AX | If the UE support CA configuration that for each CC, supported maximum number of Rx and maximum number of MIMO layers is 8:* Select the CA configurations with the maximum number of CCs, for which the supported maximum number of Rx and MIMO layers is 8.

Otherwise:* Select the CA configurations with the maximum number of CCs, conditioned that at least for one CC the supported maximum number of Rx is 8 and for each CC the supported maximum number of MIMO layers is not lower than 2
 | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 1. | If the tested UE support CA configuration that for each CC, supported maximum number of Rx and maximum number of MIMO layers is 8:* Select the CA configurations with the largest number of bands and with the maximum number of CCs, for which the supported maximum number of Rx and MIMO layers is 8.

Otherwise:* Select the CA configurations with the largest number of bands and with the maximum number of CCs, conditioned that at least for one CC the supported maximum number of Rx is 8 and for each CC the supported maximum number of MIMO layers is not lower than 2
 | Select any one of CA configurations, which contain CA bandwidth combination with the largest aggregated channel bandwidth and supported maximum data rate is not lower than the tested date rate, among all the selected CA configurations from Step 3. |
| NOTE 1: For CA\_AX capability, if CA configuration from step 2 is CA configuration with the largest number of bands then Step 3 and Step 4 are skipped. Otherwise, the two CA configurations selected from Step 2 and Step 4 are used for testing. |

* Recommended WF
	+ This is the specific test applicability rules description that can be captured in the specification.
	+ This issue is related to Issue 1-1-1 and can be discussed after finalization of Issue 1-1-1.

**Issue 1-1-3: Applicability rules for different number of RX antenna ports for CA demodulation requirements**

* Proposals
	+ Option 1 (Apple, Ericsson, Samsung, CTC, ZTE, Huawei)
		- Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.
		- Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.3.1 are applied.
		- Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, all 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.
		- For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.
	+ Option 2 (Nokia)
		- Within the CA configuration if any of the PCell and/or the SCells is a 2Rx supported RF band, 2 out of the 8Rx should be connected with data source from system simulator, depending on UE’s declaration and AP configuration. Requirements from Clause 5.2A.2.1 are applied.
		- Within the CA configuration if any of the PCell and/or the SCells is a 4Rx supported RF band, 4 out of the 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.3.1 are applied.
		- Within the CA configuration if any of the PCell and/or the SCells is a 8Rx supported RF band, 8 out of the 8Rx should be connected with data source from system simulator. Requirements from Clause5.2A.4.1 are applied.
		- For 8Rx capable UEs, the 2Rx supported RF bands, 4Rx supported RF bands and 8Rx supported RF bands are up to UE’s declaration.
* Recommended WF
	+ Option 1 is agreeable?

### Sub-topic 1-2 Antenna correlation for 8Rx

**Issue 1-2-1: Antenna correlation for 8Rx**

*Background: As per WF R4-2316914, RAN4 agreed to configure the propogation condition and antenna configuration for 8Rx tests:*

* *Rank 2, 2x8, MCS 19: TDLC300-100 ULA Medium B (α = 0.3, β = 0.005154)*
* *Rank 4, 4x8, MCS 17: TDLA30-10 Low*
* *Rank 8, 8x8, MCS 17: TDLA30-10 Low*

Observation and Proposal from Apple:

* **Observation #1:** Current work in this work item has heavily leveraged the precedent of LTE 8Rx discussion, including applicability rules and how demodulation requirements have been defined based on previous requirements.
* **Observation #2:** Under current 8Rx applicability rules, an 8Rx UE is still subject to provide 2Rx and 4Rx functionality for proper conformance testing, in addition to 8Rx functionality.
* **Observation #3:** Under current PDSCH performance requirements, the antenna correlation for 8Rx is chosen to be ULA Low. Even though the WI assumes a CPE type of device, this may impose severe restrictions to potential small form factor 8Rx UEs that may be manufactured in the future, and such low antenna correlation may not be always achieved in practice.
* **Proposal #3:** RAN4 to discuss during the last session of this WI how to improve the technical fundamentals of the specification of 8Rx requirements based on Observations #1 to #3.

Moderator: There are long discussion about the selection of antenna correlation among ULA Low, ULA Medium A and Medium B for 8Rx test during RAN4#106 meeting. Some companies raised the higher antenna correlation should be considered even for CPE/FWA/vehicle/industrial devices with the antenna number increased from 2 to 8, but at the same time, company think that low rank is mostly scheduled for Medium A/B of higher antenna correlation, as last test for Rank 2 with Medium B is agreed.

* Proposals
	+ Option 1: Further discuss the Medium antenna correlation selection for Rank 4 and Rank 8 for 8Rx test (Apple)
	+ Option 2: No needed.
* Recommended WF
	+ TBD.

# Topic #2: PDSCH requirmeents

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2318044**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318044.zip) | Discussion on PDSCH Demodulation Requirements for 8Rx | Nokia, Nokia Shanghai Bell | [**Proposal 1:** RAN4 shall define requirements with Rank2 for ‘Hybrid’ bands, alignment to occur at RAN4#109](#_Toc149750581)[**Proposal 2:** RAN4 shall use prior results from Nokia on Rank8 cases, as these had PUCCH HARQ ACK bundling disabled.](#_Toc149750582)[**Proposal 3:** RAN4 shall create a new clause 5.2A.4 in TS 38.101-4 to capture 8Rx CA Requirements.](#_Toc149750583)[**Proposal 4:** RAN4 shall include requirements for both Rank 2 and Rank 8 within the same respective FDD and TDD tables within the new clause 5.2A.4 of TS 38.101-4.](#_Toc149750584)[**Proposal 5:** RAN4 shall add a note shall to a new table “Table 5.2A.4.1-3: Minimum performance for multiple CA configurations” to state that “For CA combinations between 8Rx and 4Rx or 2Rx, Rank 2 requirements in Tables 5.2A.4.1-1 and 5.2A.4.1-2 shall be applied for both CCs.”](#_Toc149750585)[**Proposal 6:** RAN4 shall add a note shall to a new table “Table 5.2A.4.1-3: Minimum performance for multiple CA configurations” to state that “For CA Combinations with two 8Rx CCs, Rank 8 requirements in Tables 5.2A.4.1-1 and 5.2A.4.1-2 shall be applied for both CCs.”](#_Toc149750586) |
| [**R4-2318045**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318045.zip) | Supporting Simulation results for PDSCH demodulation for 8Rx | Nokia, Nokia Shanghai Bell | Simulation results |
| [**R4-2318663**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318663.zip) | Discussion on PDSCH requirements for 8Rx UE | MediaTek inc. | ***Observation 1***: The spans for the alignment results are quite large, which are “2.8dB for rank2” and “3.7dB for rank 4”.**Proposal 1**: Remove the smallest and largest values in alignment results to make the span smaller than 2.5dB. |
| [**R4-2318672**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318672.zip) | On the PDSCH Demodulation Requirements for 8Rx UEs in FR1 | Apple |  |
| R4-2318675 | Summary of Simulation Results for 8Rx Demodulation Requirements | Apple | Simulation results |
| R4-2319226 | Simulation results collection for 8 Rx UE demodulation requirements | Ericsson | Summary of simulation results from all interesting companies |
| [**R4-2319333**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319333.zip) | discussion and simulation results on 8Rx PDSCH requirements | Samsung | Simulation results.**Observation 1:** The SNR differences between the minimum and maximum bandwidths are no more than 1dB for both rank 2 and rank 8 scenarios. |
| [**R4-2319389**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319389.zip) | Discussion on PDSCH CA requirements for UE with 8Rx: Simulation results | China Telecom | Simulation results |
| [**R4-2319535**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319535.zip) | Simulation results for PDSCH demodulation requirements for 8Rx CA | ZTE Corporation | Simulation results |
| [**R4-2319705**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319705.zip) | 8Rx for CPE/FWA/vehicle/industrial devices: Demodulation requirements | QUALCOMM Europe Inc. - Spain | **Proposal 1:** RAN4 to consider 1.5 dB as margin for spec. requirements. |
| [**R4-2320189**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320189.zip) | Discussions on remain issues on 8Rx PDSCH requirements | Huawei, HiSilicon | Observation 3: It has been agreed that PDSCH is not scheduled in special slot, so for the existing k1 values table for CA test, the k1 value for special slot for TDD SCell for TDD Pcell + TDD Scell configuration should be removed.Proposal 5: Use the updated k1 values in Table 2-2 for 8Rx CA test.Proposal 6: Use number of HARQ processes listed in Table 2-3 for 8Rx CA test. |
| [**R4-2320190**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320190.zip) | Simulation results on 8Rx PDSCH requirements | Huawei, HiSilicon | Simulation results |
| [**R4-2320412**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320412.zip) | 8Rx for CPE/FWA/vehicle/industrial devices: Demodulation requirements | QUALCOMM Europe Inc. - Spain | **Proposal 1:** RAN4 to allow 3dB span for 8Rx demod. requirements. **Proposal 2:** RAN4 to consider 1.5 dB as margin for demod. requirements. |

## Open issues summary

### Sub-topic 2-1 CA requirments

**Issue 2-1-1: K1 value**

Observation 3 (Huawei): It has been agreed that PDSCH is not scheduled in special slot, so for the existing k1 values table for CA test, the k1 value for special slot for TDD SCell for TDD Pcell + TDD Scell configuration should be removed.

* Proposals
	+ Option 1: Use the following updated K1 value for 8Rx CA test (Huawei)

|  |  |  |
| --- | --- | --- |
| * The number of slots between PDSCH and corresponding HARQ-ACK information
 | CCs with the same duplex mode and SCS with Pcell | CCs with different duplex mode and/or SCS with Pcell |
| FDD 15 kHz + TDD 30 kHz CA | FDD PCell | {2} | {2} |
| TDD PCell | For CC with Rank 2 {8,7,6,5,5,4,3,11}For CC with Rank 8 {8,7,6,5,5,4,3} | {7,5,4,11,9} |
| FDD 15 kHz + FDD 15 kHz CA | FDD PCell | {2} | N/A |
| TDD 30 kHz + TDD 30 kHz CA | TDD PCell | For CC with Rank 2{8,7,6,5,5,4,3,2}For CC with Rank 8{8,7,6,5,5,4,3} | N/A |

* + Other options.
* Recommended WF
	+ TBA

**Issue 2-1-2: Number of HARQ process**

* Proposals
	+ Option 1: Use the following updated number of HARQ process for 8Rx CA test (Huawei)

|  |  |  |
| --- | --- | --- |
| 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 | For CC with Rank 2: 10For CC with Rank 8: 8 | 8 |
| FDD 15 kHz + FDD 15 kHz CA | FDD PCell | 4 | N/A |
| TDD 30 kHz + TDD 30 kHz CA | TDD PCell | 8 | N/A |

* + Other option
* Recommended WF
	+ TBA

**Issue 2-1-3: Specification structure to capture 8Rx CA requirements**

* Proposals
	+ Option 1: (Nokia) ref. to R4-2318049 for details
		- Create a new clause 5.2A.4 in TS 38.101-4
		- Include requirements for both Rank 2 and Rank 8 within the same table for FDD and TDD respectively
		- Add the following notes in the new tables for FDD and TDD 8Rx CA requirements
			* NOTE X: For CA combinations between 8Rx and 4Rx or 2Rx, Rank 2 requirements in Tables 5.2A.4.1-1 and 5.2A.4.1-2 shall be applied for both CCs.
			* NOTE Y: For CA Combinations with two 8Rx CCs, Rank 8 requirements in Tables 5.2A.4.1-1 and 5.2A.4.1-2 shall be applied for both CCs.
	+ Other option
* Recommended WF
	+ TBA

### Sub-topic 2-2 Simulation results alignment

**Issue 2-2-1: How to align the ideal results alignment**

* Proposals
	+ Option 1: Remove the smallest and largest values in alignment results to make the span smaller than 2.5dB (MTK)
	+ Option 2: Remove the farthest outlier from the average results (assumption from NR BS Rel-15)
	+ Option 2: Set the max allowed span to 3dB (QC)
* Recommended WF
	+ TBA

**Issue 2-2-2: Additional margin to be added on top of the averaged impairment results for requirements derivation**

* Proposals
	+ Option 1: 0.8 for 64QAM (assumption from NR UE Rel-15)
	+ Option 2: 1.5dB (QC)
* Recommended WF
	+ TBA

# Topic #3: SDR and CQI requriements

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2318043**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318043.zip) | Discussion on 8Rx general demodulation aspects | Nokia, Nokia Shanghai Bell | [**Observation 1:** The Big CR process for 8Rx SDR and CQI is now stable.](#_Toc149819124)[**Observation 2:** There are no further open issues for 8Rx SDR and CQI.](#_Toc149819125)[**Proposal 3:** RAN4 shall inform the chair that the 8Rx SDR and CQI work activity in Rel-18 has completed and these agenda items could be closed for future meetings.](#_Toc149819126) |
| [**R4-2318673**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318673.zip) | Discussion on SDR Requirements for 8Rx Ues | Apple | **Proposal #1:** RAN4 to confirm during RAN4#109 that by reusing the existing methodology of Re-15 SDR CA test, no more open items are to be discussed and therefore, the SDR agenda item should be closed. |
| [**R4-2318674**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318674.zip) | Discussion on CSI Requirements for 8Rx Ues | Apple | **Proposal#1:** RAN4 to confirm during RAN4#109 that since no more open items are to be discussed, and therefore, the CSI agenda item should be closed. |

## Open issues summary

### Sub-topic 3-1 SDR and CQI requirements

**Issue 3-1-1: Agenda items for SDR and CQI**

* Proposals
	+ Option 1: No more open issues for 8Rx SDR and CQI tests, the corresponding agenda item should be closed (Nokia, Apple)
	+ Other option.
* Moderator: As per the current work progress, no more open issues are left for 8Rx SDR and CQI test. Before the WI is closed, even the AI is kept in the meeting agenda, it doesn’t mean that companies must have contributions on that.
* Recommended WF
	+ Confirm no more open issues for 8Rx SDR and CQI tests.
	+ The agenda items for 8Rx SDR and CQI tests can be closed

# Topic #4: CRs

## Draft CRs for 8Rx

Moderator: companies are encouraged to check the recommendation for each contributions.

As per the agreements in RAN4#108bis, if no further updates, resubmission of draft CR is not recommended. Otherwise it is encouraged to highlight the updates to facilitate the contribution review.

Background: the endorsed draft big CR post RAN4#108bis: R4-2316979 Draft Big CR on 38.101-4 for introduction of 8Rx performance requirements (Huawei, HiSilicon)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** | **Recommendation** |
| [**R4-2318049**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318049.zip) | Introduction of 8Rx Applicability Rule | Nokia, Nokia Shanghai Bell | Depends on the discussion on 8Rx CA applicability rules during this meeting | TBD |
| [**R4-2318050**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318050.zip) | Introduction of 8Rx CA Performance Requirements | Nokia, Nokia Shanghai Bell | Introduction of 8Rx CA performance requirementsTitle in the coversheet is incorrectMCS 19 for Rank 2 and coding rate is 0.5  | Revise |
| [**R4-2318668**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318668.zip) | Draft CR to 38.101-4 Reference measurement channels for 8Rx CA PDSCH requirements (FDD, 8 layers) | MediaTek inc. | FRC for FDD 8 layersNo Rank 4 for 8Rx CA as per RAN4#108bis R4-2316914 agreement. | TBD |
| R4-2318676 | draftCR on FRC for 8Rx UEs TDD 2 layers in CBW 5MHz to 30MHz | Apple | FRC for TDD 2 layersNot available |  |
| R4-2318677 | draftCR on FRC for 8Rx UEs TDD 2 layers in CBW 40MHz to100MHz | Apple | FRC for TDD 2 layersNot available |  |
| [**R4-2319228**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319228.zip) | Draft CR to 38.101-4 for FRC for FDD 8 layers (30MHz,35MHz,40MHz, 45MHz, 50MHz) | Ericsson | FRC for FDD 8 layers (30MHz,35MHz,40MHz, 45MHz, 50MHz)Rank 4 is used | Revise |
| [**R4-2319229**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319229.zip) | Draft CR to 38.101-4 for FRC for TDD 8 layers (5MHz,10MHz,15MHz,20MHz,25MHz,30MHz) | Ericsson | FRC for TDD 8 layers (5MHz,10MHz,15MHz,20MHz,25MHz,30MHz)Rank 4 is used | Revise |
| [**R4-2319230**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319230.zip) | Draft CR to 38.101-4 for FRC for FDD 2 layers (5MHz, 10MHz, 15MHz,20MHz,25MHz) | Ericsson | FRC for FDD 2 layers | TBD |
| [**R4-2319330**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319330.zip) | Draft CR on 8Rx PDSCH demodulation requirements | Samsung | Updated SNR requirementsNeed to revise to capture the latest SNR requirements as per the latest submitted and aligned results | Revise |
| [**R4-2319331**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319331.zip) | Draft CR on FRC for TDD 8 layers (40-100MHz) | Samsung | FRC for TDD 8 layersRank 4 is used | Revise |
| [**R4-2319388**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319388.zip) | Draft CR on 8Rx PDSCH CA requirements FRC for FDD 2 layers | China Telecom | FRC for FDD 2 layersFRC applicability is specified in the minimum performance requirements table | TBD |
| [**R4-2320191**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320191.zip) | CR on 38.101-4 Introduction of applicability rules for 8Rx CA requirements | Huawei,HiSilicon | Applicability rules for 8Rx CA | TBD |
| **R4-232XXXX** | Big CR for TS 38.101-5 Introduction of 8Rx performance requirements | Huawei, HiSilicon | Capture the latest agreements reached during this meeting | For email approval |

### Test cases for 8Rx CA

|  |  |  |  |
| --- | --- | --- | --- |
| **Test case** | **Duplex mode** | **Performance requirements** | **FRC** |
| 2Rx: Rank 2(2x2) | FDD 15kHz SCS | Reuse Table 5.2A.2.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations (2x2) | Reuse the existing the FRC |
| TDD 30kHz SCS | Reuse Table 5.2A.2.1-3 Single carrier performance for TDD 30 kHz SCS for CA configurations (2x2) | Reuse the existing the FRC |
| 4Rx: Rank 2(2x4) | FDD 15kHz SCS | Reuse Table 5.2A.3.1-1: Single carrier performance for FDD 15 kHz SCS for CA configurations (2x4) | Reuse the existing the FRC |
| TDD 30kHz SCS | Reuse Table 5.2A.3.1-3: Single carrier performance for TDD 30 kHz SCS for CA configurations (2x4) | Reuse the existing the FRC |
| 8Rx: Rank 2(2x8) | FDD 15kHz SCS | New single carrier performance for MCS 19 and CBW: 5/15/20/25/30/35/40/45/50 MHzReuse requirements for 10MHz CBW defined in Table 5.2.4.1.1-3 for single carrier (ref to R4-2316979) | New FRC except 10MHz (ref to Table A.3.2.1.1-3 in TS 38.101-4) |
| TDD 30kHz SCS | New single carrier performance for CBW: 5/10/15/20/25/30/50/60/80/90/100 MHzReuse requirements for 10MHz CBW defined in Table 5.2.4.2.1-3 for single carrier (ref to R4-2316979) | New FRC except 40MHz (ref to Table A.3.2.2.2-3 in TS 38.101-4) |
| 8Rx: Rank 8(8x8) | FDD 15kHz SCS | New single carrier performance for CBW: 5/15/20/25/30/35/40/45/50 MHzReuse requirements for 10MHz CBW defined in Table 5.2.4.1.1-5 for single carrier (ref to R4-2316979) | New FRC except 10MHz |
| TDD 30kHz SCS | New single carrier performance for CBW: 5/10/15/20/25/30/50/60/80/90/100 MHzReuse requirements for 40MHz CBW defined in Table 5.2.4.1.2-5 for single carrier (ref to R4-2316979) | New FRC except 40MHz |

### CR work split for 8Rx CA

|  |  |  |
| --- | --- | --- |
| **Section** | **Test case** | **Company** |
| 5.1.1.7 | CA applicability rules  | Huawei |
| 5.2A.4 (New) | 8Rx CA performance requirements | Nokia, Nokia Shanghai Bell |
| A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1 | FRC for FDD 15kHz SCS 2 layers (5MHz, 10MHz?, 15MHz,20MHz,25MHz) : MCS19 | Ericsson |
| FRC for FDD 15kHz SCS 2 layers (30MHz,35MHz,40MHz, 45MHz, 50MHz): MCS 19 | China Telecom |
| A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1 | FRC for TDD 30kHz SCS 2 layers (5MHz,10MHz,15MHz,20MHz,25MHz,30MHz): MCS 19 | Apple |
| FRC for TDD 30kHz SCS 2 layers (40MHz?,50MHz,60MHz,80MHz,90MHz,100MHz): MCS 19 | Apple |
| A.3.2.1.1 Reference measurement channels for SCS 15 kHz FR1 | FRC for FDD 15kHz SCS 8 layers (5MHz, 10MHz, 15MHz,20MHz,25MHz) : MCS17 | MTK |
| FRC for FDD 15kHz SCS 8 layers (30MHz,35MHz,40MHz, 45MHz, 50MHz): MCS 17 | Ericsson |
| A.3.2.2.2 Reference measurement channels for SCS 30 kHz FR1 | FRC for TDD 30kHz SCS 8 layers (5MHz,10MHz,15MHz,20MHz,25MHz,30MHz): MCS 17 | Ericsson |
| FRC for TDD 30kHz SCS 8 layers (40MHz,50MHz,60MHz,80MHz,90MHz,100MHz): MCS 17 | Samsung |

## Draft CRs for 4Tx

Moderator: companies are encouraged to check the recommendation from moderator for each contributions.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** | **Recommendation** |
| [**R4-2318051**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318051.zip) | Disucssion on 4Tx Demodulation | Nokia, Nokia Shanghai Bell | **Observation 1**: The BigCR process for 4Tx is now stable and completed.**Observation 2:** There are no further open issues for 4Tx.**Proposal 1:** RAN4 shall inform the chair that all 4Tx work activity is complete and that for future the agenda item can be closed. | NotedUsually the AI is kept before the WI is closed, but it doesn’t mean that company must have contributions under it |
| [**R4-2319528**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319528.zip) | CR to TS 38.141-1 for supporting of 4Tx in R18 | ZTE Corporation |  | Withdrawn |
| [**R4-2319710**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319710.zip) | Correction on draft BtoigCR 38.141-1 NR\_ENDC\_RF\_FR1\_enh2-Perf 4Tx demod | Keysight Technologies UK Ltd | Correct to endorsed draft big CR R4-2317012 | Agreeable |
| [**R4-2319812**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319812.zip) | CR to TS 38.141-1 for supporting of 4Tx in R18 | ZTE Corporation | Added CR number 0396 in the coversheet compared to R4-2319528Added the FRC and SNR requirements compared to R4-2309801 | Agreeable |
| [**R4-2320157**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320157.zip) | Draft CR to TS 38.141-1: FRC table for 4Tx PUSCH demodulation requirement | NEC | Correct to the FRC table in endorsed draft CR R4-2317012 | Merged into R4-2319710 |
| [**R4-2319317**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319317.zip) | Big CR for 38.104 on 4Tx PUSCH demodulation requirements | Ericsson | Formal big CR for TS 38.104New updates compared to the draft big CR R4-2315043 endorsed after RAN4#108bis:1. Remove [ ] on FRC index in 8.2.1
2. Adjust SNR value according to R4-2312066
 | Agreeable |
| [**R4-2319850**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319850.zip) | Big CR for TS 38.141-2 on 4Tx demodulation requirements | Samsung | Formal big CR for TS 38.141-2:CR number 0558 is missing | Withdrawn?Revised? |
| R4-232xxxx | Big CR for TS 38.141-2 on 4Tx demodulation requirements | Samsung | Formal big CR for TS 38.141-2 | New Tdoc is needed |
| R4-232xxxx | Big CR for TS 38.141 | Huawei, HiSilicon | Updates to the endorsed draft big FR R4-2317012: * Replace R4-2309801 with R4-2319812 (if endorsed)
* Merge R4-2319710 (if endorsed)
 | New Tdoc is needed |