**3GPP TSG-RAN WG4 Meeting #97-e R4-20xxxxx**

**Electronic Meeting, 2-13 Nov., 2020**

**Agenda item:** 7.16

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for [97e][328] NR\_perf\_enh\_Demod

**Document for:** Information

# Introduction

This email thread discusses the NR Rel-16 demodulation performance requirements in agenda 7.16.

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

* 1st round: Invite companies to review the recommended WF in section 1~6, and provide comments (if any) in section 1.3, 2.3, 3.3, 4.3, 5.3 and 6.3.
* 2nd round: TBA

# Topic #1: Release independent aspect

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014253 | Apple | Observation #1: Test setup for PMI reporting with Type II is still under discussion in RAN4  Observation #2: With MU-MIMO test setup the test metric for PMI reporting with Type II would be different than what is used in Rel-15 PMI reporting tests  Proposal #1: Do not define PMI reporting requirements with Type II codebook as release independent from Rel-15. |
| R4-2014501 | China Telecom | Draft CR for TS 38.307 on UE demodulation performance requirements (Rel-15) |
| R4-2014502 | China Telecom | Draft CR for TS 38.307 on UE demodulation performance requirements (Rel-16) |
| R4-2015316 | NTT DOCOMO, INC. | Observation 1: In case UE is tested with CA configurations that defined as release independent from release 15, TDD power imbalance requirements for FR1 intra-band contiguous CA can be treated as release independent from release 15.  Observation 2: In case UE is tested with EN-DC configurations that defined as release independent from release 15, FDD power imbalance requirements for FR1 intra-band contiguous EN-DC and that of TDD can be treated as release independent from release 15.  Observation 3: Only the power imbalance requirements for CA/EN-DC configurations that are defined as release independent from release 15 can be release independent from release 15.  Proposal 1: Define the power imbalance requirements for CA/EN-DC as release independent from release 15. |
| R4-2015663 | Huawei, HiSilicon | Proposal 1: It is feasible to enable PMI reporting test for Rel-15 type II codebook to be release independent from Release 15.  Proposal 2: The CA/EN-DC power imbalance requirements only for those intra-band contiguous CA configurations, intra-band contiguous and non-contiguous EN-DC configurations defined as release independent from release 15 in TS 38.307 can be defined as release independent from Release 15.  Proposal 3: The CA CQI reporting requirements for those CA configurations defined as release independent from release 15 in TS 38.307 can be defined as release independent from Release 15. |
| R4-2015822 | Ericsson | Observation 1: Rel-15 PMI type II codebook reporting requirement can be release independent from Rel-15.  Observation 2: Supporting Rel-15 PMI type II codebook is optional according to TS38.306.  Proposal 1: Rel-15 PMI type II codebook reporting requirement is release independent from Rel-15.  Proposal 2: CA/EN-DC power imbalance requirement is release independent from Rel-15.  Proposal 3: CA CQI reporting requirements is release independent from Rel-15. |

## Open issues summary

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

**Issue 1-1-1: Release independent issue for type II PMI**

* Proposals
  + Option 1: Release independent from Rel-15 (HW, E///)
  + Option 2: Not release independent from Rel-15 (Apple)
    - Apple: Test setup for PMI reporting with Type II is still under discussion in RAN4. With MU-MIMO test setup the test metric for PMI reporting with Type II would be different than what is used in Rel-15 PMI reporting tests.
* Recommended WF
  + Check if option 1 can be agreeable based on more companies’ feedback.

**Issue 1-1-2: Release independent issue for CA and EN-DC power imbalance**

* Proposals
  + Option 1: Release independent from Rel-15 (DCM, HW, E///)
    - HW: The CA/EN-DC power imbalance requirements only for those intra-band contiguous CA configurations, intra-band contiguous and non-contiguous EN-DC configurations defined as release independent from release 15 in TS 38.307 can be defined as release independent from Release 15.
* Recommended WF
  + Can we agree option 1 with the additional clarification from Huawei?

**Issue 1-1-3: Release independent issue for CA CQI**

* Proposals
  + Option 1: Release independent from Rel-15 (HW, E///)
    - HW: The CA CQI reporting requirements for those CA configurations defined as release independent from release 15 in TS 38.307 can be defined as release independent from Release 15.
* Recommended WF
  + Can we agree option 1 with the additional clarification from Huawei?

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Company A | Issue 1-1-1: Release independent issue for type II PMI  Issue 1-1-2: Release independent issue for CA and EN-DC power imbalance  Issue 1-1-3: Release independent issue for CA CQI |
| China Telecom | Issue 1-1-1: Release independent issue for type II PMI  Option 1. It is clear that the requirements are developed for Rel-15 type II codebook.  Issue 1-1-2: Release independent issue for CA and EN-DC power imbalance  OK with the recommended WF.  Issue 1-1-3: Release independent issue for CA CQI  OK with the recommended WF. |
| Apple | Issue 1-1-1: Release independent issue for type II PMI  We prefer option 2. We understand that requirements apply to Rel-15 Type II codebook, but UE might risk failing the test if it has not been tested during development in MU-MIMO setup with different test metric. We can discuss this after test setup for Type II codebook is agreed.  Issue 1-1-2: Release independent issue for CA and EN-DC power imbalance  We are ok with recommended WF  Issue 1-1-3: Release independent issue for CA CQI  We are ok with recommended WF |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2014501, Rel-15 38.307 draft CR, CTC | Company A: |
| Company B: |
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| R4-2014502, Rel-16 38.307 draft CR, CTC | Company A: |
| Company B: |
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Note: To save time on typing the comments one by one, companies can also directly revise the draft CR and upload the revision in the draft inbox.

## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
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*Recommendations on WF/LS assignment*

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

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

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

## Discussion on 2nd round

## Summary on 2nd round

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

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014498 | China Telecom | For the test of different CA capabilities:  Proposal 1: For the test of different CA capabilities, option 2 is preferred, and option 3 is acceptable.  For the Selection of CA configuration(s) and CBW combination:  Observation 1: Although not challenging, the support 2 MIMO layers is still up to UE capability reporting, it is not harm to first ensure that layer 2 can be supported by each tested CC.  Observation 2: The capability of supportedModulationOrderDL and scalingFactor can be reflected in the final max data rate calculation.  Observation 3: To accommodate the FR2 testability, the approach which excludes the CA configurations that are not testable in the beginning is better.  Proposal 2: For selection of CA configuration(s) and CBW combination:  For FR1, for each CA duplex mode and each CA capability selected for testing (i.e., intra-band contiguous CA, intra-band non-contiguous CA, inter-band CA, inter-band CA with the largest number of bands)   * Step 1: Select the CA configuration(s) satisfying the following conditions:   + 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 CA duplex mode and each CA capability selected for testing (i.e., intra-band contiguous CA, intra-band non-contiguous CA, inter-band CA, inter-band CA with the largest number of bands)   * Step 0: Select CA configuration(s), which contain CBW combination(s) with SNRTEmax higher or equal to SNRreq, among all supported CA configurations. * Step 1: Among the selected CA configuration(s) in step 0, select the CA configuration(s) satisfying the following conditions:   + 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: 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. |
| R4-2014549 | Intel Corporation | Proposal 1: Consider the following CA capabilities for NR Normal CA testing: Intra-band contiguous CA, Intra-band non-contiguous CA and Inter-band CA with CA bandwidth combination the largest data rate.  Proposal 2: Use the following approach for selection of CA configuration for NR FR1 Normal CA testing for each CA capability:   * Step 1: Select CA configurations with maximum number of CCs, on which UE capability field *maxNumberMIMO-LayersPDSCH* is higher or equal to νLayersreq, among all supported CA configurations * Step 2: Select any one of CA configurations, which contain CBW combination with the largest data rate not lower than *DataRatereq*, among all the selected CA configurations from Step 1.   Proposal 3: Use the following approach for selection of CA configuration for NR FR2 Normal CA testing for each CA capability:   * 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 *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 lower than *DataRatereq* and aggregated bandwidth with SNRTEmax higher or equal to SNRreq, among all the selected CA configurations from Step 2. |
| R4-2014550 | Intel Corporation | CR on FRC for Normal NR CA requirements (Resubmission of endorsed Draft CR R4-2012696) |
| R4-2014729 | CMCC | (DraftCR has been endorsed in RAN4 #96-e R4-2012693) |
| R4-2014730 | CMCC | *Proposal 1: If Pcell in both carriers are supported for TDD 15 kHz + TDD 30 kHz, configure 15 kHz SCS cell as Pcell.*  *Proposal 2: It is proposed that:*   * + - *Intra-band CA: test intra-band contiguous CA, and intra-band non-contiguous CA*     - *Inter-band CA: test inter-band CA with the largest number of bands and inter-band CA with the largest aggregated CBW*     - *If the selection of “inter-band CA with the largest number of bands” and “inter-band CA with the largest aggregated CBW” results in the same CA configuration(s), only one inter-band CA configuration will be tested; otherwise, two inter-band CA configurations will be tested.*   *Proposal 3: There is no need to consider maxNumberMIMO-LayersPDSCH, supportedModulationOrderDL and scalingFactor.* |
| R4-2015312 | NTT DOCOMO, INC. | Proposal 1 (1st priority):   * + 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 2 (2nd priority):   * + Intra-band CA: test intra-band contiguous CA, and intra-band non-contiguous CA   + Inter-band CA: test inter-band CA with the largest number of bands and inter-band CA with the largest aggregated CBW     - If the selection of “inter-band CA with the largest number of bands” and “inter-band CA with the largest aggregated CBW” results in the same CA configuration(s), only one inter-band CA configuration will be tested; otherwise, two inter-band CA configurations will be tested. |
| R4-2015655 | Huawei, HiSilicon | Proposal 1:   * Intra-band CA: test intra-band contiguous CA, intra-band non-contiguous CA * Inter-band CA:   + test inter-band CA with the largest number of bands     - If more than one inter-band CA configurations with the largest number of bands, any one of inter-band CA configurations with the largest aggregated CBW can be selected for test   Proposal 2: No need to consider *maxNumberMIMO-LayersPDSCH, supportedModulationOrderDL and scalingFactor* inNR CA normal demodulation performance requirements  Proposal 3: Adopt the following test applicability rule for selection of CA configurations and CBW combination for test:   * + For intra-band contiguous CA and intra-band non-contiguous CA with same numerology, for each supported SCS     - Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination for certain selected CA duplex mode     - If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs   + For intra-band contiguous CA and intra-band non-contiguous CA with different numerology, as per the PCell configuration for the test     - Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination for certain selected CA duplex mode     - If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs   + For inter-band CA, as per the PCell configuration for the test     - Select any one of the supported CA configurations with the largest number of bands aggregated       * If more than one inter-band CA configurations with the largest number of bands, any one of inter-band CA configurations with the largest aggregated CBW can be selected for test |
| R4-2015656 | Huawei, HiSilicon | (draftCR R4-2012694 was endorsed in RAN4#96-e meeting) |
| R4-2016003 | Intel Corporation |  |
| R4-2016512 | Qualcomm Incorporated | CR on FR2 PDSCH CA Requirements (Draft CR R4-2012695 was endorsed in last meeting with this change: FR2 PDSCH CA requirements are not defined.) |

## Open issues summary

### Sub-topic 2-1: Test of different CA capabilities

**Issue 2-1: Test of different CA capabilities**

* *Agreement in RAN4 #96e (R4-2012688, 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 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 3:*
    - *Intra-band CA: test intra-band contiguous CA, and intra-band non-contiguous CA*
    - *Inter-band CA: test inter-band CA with the largest number of bands and inter-band CA with the largest aggregated CBW*
      * *The details are to be discussed*
      * *If the selection of “inter-band CA with the largest number of bands” and “inter-band CA with the largest aggregated CBW” results in the same CA configuration(s), only one inter-band CA configuration will be tested; otherwise, two inter-band CA configurations will be tested.*
  + *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 (HW)
    - HW: if UE can support inter-band CA with larger number of bands, it definitely can support and pass the related performance requirements for inter-band CA with smaller number of bands.
    - CTC: Concern on option 1: for example, one UE supports CA configurations CA\_n78A-n79A with 200MHz max aggregated CBW and CA\_n1A-n3A-n78A with 150 MHz max aggregated CBW. If only the CA capability with the largest number of bands, i.e., CA configuration CA\_n1A-n3A-n78A is tested, there will be no tests for CA\_n78A-n79A with 200MHz aggregated CBW.
  + Option 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 bands (CTC first priority, DCM first priority).
  + Option 3 (CTC second priority, CMCC, DCM second priority)
    - Intra-band CA: test intra-band contiguous CA, and intra-band non-contiguous CA
    - Inter-band CA: test inter-band CA with the largest number of bands and inter-band CA with the largest aggregated CBW
      * If the selection of “inter-band CA with the largest number of bands” and “inter-band CA with the largest aggregated CBW” results in the same CA configuration(s), only one inter-band CA configuration will be tested; otherwise, two inter-band CA configurations will be tested.
  + Option 4: Intra-band contiguous CA, Intra-band non-contiguous CA and Inter-band CA with CA bandwidth combination the largest data rate. (Intel, new option proposed in this meeting)
    - Intel: Scenario with the largest aggregated CBW may not correspond to scenarios with the largest supported data rate and, if UE does not support Rank 2 with 16QAM transmission for such aggregated channel bandwidth.
* Recommended WF
  + Can we go with option 3 as a compromise to conclude this issue on time?

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

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

* *Agreement in RAN4 #96e (R4-2012688, WF)*
  + *Options for further discussion*
    - *Option 1: Proposal 7 in R4-2009579*
    - *Option 2: Proposal 6 in R4-2011010*
    - *Option 3: Proposals 5 and 6 in R4-2009730*
    - *Other options are not precluded*
  + *Way forward*
    - *Companies are encouraged to provide the comments on the following questions:*
      * *Whether to consider maxNumberMIMO-LayersPDSCH, supportedModulationOrderDL and scalingFactor, since only 16QAM and rank 2 are used?*
      * *If yes for the above bullet, align the understanding of these capability based on 38.306, such as, applied per CC, per band or in the final data rate calculation?*
      * *Which option is better to accommodate the FR2 testability?*
* **Proposed answers to the three questions:**
  + Q1: Whether to consider *maxNumberMIMO-LayersPDSCH*, *supportedModulationOrderDL* and *scalingFactor*, since only 16QAM and rank 2 are used?
    - Option 1 (CTC, Intel):
      * Although not challenging, the support 2 MIMO layers is still up to UE capability reporting, it is not harm to first ensure that layer 2 can be supported by each tested CC.
      * The capability of *supportedModulationOrderDL* and *scalingFactor* can be reflected in the final max data rate calculation.
    - Option 2 (CMCC, HW): no need to consider *maxNumberMIMO-LayersPDSCH*, *supportedModulationOrderDL* and *scalingFactor*.
  + Q2: If yes for the above bullet, align the understanding of these capability based on 38.306, such as, applied per CC, per band or in the final data rate calculation?
    - Option 1 (CTC):
      * *maxNumberMIMO-LayersPDSCH* : per CC
      * max data rate calculation: per band
  + Q3: Which option is better to accommodate the FR2 testability?
    - Option 1 (Intel, CTC): The approach which excludes the CA configurations that are not testable in the beginning is better.
* **Proposals for Selection of CA configuration(s) and CBW combination:**
  + Option 1 (China Telecom):

For FR1, for each CA duplex mode and each CA capability selected for testing

* Step 1: Select the CA configuration(s) satisfying the following conditions:
  + 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 CA duplex mode and each CA capability selected for testing

* Step 0: Select CA configuration(s), which contain CBW combination(s) with SNRTEmax higher or equal to SNRreq, among all supported CA configurations.
* Step 1: Among the selected CA configuration(s) in step 0, select the CA configuration(s) satisfying the following conditions:
  + 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: 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.
  + Option 2 (Intel)

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

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

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

* 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 *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 lower than *DataRatereq* and aggregated bandwidth with SNRTEmax higher or equal to SNRreq, among all the selected CA configurations from Step 2.
  + Option 3 (HW)
  + For intra-band contiguous CA and intra-band non-contiguous CA with same numerology, for each supported SCS
    - Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination for certain selected CA duplex mode
    - If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs
  + For intra-band contiguous CA and intra-band non-contiguous CA with different numerology, as per the PCell configuration for the test
    - Select any one of the supported CA configurations with the largest aggregated CA bandwidth combination for certain selected CA duplex mode
    - If more than one CA configurations with the same largest aggregated CA bandwidth combination, select the CA configurations with the largest number of CCs
  + For inter-band CA, as per the PCell configuration for the test
    - Select any one of the supported CA configurations with the largest number of bands aggregated
      * If more than one inter-band CA configurations with the largest number of bands, any one of inter-band CA configurations with the largest aggregated CBW can be selected for test
* **Moderator’s observations:**
  + With the same understanding on the UE capability and approach to accommodate FR2 testability, Option 1 and Option 2 are very similar.
  + The difference in Option 3 is related to three questions discussed above.
* **Recommended WF**
  + Can we go with option 1?

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Company A | Issue 2-1: Test of different CA capabilities  Issue 2-2: Selection of CA configuration(s) and CBW combination |
| China Telecom | Issue 2-1: Test of different CA capabilities  Support the recommended WF to address this long-standing issue.  For inter-band CA, it is reasonable to cover both the largest number of bands and the largest aggregated CBW, considering different UE implementations. We have given an example to demonstrate the necessity to cover both, as summarized under option 1 in the summary.  Issue 2-2: Selection of CA configuration(s) and CBW combination  Ok with option 1, based on the analysis of the three identified questions. |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2016003, CR on Applicability rules, Intel (New CR) | China Telecom: have uploaded an revision with our proposed changes in:  https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_97\_e/Inbox/Drafts/%5B97e%5D%5B328%5D%20NR\_perf\_enh\_Demod/CR%20for%20CA%20normal%20PDSCH/Revised%20R4-2016003%20-%20CR%20Applicability%20rules%20Normal%20CA\_CTC.docx |
| Company B: |
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| R4-2014729, CR on FR1 2Rx, CMCC (Draft CR endorsed in R4-2012693) | China Telecom: Propose an editorial update, according to the updated CR from Huawei:  Change “Table 5.2A-2” to “Table 5.2A-**3**” in the first paragraph under section 5.2A.2.1. |
| Company B: |
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| R4-2015656, CR on FR1 4Rx, HW (draft CR endorsed in R4-2012694) | China Telecom: have uploaded an revision with our proposed changes in:  https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_97\_e/Inbox/Drafts/%5B97e%5D%5B328%5D%20NR\_perf\_enh\_Demod/CR%20for%20CA%20normal%20PDSCH/Revised%20R4-2015656%20CR%20for%20NR%20CA%20FR1%204Rx%20PDSCH\_CTC.docx |
| Company B: |
|  |
| R4-2016512, CR on FR2 requirements, QC (Draft CR endorsed in R4-2012695) | Company A: |
| Company B: |
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| R4-2014550, CR on FRC, Intel (Draft CR endorsed in R4-2012696) | Company A: |
| Company B: |
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Note: To save time on typing the comments one by one, companies can also directly revise the draft CR and upload the revisions in the draft inbox.

## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
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*Suggestion on WF/LS assignment*

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

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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## Discussion on 2nd round

## Summary on 2nd round

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

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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# Topic #3: UE PMI reporting requirements with larger number of Tx ports

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014252 | Apple Inc. | Proposal #1: Proposed value for TP gain for defining requirements for PMI reporting for 16,32 TX with Type I PMI   |  |  | | --- | --- | | Antenna Config | TP Gain | | 16x2 | 2 | | 16x4 | 2.5 | | 32x2 | 5.2 | | 32x4 | 6.5 |   Observation #1: With SU-MIMO setup performance with correctly reported Type II PMI is significantly better than incorrect Type II PMI reporting.  Observation #2: With SU-MIMO setup performance of Type II PMI is better than Type I PMI.  Proposal #2: Define PMI reporting requirements in Rel-16 with SU-MIMO test setup for Type II and enhanced Type II codebook.  Observation #3: Antenna correlation of XP-Medium gives better performance than XP-High for Type II PMI reporting.  Observation #4: Subband PMI reporting gives better performance than wideband PMI reporting for Type II PMI reporting.  Observation #5: For SB PMI reporting and XP-Medium antenna correlation, with SB amplitude TRUE gives better performance.  Proposal #3: For Type II codebook, introduce requirements with SU-MIMO test setup with the following assumptions:  Antenna Correlation: XP-Medium  PMI format Indicator: Subband  Subband Amplitude: TRUE  Subband size: 4 for FDD and 8 for TDD  Proposal #4: Implement random PMI with limiting the set of possible beams under the configuration of follow PMI. |
| R4-2014551 | Intel Corporation | Proposal 1: Use the following gamma values for Type I PMI requirements definition   * 16 Tx 2 Rx – 2.0, 16 Tx 4 Rx – 3.0 * 32 Tx 2 Rx – 5.0, 32 Tx 4 Rx – 8.0 |
| R4-2014672 | China Telecom | Proposal 1: For 16 Tx type I subband, for both FDD and TDD, set gamma (gain) values as 2.5 and 3.5 for 2Rx and 4Rx respectively.  Proposal 2: For 32 Tx type I wideband, for both FDD and TDD, set gamma (gain) values as 5.0 and 6.0 for 2Rx and 4Rx respectively.  Proposal 3: On subband size for type II SU-MIMO PMI, slightly prefer 8 for FDD and 16 for TDD. |
| R4-2014746 | Samsung | Observation 1: With SU-MIMO Set-up, we observed around 1dB performance difference among Type II and Type I codebook under XP medium MIMO correlation and 64QAM rank2 transmission.  Observation 2: With MU-MIMO Set-up, the performance of Type II codebook even worse than Type I codebook based on the agreed test parameters.  Furthermore, following proposals given for remaining open issues:  Proposal 1: Overall Test set-up:   * Introduce Rel-15 Type II PMI test cases under SU-MIMO test set-up in Rel-16 timeframe. * Further study and define proper performance requirements if needed under MU-MIMO scenarios in Rel-17 performance enhancement WI.   Proposal 2: Type II Test parameters-codebook (SU-MIMO):   * + SubbandAmplitude: “TRUE”   + PMI-FormatIndicator: “Subband”   + Subbandsize: “8 for FDD and 16 for TDD”   Proposal 2: Type II Test parameters-random PMI generation (SU-MIMO):   * + Random PMI generated following the codebook reporting and construction to random select from full available codebook reporting indices (i1,i2) (which aligned with option 1) .   Proposal 2: Type II Test parameters-MIMO correlation (SU-MIMO): Using XP Medium |
| R4-2014748 | Samsung | Draft CR for introduction of Rel-15 Type II PMI test cases |
| R4-2015657 | Huawei, HiSilicon | Simulation results. |
| R4-2015658 | Huawei, HiSilicon | Proposal 1: For 16 Tx ports, use 2.5 for 2Rx and use 3.5 or 3 for 4Rx  Proposal 2: For 32 Tx ports, use 5 for 2Rx and use 8 for 4Rx  Proposal 3: Use ‘false’ for SubbandAmplitude configuration  Proposal 4: Use ‘Wideband’ for PMI-FormatIndicator configuration  Proposal 5: Choosing XP medium as the MIMO correlation configuration  Observation 1: A common way of doing random PMI for Type II codebook simulation might need to be agreed in order to reach sufficient randomization and meanwhile avoid uncertainty and unexpected results brought by infinite random parameters  Proposal 6: RAN4 needs to discuss and align the definition of Random PMI for Type II codebook before aligning simulation results based on the test metric of TP ratio between Follow PMI and Random PMI |
| R4-2015659 | Huawei, HiSilicon | CR for TS 38.101-4: Applicability for NR PMI requirements with Tx ports larger than 8 and up to 32 |
| R4-2016099 | Ericsson | Simulation results |
| R4-2016100 | Ericsson | Observation 1: The proposed SU-MIMO test cannot be used for Type II CSI reporting since the performance benefit of Type II feedback is not visible. This is due to that SU-MIMO doesn’t take advantage of the rich channel feedback of Type II reporting  Observation 2: Type I codebook is a subset of the Type II codebook, the “Type I subset”  Observation 3: It is difficult to guarantee a minimum performance and benchmark when employing a random type II PMI value to the gNB precoder.  Observation 4: There is practically no performance difference when ‘High’ correlation matrix is employed in the SU-MIMO test  Observation 5: 70% throughput mark shows more gain with Type II codebook over the 90% throughput mark for custom correlation and medium correlation.  Proposal 1: Use 70% throughput mark as reference throughput for gain requirement  Observation 6: The subband size does not distinguish performance to any significant degree  Proposal 2: Configure either 4, or 8 for subband size  Observation 7: The gain when calculated by comparing follow Type II PMI with random Type II PMI has high variance arising from the stochastical behaviour and uncertainty of random PMI precoder selection  Proposal 3: Use Type II follow PMI divided by Type I follow PMI to guarantee performance benefit of Type II codebooks  Proposal 4: Configure medium or custom correlation  Proposal 5: use MCS11 Rank1 for MU-MIMO testing  Proposal 6: use custom correlation for MU-MIMO PMI testing |
| R4-2016434 | Qualcomm Incorporated | Observation 1: There is a significant difference in PMI ratio and SNR needed to reach 90% of peak throughput between Type 2 and Type 1 PMI reporting.  Proposal 1: Use SU-MIMO test setup for defining Type II PMI reporting tests.  Proposal 2: Use subband PMI reporting for defining Type II PMI reporting tests.  Proposal 3: Define Type II PMI reporting requirements with subbandAmplitude = true and XP High correlation.  Proposal 4: Define Type II PMI reporting requirements with larger sub-band size.  Proposal 5: To generate random Type II PMI, limit the set of precoders to the list of precoders under codebook parameters configured for following PMI case. |

## Open issues summary

### Sub-topic 3-1: Type I PMI test

**Issue 3-1-1: Gamma (gain) values**

* *Previous Agreements* 
  + *Agreements in RAN4 #92bis (R4-1912834, WF)*
    - *Test metric: Relative throughput ratio between following PMI and random PMI at SNR point corresponding to 90% TP with follow PMI*
  + *Agreement in RAN4 #95e (R4-2008846, WF)*
    - *Set gamma (gain) values based on simulation results in RAN4#96-e*
  + *Agreement in RAN4 #96e (R4-2012762, WF)*
    - *Further check gain requirements and alignment results*
* Summary of relative TP ratios for 16 Tx subband (the numbers in blue have been updated compared to the numbers at RAN4 #96e)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Duplex Mode | Rx number | Relative TP Ratio (gamma) | | | | | | |
| CTC | QC | Huawei | Ericsson | Samsung | Apple | Intel |
| FDD | 2 | 3.9 | 3.29 | 4.4 | 4.3 | 4.6 | 3.34 | 3.7 |
| 4 | 4.6 | 4.05 | 4.9 | 6.0 | 5.2 | 4.24 | 5.1 |
| TDD | 2 | 2.6 | 4.93 | 4.8 | 4.9 | 4.2 | 2.93 | 3.4 |
| 4 | 3.8 | 5.77 | 4.7 | 4.4 | 5.0 | 3.81 | 5.0 |

* Summary of the relative TP ratios for 32 Tx wideband (the numbers in blue have been updated compared to the numbers at RAN4 #96e)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Duplex Mode | Rx number | Relative TP Ratio (gamma) | | | | | | |
| CTC | QC | Huawei | Ericsson | Samsung | Apple | Intel |
| FDD | 2 | 7.5 | 6.55 | 9.1 | 10.17 | 9.2 | 8.04 | 10.3 |
| 4 | 12.5 | 11.13 | 18.2 | 15.32 | 11.35 | 10.55 | 16.8 |
| TDD | 2 | 17.1 | 5.29 | 11.3 | 9.62 | 9.3 | 10.20 | 11.3 |
| 4 | 25.6 | 9.56 | 21.4 | 13.35 | 14 | 14.02 | 19.7 |

* Proposals on Gamma (gain) values

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Apple | Intel | CTC | Huawei | Samsung |
| 16T2R | 2 | 2.0 | 2.5 | 2.5 | 2.0 |
| 16T4R | 2.5 | 3.0 | 3.5 | 3 or 3.5 | 2.0 |
| 32T2R | 5.2 | 5.0 | 5.0 | 5 | 4.5 |
| 32T4R | 6.5 | 8.0 | 8.0 | 8 | 4.5 |

* Recommended WF
  + For 16Tx, further discuss the Gamma values in the first round
  + For 32Tx, can we go with 5.0 for 2Rx and 8.0 for 4Rx based on majority’s view?

### Sub-topic 3-2: Type II PMI test setup

**Issue 3-2-1: Test setup for type II**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *Test setup:*
    - *Option 1: Only use SU-MIMO test setup, i.e., one tested UE*
    - *Option 2: MU-MIMO based test setup, i.e., one tested UE + one co-scheduled UE (generated by TE)*
    - *Option 3: Using SU-MIMO set-up to Introduce PMI test cases. Meanwhile a MU-MIMO setup based demodulation test with test metric of either follow PMI based or random PMI based throughput can be introduced*
  + *The baseline receiver assumption is UE without interference cancellation capability with/without co-scheduled UE.*
  + *Under the baseline UE receiver assumption, the PMI calculation processing will not change with and without co-scheduled UE.*
  + *The test purpose of such requirements is to verify UE PMI reporting accuracy following NW configuration with RAN1 feature: enhanced type II codebook* 
    - *There is no restriction for gNB scheduling with such requirements.*
    - *RAN4 need to ensure UE reporting PMI follow Type II codebook other than Type I codebook under proper test set-up either with MU-MIMO set-up or SU-MIMO set-up.*
    - *We need to ensure the performance requirements with proper test set-up as receiver implementation agonistic manner i.e. no punishment for advanced receiver with inference cancellation capability.*
* Proposals
  + Option 1: Only use SU-MIMO test setup, i.e., one tested UE (Apple, Samsung, QC)
    - Apple: 1) With SU-MIMO setup performance with correctly reported Type II PMI is significantly better than incorrect Type II PMI reporting. 2) With SU-MIMO setup performance of Type II PMI is better than Type I PMI.
    - Samsung: 1) With SU-MIMO Set-up, we observed around 1dB performance gain with Type II compared to Type I codebook under XP medium MIMO correlation and 64QAM rank2 transmission. 2) With MU-MIMO Set-up, the performance of Type II codebook even worse than Type I codebook based on the agreed test parameters.
    - QC: There is a significant difference in PMI ratio and SNR needed to reach 90% of peak throughput between Type 2 and Type 1 PMI reporting.
  + Option 2: MU-MIMO based test setup, i.e., one tested UE + one co-scheduled UE (generated by TE)
* Recommended WF
  + Can we agree option 1?

### Sub-topic 3-3: SU-MIMO Type II PMI test parameters

**Issue 3-3-0: Summary of companies’ Type II PMI simulation results**

* Summary of companies’ Type II FDD 16T2R PMI simulation results under TDLA30-5 with NPSK=8 (for information)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| MIMO Correlation | subbandAmplitude | PMI-FormatIndicator | SNR point @90%TP (dB) / TP ratio | | | |
| Huawei | Qualcomm | Apple | Samsung |
| XP Medium | False | Subband | 9.9/ | 10.67/3.87 | 12.37/3.47 |  |
| XP Medium | True | Subband | 9.82/ | 10.44/4.10 | 12.16/3.57 | 9.5/4.8 |
| XP High | False | Subband | 10.86/ | 10.42/6.46 | 13.51/3.34 |  |
| XP High | True | Subband | 10.8/ | 10.16/7.32 | 13.41/3.36 |  |
| XP Medium | False | Wideband | 10.12/ |  | 13.23/2.85 |  |
| XP High | False | Wideband | 11.06/ |  | 13.58/3.17 |  |
| XP High | True | Subband |  | 10.20/7.23 |  |  |
| **Note** | | |  | Subband size = 8  Subband size = 4 |  |  |

**Issue 3-3-1: subbandAmplitude for type II codebook construction**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *SubbandAmplitude*
    - *Option 1: False*
    - *Option 2: True*
* Proposals
  + Option 1: False (Huawei)
    - Huawei: We don’t achieve much gain when configuring ‘True’ on SubbandAmplitude based on the simulation results.
  + Option 2: True (Apple, Samsung, QC)
    - Apple: For SB PMI reporting and XP-Medium antenna correlation, with SB amplitude TRUE gives better performance.
    - Samsung: We can maximize number of candidate codebooks and number of sub-band for PMI reporting. From UE processing respective, this requires maximum UE calculation complexity and acts like a pressure test.
    - QC: XP High correlation with subbbandAmplitude = true provide the largest difference in PMI ratio between Type2 and Type1 PMI reporting.
* Recommended WF
  + Given no consensus for 5 meetings, can we go with option 2 based on majority companies’ view?

**Issue 3-3-2: PMI-FormatIndicator for type II codebook**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *PMI-FormatIndicator*
    - *Option 1: Wideband*
    - *Option 2: Subband*
* Proposals
  + Option 1: Wideband (Huawei)
    - Huawei: No more than 1dB performance difference has been observed. Under the current agreed simulation assumption, configuring Subband can not fully use Type II codebook potential, and its performance is very close to the one of configuring Wideband.
  + Option 2: Subband (Apple, Samsung, QC)
    - Apple: Subband PMI reporting gives better performance than wideband PMI reporting for Type II PMI reporting.
    - Samsung: Maximize number of candidate codebooks and number of sub-band for PMI reporting.
    - QC: it makes more sense to have Subband PMI reporting for Type II codebook so that this codebook can be used to its full potential.
* Recommended WF
  + Given no consensus for 5 meetings, can we go with option 2 based on majority companies’ view?

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

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *MIMO correlation*
    - *Option 1: XP High*
    - *Option 2: XP Medium*
* Proposals
  + Option 1: XP High (QC)
    - QC: XP High correlation with subbbandAmplitude = true provide the largest difference in PMI ratio between Type2 and Type1 PMI reporting.
  + Option 2: XP Medium (Apple, Samsung, Huawei, Ericsson)
    - Apple: Antenna correlation of XP-Medium gives better performance than XP-High for Type II PMI reporting.
    - Samsung: We observed larger performance gap among different codebook types (Rel-16 Type II, Rel-15 Type II and Rel-15 Type I).
    - Huawei: SNR differences between configurations are more obvious when using XP medium for MIMO correlation. Considering that the test metric is not the TP ratio between Type II and Type I codebook, we slightly prefer to choosing XP medium as the MIMO correlation configuration.
    - Ericsson: There is practically no performance difference when ‘High’ correlation matrix is employed in the SU-MIMO test
  + Option 3: XP Custom (Ericsson)
* Recommended WF
  + Given no consensus for 5 meetings, can we go with option 2 based on majority companies’ view?

**Issue 3-3-4: Subband size for type II PMI**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *Subband size*
    - *Option 1: 4 for FDD and 8 for TDD*
    - *Option 2: 8 for FDD and 16 for TDD*
* Proposals
  + Option 1: 4 for FDD and 8 for TDD (Apple, Ericsson)
  + Option 2: 8 for FDD and 16 for TDD (CTC, Samsung, Ericsson, QC)
    - CTC: We slightly prefer option 2 because 8 for FDD and 16 for TDD is used for all the existing Rel-15 test cases, and the subband type I PMI test case for 16Tx as well.
    - Ericsson: The subband size does not distinguish performance to any significant degree.
    - QC: Based on above simulations, we notice that there is not much difference in performance with any sub-band size. So, we would like to keep it same as other PMI reporting tests.
* Recommended WF
  + Can we go with option 2 based on majority’s view?

**Issue 3-3-5: Implementation of Random type II PMI**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *Implementation of Random Type II PMI*
    - *Proposal 1: A common way of doing random PMI for Type II codebook simulation might need to be agreed in order to reach sufficient randomization and meanwhile avoid uncertainty and unexpected results brought by infinite random parameters.*
      * *Beam randomization:*
* *Option 1: Randomly select a beam combination from a set which include all possible beam combinations*
* *Option 2: Limit the set of possible beams to the possible beams under the configuration of following PMI* 
  + - * *Amplitude and phase coefficient randomization:*
* *Option 1: For each weighting coefficient, independently and randomly chose an amplitude quantization gear and a phase quantization gear. To at least ensure one of the weighting coefficients is quantized as the highest grade, phase quantization is 0 gear and its position at 2L is randomly generated.*
  + - * *Note: The set is limited due to the limitation of quantization gears.*
* Proposals
  + Beam randomization
    - ~~Option 1: Randomly select a beam combination from a set which include all possible beam combinations (Samsung)~~
    - Option 2: Limit the set of possible beams to the possible beams under the configuration of following PMI, i.e., set L=2 for random PMI generation (Apple, Huawei, QC,Samsung)
      * Huawei: we think that option 2 gives a reasonable set based on the following PMI parameter configurations that avoid the massive random possibilities brought by option 1
      * QC: parameters like L, N\_PSK and subbandAmplitude are already known to the UE, so it doesn't make sense to evaluate the performance under all possible random precoders
  + Amplitude and phase coefficient randomization
    - ~~Option 1: Amplitude and phase coefficient are randomly selected from a set which include all possible combinations (Samsung)~~
    - Option 2: Limit the set of possible amplitude and phase coefficient combinations (Huawei, Apple, QC)
      * Option 2A: For each weighting coefficient, independently and randomly chose an amplitude quantization gear and a phase quantization gear. To at least ensure one of the weighting coefficients is quantized as the highest grade, phase quantization is 0 gear and its position at 2L is randomly generated. (Apple)
* Huawei: Although the set is limited due to the limitation of quantization gears, the set that contains all the possibilities is also very large, and it takes a long time for simulation to achieve uniform randomness. A unified random method can be considered, such as reducing the optional set to ensure fairness.
  + - * Option 2B: Set the same NPSK, subbandAmplitude with the configuration for follow PMI for random PMI generation. (QC, Samsung)
* Recommended WF
  + Encourage more discussion on the below aspects for random PMI generation in the first round:
    - Firstly, is it ok to use the same L, NPSK and subbandAmplitude with that for follow PMI?
    - If the above sub-bullet is agreeable, discuss whether additional limitation to the amplitude and phase coefficient combination set is needed? If needed, detailed methods are encouraged.

**Issue 3-3-6: SNR point for type II PMI**

* Proposals
  + Option 1: SNR point that achieves 90% TP with follow type II PMI
  + Option 2: SNR point that achieves 70% TP with follow type II PMI (Ericsson)
    - Ericsson: 70% throughput mark shows more gain with Type II codebook over the 90% throughput mark for custom correlation and medium correlation
* Recommended WF
  + Encourage feedback from companies.

**Issue 3-3-7: Test metric for type II PMI**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *Test metric*
    - *TP ratio between following PMI and rand PMI*
* Proposals
  + Option 1: TP ratio between following PMI and rand PMI (Agreement in the previous meeting)
  + Option 2: TP ratio between type II follow PMI and type I follow PMI (Ericsson)
    - Ericsson: The gain when calculated by comparing follow Type II PMI with random Type II PMI has high variance arising from the stochastical behaviour and uncertainty of random PMI precoder selection
* Recommended WF
  + Keep the previous agreement unless consensus is reached to revert the previous agreement.
  + Encourage companies to feedback if it is ok to use option 2.

### Sub-topic 3-4: MU-MIMO Type II PMI test parameters

**Issue 3-4-1: MIMO correlation for MU-MIMO Type II PMI**

* *Agreement in RAN4 #96e (R4-2012762, WF)*
  + *MIMO correlation*
    - *XP Medium*
* Proposals
  + Option 1: XP Custom (Ericsson)
* Recommended WF
  + TBA

**Issue 3-4-2: Rank and MCS for MU-MIMO Type II PMI**

* Proposals
  + Option 1: Rank 1 MCS11 (Ericsson)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Sub-topic 3-1: Type I PMI test Issue 3-1-1: Gamma (gain) values Sub-topic 3-2: Type II PMI test setup Issue 3-2-1: Test setup for type II Sub-topic 3-3: SU-MIMO Type II PMI test parameters Issue 3-3-1: subbandAmplitude for type II codebook construction  Issue 3-3-2: PMI-FormatIndicator for type II codebook  Issue 3-3-3: MIMO correlation for type II codebook  Issue 3-3-4: Subband size for type II PMI  Issue 3-3-5: Implementation of Random type II PMI  Issue 3-3-6: SNR point for type II PMI  Issue 3-3-7: Test metric for type II PMI  Others Sub-topic 3-4: MU-MIMO Type II PMI test parameters Issue 3-4-1: MIMO correlation for MU-MIMO Type II PMI  Issue 3-4-2: Rank and MCS for MU-MIMO Type II PMI  Others |
| China Telecom | Sub-topic 3-1: Type I PMI test Issue 3-1-1: Gamma (gain) values   * + For 16Tx, we proposed 2.5 and 3.5 for 2Rx and 4Rx respectively, which can be achieved based on all companies’ simulation results. So we would like to check if 2.5/3.5 would be agreeable?   + For 32Tx, ok to use 5.0 for 2Rx and 8.0 for 4Rx based on majority’s view.  Sub-topic 3-2: Type II PMI test setup Issue 3-2-1: Test setup for type II  Option 1, considering the simulation results and analysis to this meeting, as well as the WI completion date. Sub-topic 3-3: SU-MIMO Type II PMI test parameters Issue 3-3-4: Subband size for type II PMI  Option 2.  Issue 3-3-5: Implementation of Random type II PMI  It looks reasonable for us to use the same L, NPSK and subbandAmplitude with that for follow PMI, and this can be seen as baseline for further evolution. Additional limitation to the amplitude and phase coefficient combination set can be considered if a unified method can be agreed in this meeting.  Issue 3-3-7: Test metric for type II PMI  We understand the motivation of option 2.  The question is: is there any UE supporting only type II PMI but not type I PMI with 16 ports. |
| Apple | Sub-topic 3-1: Type I PMI test Issue 3-1-1: Gamma (gain) values  For 16 TX we propose 2 and 2.5 for 2RX and 4RX respectively  For 32TX we can go with 5 for 2RX, but propose 6.5 for 4RX. Sub-topic 3-2: Type II PMI test setup Issue 3-2-1: Test setup for type II  We support option 1/ recommended WF. Sub-topic 3-3: SU-MIMO Type II PMI test parameters Issue 3-3-1: subbandAmplitude for type II codebook construction  We support option 2/ the recommended WF.  Issue 3-3-2: PMI-FormatIndicator for type II codebook  We support option 2/ the recommended WF.  Issue 3-3-3: MIMO correlation for type II codebook  We support option 2/ the recommended WF.  Issue 3-3-4: Subband size for type II PMI  We are fine to have the same SB size as Type I PMI reporting for 16TX and support recommended WF.  Issue 3-3-5: Implementation of Random type II PMI  Issue 3-3-6: SNR point for type II PMI  We prefer to use same test point as Type I PMI, but are open to go with majority view  Issue 3-3-7: Test metric for type II PMI  We prefer to use same test metric as Type I PMI reporting and follow agreement in last meeting. We would need 2 tests with PMI feedback with option 2. If we agree on method for random Type II PMI generation, we should not have any uncertainity.  Others Sub-topic 3-4: MU-MIMO Type II PMI test parameters Issue 3-4-1: MIMO correlation for MU-MIMO Type II PMI  Issue 3-4-2: Rank and MCS for MU-MIMO Type II PMI  Others |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2014748, Samsung, Draft CR for Type II PMI | Company A |
| Company B |
|  |
| R4-2015659, HW, CR on applicability for Type II PMI | Company A |
| Company B |
|  |

Note: To save time on typing the comments one by one, companies can also directly revise the draft CR and upload the revision in the draft inbox.

## 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** |
|  |  |

*Suggestion on WF/LS assignment*

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

### 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

## 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”* |
|  |  |
|  |  |

# Topic #4: UE power imbalance requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014499 | China Telecom | On FR1 intra-band contiguous CA:  *Observation 1: Based on our simulation results, 100% relative throughput can be achieved for 1T2R with MCS 27 and 1T4R with MCS 28.*  *Proposal 1: Use MCS 27 for 2Rx and MCS 28 for 4Rx.*  *Proposal 2: Reuse the following applicability rule from LTE CA power imbalance test:*   * *For FDD or TDD CA power imbalance tests, if they are tested with FDD or TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD or TDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE.* * *For FDD or TDD 2 DL CCs, only test the supported intra-band contiguous CA configurations covering the lowest and highest operating bands.*   On FR1 intra-band contiguous and non-contiguous EN-DC:  *Proposal 3: For the CBW combination for testing, use Option 4 + partial RB.* |
| R4-2015317 | NTT DOCOMO, INC. | Observation 1: Consider following option for test applicability   * Option 1   + UE supports only intra-band contiguous EN-DC, i,e., if UE does not indicate “intraBandENDC-Support”,     - power imbalance requirement for intra-band contiguous EN-DC is applied   + UE supports only intra-band non-contiguous EN-DC, i.e., if UE indicates “non-contiguous” in “intraBandENDC-Support” or UE does not indicate “interBandContiguousMRDC”,     - power imbalance requirement for intra-band non-contiguous EN-DC is applied   + UE supports both intra-band contiguous and non-contiguous EN-DC, i.e., if UE indicates “both” in “intraBandENDC-Support” or UE indicates “interBandContiguousMRDC”,     - power imbalance requirement for FR1 intra-band contiguous EN-DC   Proposal 1: Consider following option for LO position first   * LO position   + Option 1: “LO in middle” (1st priority)   Observation 2: Rx image from LTE carrier can be observed properly in NR CBW in case of NR CBW = LTE CBW (Case 1, 4).  Observation 3: Rx image from LTE carrier can be observed properly in NR CBW in case of NR CBW < LTE CBW (Case 2a, 2b, 5a, 5b).  Observation 4: In case NR carrier frequency is higher than LTE carrier frequency and also NR CBW > LTE CBW, Rx image from LTE carrier can be observed as same size as the LTE CBW at the highest part of NR carrier. (Case 3a, 6a).  Observation 5: In case NR carrier frequency is lower than LTE carrier frequency and also NR CBW > LTE CBW, Rx image from LTE carrier can be observed as same size as the LTE CBW at the lowest part of NR carrier. (Case 3b, 6b).  Observation 6: Observation 2, 3, 4 and 5 can be applied for both intra-band contiguous EN-DC and non-contiguous EN-DC  Proposal 2: Define the following test procedure for intra-band contiguous and non-contiguous EN-DC  Step 1: Select the CBW combinations with the same BWs between LTE carrier (single carrier or aggregated contiguous carriers) and NR carrier. Test RBs should be allocated with full NR CBW.  Step 2: If there is no such CBW combination, go to Step 2a.  Step 2a: Select the CBW combinations that the BW of NR carrier is smaller than the BW of LTE carrier (single carrier or aggregated contiguous carriers). Test RBs should be allocated with full NR CBW. If there is no such CBW combination, go to Step 2b.  Step 2b: Select the CBW combinations with smallest CBW difference between the NR carrier and LTE carrier (single carrier or aggregated contiguous carriers).  ・In case NR carrier frequency is higher than LTE carrier frequency, test RBs should be allocated as same size as the LTE CBW from the edge of the highest part of NR carrier.  ・In case NR carrier frequency is lower than LTE carrier frequency, test RBs should be allocated as same size as the LTE CBW from the edge of the lowest part of NR carrier.  Step 3: Among the CBW combinations selected from Step 1 to 2, select the EN-DC combination with the largest aggregated CBW.  Proposal 3 Apply the changes listed in the table below to CR  Table1: The main changes from Draft CR (R4-2012697) and the reason for the change   |  |  | | --- | --- | | The main changes from Draft CR (R4-2012697) | The reason for the change | | We add the applicability of requirement. | To reflect the agreement of this WI in TS38.101-4. | | We add a sentence to “Bandwidth (MHz)” column of the table of performance requirements. | Considering the E-mail discussion in RAN4#96e, RAN4 needs to define a test procedure for selecting the BW used for the test. Thus, we add “Channel bandwidth from selected EN-DC combination” to “Bandwidth (MHz)” column. | | We remove the “Reference channel” column from the table of performance requirements. | This test uses a fixed MCS value, but the CBW and the number of allocated RBs depends on the UE. Since it is not practicable to cover all cases, we believe it is better not to introduce the FRC as in the SDR test. | | We add the value of “Power at Antenna Port in dBm/Hz”. | From Section 4.4.4.2 in TS38.101-4, RAN4 agreed that a fixed Es power level of -112 dBm/Hz shall be used for all operating bands in FR1. Thus, we add -112dBm/Hz to SCG CC and -106dBm/Hz to MCG CC. | | We add the Intra-band non-contiguous EN-DC requirements. | To reflect the agreement of this WI in TS38.101-4. | |
| R4-2015318 | NTT DOCOMO, INC, SoftBank Corp. | Resubmission of endorsed Draft CR R4-2012697, with some additional changes listed in proposal 3 of R4-2015317. |
| R4-2015660 | Huawei, HiSilicon | For FR1 intra-band contiguous CA:  Proposal 1: Use MCS 27 for 1T2R and MCS 28 for 1T4R with MCS table 64QAM.  Proposal 2: Option 1, reuse test applicability rule of LTE CA power imbalance test  For intra-band EN-DC:  Proposal 3: For TDD, use SCS 30 kHz  Proposal 4: Not consider the aggregated contiguous carrier for LTE  Proposal 5: Adopt the following methodology for selection of channel bandwidth combination for testing   * Step 1: First select the CBW combinations with the same BWs between LTE carrier and NR carrier. If there is no such CBW combination, go to Step 1a, otherwise Step 2.   + Step 1a: Select the CBW combinations that the BW of NR carrier is smaller than the BW of LTE carrier and with the smallest CBW difference between the NR carrier and LTE carrier. If there is no such CBW combination, go to step 1b.   + Step 1b: Select the EN-DC combination with the smallest CBW difference between the NR carrier and LTE carrier * Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW   Proposal 6: Partial PRB for NR carrier can be considered if CBW of NR carrier is larger than that of LTE carrier; otherwise full PRB of NR carrier should be tested.  Proposal 7: Only consider “LO in middle” for test.  Proposal 8: Not consider case of only support interBandContiguousMRDC, adopt option 2 for test applicability rule of intra-band EN-DC power imbalance requirements testing. |
| R4-2015661 | Huawei, HiSilicon |  |
| R4-2015820 | Ericsson | Proposal 1: Configure MCS 27 for 2Rx and MCS 28 for 4Rx for intra-band contiguous CA test with power imbalance.  Proposal 2: Apply the following applicability rule for NR intra-band contiguous CA with power imbalance scenario:   * For FDD CA power imbalance tests, if they are tested with FDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE. * For FDD CA power imbalance tests with 2 DL CCs, test only the supported intra-band contiguous CA configurations covering the lowest and highest operating bands. * For TDD CA power imbalance tests, if they are tested with TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with TDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE. * For TDD CA power imbalance tests with 2 DL CCs, test only the supported intra-band contiguous CA configurations covering the lowest and highest operating bands.   Proposal 3: Configure MCS 27 for 2Rx and MCS 28 for 4Rx for intra-band contiguous NE-DC test with power imbalance.  Proposal 4: Adopt the following procedure to select the CBW combination for intra-band non-contiguous EN-DC power imbalance test.   |  | | --- | | Step 1: First select the CBW combinations with the same BWs between LTE carrier (single carrier or aggregated contiguous carriers) and NR carrier. If there is no such CBW combination, go to step 1-1. Otherwise go to step 2.  Step 1-1: Select the CBW combinations that the BW of NR carrier is smaller than the BW of (aggregated) LTE carrier(s). Go to step 1-2 if the CBW combination found. If no such a combination, go to step 1-3.  Step 1-2: Among the CBW combinations selected from Step 1-1, select the CBW combinations with the smallest CBW difference between NR carrier and (aggregated) LTE carrier(s). Go to step 2.  Step 1-3: Select the EN-DC combinations with smallest CBW difference between the NR carrier and (aggregated) LTE carrier(s). Go to step 2.  Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW. |   Proposal 5: Allocate full PRB for intra-band non-contiguous EN-DC power imbalanced test.  Proposal 6: For intra-band non-contiguous EN-DC test with power imbalance, RAN4 demodulation requirements assume LO is set in the middle of two carriers, but it is up to UE implementation.  Proposal 7: Set the applicability of EN-DC power imbalance test as follow:   * If UE supports intra-band contiguous EN-DC only, i.e., if UE does not indicate “intraBandENDC-Support”,   + Power imbalance requirement for intra-band contiguous EN-DC is applied * If UE supports intra-band non-contiguous EN-DC only, i.e., if UE indicates “non-contiguous” in “intraBandENDC-Support” or UE does not indicate “interBandContiguousMRDC”,   + Power imbalance requirement for intra-band non-contiguous EN-DC is applied * If UE supports both intra-band contiguous and non-contiguous EN-DC, i.e., if UE indicates “both” in “intraBandENDC-Support” or UE indicates “interBandContiguousMRDC”,   + Power imbalance requirement for intra-band contiguous EN-DC is applied. |
| R4-2016463 | Qualcomm Incorporated | Observation 1: Slots containing TRS have effective code rate greater than 0.95 for MCS28.  Proposal 1: Maximum MCS for power imbalance test should be less than or equal to MCS27.  Observation 2: Requirement SNR for 64QAM MCS25 is very close to 19dB, as desired for power imbalance test cases.  Observation 3: As CBW changes, requirement SNR does not change significantly for 64QAM MCS25, Rank1.  Proposal 2: Use 64QAM MCS25, Rank1 to define the power imbalance requirements for 2Rx. |
| R4-2014728 | CMCC | Proposal 1: Reuse the following applicability rule from LTE CA power imbalance test.  Proposal 2: For CBW combination method for intra-band contiguous EN-DC and intra-band non-contiguous EN-DC   * + Step 1: First select the CBW combinations with the same BWs between LTE carrier (single carrier or aggregated contiguous carriers) and NR carrier. If there is no such CBW combination, go to Step 1a, Step 1b and Step 1c.     - Step 1a: Select the CBW combinations that the BW of NR carrier is smaller than the (aggregated) BW of LTE carrier(s). If there is no such CBW combination, go to Step 1c.     - Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between NR carrier and LTE carrier(s)     - Step 1c: select the EN-DC combinations with smallest CBW difference between the NR carrier and LTE carrier(s).   + Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW   Proposal 3: Consider the aggregated contiguous carriers for LTE if UE supports it  Proposal 4: We support considering only “LO in middle”  Proposal 5: For intra-band non-contiguous EN-DC, if “LO at edge of one CC” is considered, then the separation between two CCs should be much smaller than the minimum of the CBW of two CCs.  Proposal 6:  In intra-band contiguous EN-DC or intra-band non-contiguous EN-DC with LO in the middle of CBW combination:   * when the CBW of LTE carrier(s) is larger than NR carrier, test full PRBs; * when the CBW of LTE carrier(s) is smaller than NR carrier, test partial PRBs, where test PRBs on NR carrier and LTE carrier are symmetric about the LO position.   In intra-band non-contiguous EN-DC with LO at the edge of one CC(if needed)   * test partial PRBs, where the bandwidth of tested PRBs can be covered by LTE carrier(s) after symmetry with LO position. |
| R4-2014552 | Intel Corporation | Proposal 1: Use 64QAM with MCS 26 for 2 Rx and 64QAM with MCS 28 for 4 Rx for NR CA power imbalance requirements.  Proposal 2: Reuse applicability rules from LTE Power imbalance requirements for NR Power imbalance requirements  Proposal 3: Use Option 4 from page 7 of WF R4-2012691 for selection of tested channel bandwidth combination for intra-band contiguous EN-DC power imbalance requirements.  Proposal 4: Use Option 4 from page 7 of WF R4-2012691 with limitation on frequency separation (less then (CBWLTE + CBWNR)/2 + min(CBWLTE, CBWNR)) for selection of tested channel bandwidth combination for intra-band contiguous EN-DC power imbalance requirements. |

## Open issues summary

### Sub-topic 4-1: Requirements for FR1 intra-band contiguous CA

**Issue 4-1-1: MCS**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Modulation order: 64QAM for 2Rx and 4Rx*
  + *MCS*
    - *Option 1: MCS 27 for 2Rx, MCS 28 for 4Rx*
    - *Option 2: MCS 25 for 2Rx*
* Proposals for MCS
  + MCS
    - Option 1: MCS 27 for 2Rx, MCS 28 for 4Rx (CTC, HW, E///)
    - Option 2: MCS 25 for 2Rx (QC)
      * QC: Slots containing TRS have effective code rate greater than 0.95 for MCS28. Maximum MCS for power imbalance test should be less than or equal to MCS27.
    - Option 3: MCS 26 for 2 Rx, MCS 28 for 4Rx (Intel)
* Recommended WF
  + For the sake of progress, can we agree option 3 as a compromise?

**Issue 4-1-2: Test applicability rule**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Option 1: Reuse the following applicability rule from LTE CA power imbalance test*
    - *For FDD or TDD CA power imbalance tests, if they are tested with FDD or TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD or TDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE.*
    - *For FDD or TDD 2 DL CCs, only test the supported intra-band contiguous CA configurations covering the lowest and highest operating bands.*
  + *Other options are not precluded.*
* Proposals
  + Use the above option 1 (CTC, HW, E///, CMCC, Intel)
    - For FDD or TDD CA power imbalance tests, if they are tested with FDD or TDD intra-band contiguous CA configurations with 2 DL CCs, the test coverage can be considered fulfilled with FDD or TDD intra-band contiguous CA configurations with 3 or more DL CCs supported by the UE.
    - For FDD or TDD 2 DL CCs, only test the supported intra-band contiguous CA configurations covering the lowest and highest operating bands.
* Recommended WF
  + Can we agree option 1?

### Sub-topic 4-2: Requirements for intra-band contiguous and non-contiguous EN-DC

**Issue 4-2-1: LO position assumption**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *LO position*
    - *Option 1: “LO in middle” (1st priority)*
    - *Option 2: “LO in middle” and “LO at edge of one CC” (2nd priority)*
      * *FFS: Channel bandwidth combination for testing*
      * *FFS: whether some limitations on frequency separation between two CCs should be included in applicability rule for non-contiguous EN-DC*
* Proposals on LO position assumption for defining demodulation requirements
  + Option 1: “LO in middle” only (DCM, HW, E///, CMCC)
    - Note: the exact implementation is up to UE.
  + Option 2: “LO in middle” and “LO at edge of one CC” (Intel)
    - Intel: set limitation on frequency separation (less then (CBWLTE + CBWNR)/2 + min(CBWLTE, CBWNR))
* Recommended WF
  + Is it possible to agree option 1 based on majority’s view?

**Issue 4-2-2: Single or aggregated carriers for LTE in the test**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Whether to consider the aggregated contiguous carriers for LTE if UE supports it?*
    - *Option 1: Consider the aggregated contiguous carriers for LTE*
    - *Option 2: Do not consider the aggregated contiguous carriers for LTE*
* Proposals
  + Option 1: Consider the aggregated contiguous carriers for LTE if UE supports it (E///, CMCC, DCM, CTC, Intel)
  + Option 2: Do not consider the aggregated contiguous carriers for LTE (HW)
* Recommended WF
  + Is it possible to agree option 1 based on majority’s view?

**Issue 4-2-3: Full PRB or partial PRB for NR carrier**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Whether to test partial PRB or full PRB for NR carrier, in case the CBW is different in LTE carrier(s) and NR carrier?*
    - *Option 1: Partial PRB*
    - *Option 2: Full PRB*
* Proposals
  + Option 1 (CMCC, HW, DCM, CTC)
    - When the CBW of NR carrier is smaller than LTE carrier(s), test full PRBs;
    - When the CBW of NR carrier is larger than LTE carrier(s), test partial PRBs, where test PRBs on NR carrier and LTE carrier are symmetric about the LO position.
  + Option 2: Full PRB (E///, Intel)
    - E///: In our proposal of CBW combination selection procedure, NR carrier BW is configured so that it is equal or smaller than (aggregated) LTE carrier BW.
    - Intel: It is rather hard to select which PRB is selected for transmission because per PRB SNR depends on UE implementation on LO position.
* Recommended WF
  + Is it possible to agree option 1 based on majority’s view?

**Issue 4-2-4: Channel bandwidth combination for testing**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Option 1*
    - *Step 1: First select the CBW combinations with the same BWs in each carrier*
      * *If there is no such CBW combination, select the CBW combinations with smallest CBW difference between the two carriers.*
    - *Step 2: Among the CBW combinations selected from step 1, select the CBW combinations where the NR carrier has smaller CBW than the LTE carrier; if no such CBW combination, directly go to step 3.*
    - *Step 3: Among the CBW combinations selected from step 2, select the EN-DC combination with largest aggregated CBW*
  + *Option 2*
    - *Step 1: First select the CBW combinations with the same BWs between LTE carrier (single carrier or aggregated carriers) and NR carrier*
      * *If there is no such CBW combination, select the CBW combinations with smallest CBW difference between the two carriers.*
        + *If frequency range of NR carrier is higher than LTE carrier, then the test RBs will be allocated on the highest part of NR carrier.*
        + *If frequency range of NR carrier is lower than LTE carrier, then the test RBs will be allocated on the lowest part of NR carrier.*
    - *Step 2: Among the CBW combinations selected from step 1, select the EN-DC combination with largest aggregated CBW.*
  + *Option 3*
    - *Step 1: First select the CBW combinations with the same BWs in each carrier. If there is no such CBW combination, go to Step 1a and Step 1b, otherwise Step 2.*
      * *Step 1a: Select the CBW combinations that the BW of NR carrier is smaller than the BW of LTE carrier*
      * *Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between the two carriers*
    - *Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW*
  + *Option 4*
    - *Step 1: First select the CBW combinations with the same BWs between LTE carrier (single carrier or aggregated contiguous carriers) and NR carrier. If there is no such CBW combination, go to Step 1a, Step 1b and Step 1c.*
      * *Step 1a: Select the CBW combinations that the BW of NR carrier is smaller than the (aggregated) BW of LTE carrier(s). If there is no such CBW combination, go to Step 1c.*
      * *Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between NR carrier and LTE carrier(s)*
      * *Step 1c: select the EN-DC combinations with smallest CBW difference between the NR carrier and LTE carrier(s).*
    - *Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW*
* **Summary of proposals in this meeting**
  + The proposal from E///, DCM, CMCC, CTC, Huawei and Intel are generally based on option 4, with some refinement on the description and/or additional consideration on issue 4-2-1 to issue 4-2-3.
* **Recommended WF**
  + Firstly discuss issue 4-2-1 to issue 4-2-4 separately, and then come up the CBW selection solution based on the agreements on these 4 issues.
  + For this issue 4-2-4, can we agree with the following option 4A updated based on option 4?

Option 4A:

* + - Step 1: First select the CBW combinations with the same BWs between LTE carrier(s) ~~(single carrier or aggregated contiguous carriers)~~ and NR carrier. If there is no such CBW combination, go to Step 1a~~, Step 1b and Step 1c~~. Otherwise go to step 2.
      * Step 1a: Select the CBW combinations that the BW of NR carrier is smaller than the ~~(aggregated)~~ BW of LTE carrier(s). If there is no such CBW combination, go to Step 1c.
      * Step 1b: Among the CBW combinations selected from Step 1a, select the CBW combinations with the smallest CBW difference between NR carrier and LTE carrier(s). Go to step 2.
      * Step 1c: select the EN-DC combinations with smallest CBW difference between the NR carrier and LTE carrier(s). Go to step 2.
    - Step 2: Among the CBW combinations selected from Step 1, select the EN-DC combination with the largest aggregated CBW

**Issue 4-2-5: Test applicability and special inter-band EN-DC**

* *Agreement in RAN4 #95e (R4-2008848, WF)*
  + *For intra-band non-contiguous EN-DC*
    - *The possibility of using single RF chain to receive two non-continuous carriers in co-located scenario cannot be precluded.*
* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *Option 1*
    - *UE supports only intra-band contiguous EN-DC, i,e., if UE does not indicate “intraBandENDC-Support”,* 
      * *power imbalance requirement for intra-band contiguous EN-DC is applied*
    - *UE supports only intra-band non-contiguous EN-DC, i.e., if UE indicates “non-contiguous” in “intraBandENDC-Support” or UE does not indicate “interBandContiguousMRDC”,* 
      * *power imbalance requirement for intra-band non-contiguous EN-DC is applied*
    - *UE supports both intra-band contiguous and non-contiguous EN-DC, i.e., if UE indicates “both” in “intraBandENDC-Support” or UE indicates “interBandContiguousMRDC”,* 
      * *power imbalance requirement for FR1 intra-band contiguous EN-DC*
  + *Option 2* 
    - *UE supports only intra-band contiguous EN-DC, i,e., if UE does not indicate “intraBandENDC-Support”,* 
      * *power imbalance requirement for intra-band contiguous EN-DC is applied*
    - *UE supports only intra-band non-contiguous EN-DC, i.e., if UE indicates “non-contiguous” in “intraBandENDC-Support”* 
      * *power imbalance requirement for intra-band non-contiguous EN-DC is applied*
    - *UE supports both intra-band contiguous and non-contiguous EN-DC, i.e., if UE indicates “both” in “intraBandENDC-Support”* 
      * *power imbalance requirement for FR1 intra-band contiguous EN-DC*
  + *Other options are not precluded.*
* *Agreement in RAN4 #96e GTW session (RAN4 #96e Meeting report)*
  + *Agreement: Companies are encouraged to further check this scenario in RF agenda in next meeting, with the confirmation in RF part, we can introduce requirements for such case (option 1).*
* Proposals
  + Option 1 (DCM, E///)
    - E///: Considering TS 38.306 and TS38.101-3, RAN4 should consider the UE capability *interBandContiguousMRDC* for the applicability of intra-band contiguous/non-contiguous EN-DC power imbalance tests.
  + Option 2 (HW)
    - HW: Based on TS 38.101-3 and 38.306, we can conclude that UE supporting *interBandContiguousMRDC* should also support intra-band contiguous or non-contiguous EN-DC, separate consideration only support *interBandContiguousMRDC* is not realistic scenario.
* **Moderators’ observation**
  + Following the agreement in RAN4 #96e GTW session, and consider the agreement in RAN4 #95e on the possibility of using single RF chain to receive two non-continuous carriers in co-located scenario, option 1 can be agreeable.
  + Meanwhile, the new issue is that companies have different understanding on the NOTE 4 in TS 38.101-3 and *interBandContiguousMRDC* capability in TS 38.306 (see details in E/// paper R4-2015820 and HW paper R4-2015660).
* **Recommended WF**
  + First align the understanding on the NOTE 4 in TS 38.101-3 and *interBandContiguousMRDC* capability in TS 38.306, and then check if option 1 is agreeable.

**Issue 4-2-6: Other test parameters and applicability rules**

* *Agreement in RAN4 #96e (R4-2012691, WF)*
  + *RAN4 uses the following test parameters if no technical issues will be figured out.*

|  |  |
| --- | --- |
| Parameters | Value |
| Reference testing point | 85% of maximum throughput |
| PDSCH DMRS configurations | DMRS type: Type 1  Number of additional DMRS: 1 (i.e., 1+1) |
| Transmission rank | Rank 1 |
| MCS | Same value as FR1 intra-band contiguous NR CA |
| Max number of HARQ transmission | 1 (RV = {0}) |
| Precoding configuration | SP Type I, Random per slot with PRB bundling granularity |
| PRB bundling size | WB |

* + *For the other test parameters and applicability rules, if not explicitly discussed, reuse the same agreements from CA power imbalance test.*
* Proposals
  + Proposal 1: Configure MCS 27 for 2Rx and MCS 28 for 4Rx for intra-band contiguous EN-DC test with power imbalance (E///)
* Recommended WF
  + For intra-band contiguous and non-contiguous EN-DC test with power imbalance, use the same MCS for 2Rx and 4Rx as that for FR1 intra-band contiguous CA.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Sub-topic 4-1: Requirements for FR1 intra-band contiguous CA Issue 4-1-1: MCS  Issue 4-1-2: Test applicability rule Sub-topic 4-2: Requirements for intra-band contiguous and non-contiguous EN-DC Issue 4-2-1: LO position assumption  Issue 4-2-2: Single or aggregated carriers for LTE in the test  Issue 4-2-3: Full PRB or partial PRB for NR carrier  Issue 4-2-4: Channel bandwidth combination for testing  Issue 4-2-5: Test applicability and special inter-band EN-DC  Issue 4-2-6: Other test parameters and applicability rules |
| China Telecom | Sub-topic 4-1: Requirements for FR1 intra-band contiguous CA Issue 4-1-1: MCS  In our simulation results, 100% throughput can be achieved for 1T2R with MCS 27 and 1T4R with MCS 28. But we can accept option 3 to conclude this issue on time.  Issue 4-1-2: Test applicability rule  Ok with the recommended WF. Sub-topic 4-2: Requirements for intra-band contiguous and non-contiguous EN-DC Issue 4-2-1: LO position assumption  Ok with the recommended WF.  Issue 4-2-2: Single or aggregated carriers for LTE in the test  Ok with the recommended WF.  Issue 4-2-3: Full PRB or partial PRB for NR carrier  Ok with the recommended WF.  Issue 4-2-4: Channel bandwidth combination for testing  Ok with the option 4A.  Issue 4-2-6: Other test parameters and applicability rules  Ok with therecommended WF, which is aligned with the previous agreement. |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2015318, EN-DC power imbalance, DCM, SoftBank (Draft CR endorsed in R4-2012697, with some additional changes as listed in proposal 3 of R4-2015317) | China Telecom:  It would be better to align the text in CRs for EN-DC and CA. |
|  |
|  |
| R4-2015661, CA power imbalance, Huawei, HiSilicon (New CR) | China Telecom:  1) It would be better to align the text in CRs for EN-DC and CA.  2) For the applicability, may use the clause number of 5.1.1.6, since Intel’s CR on normal PDSCH CA applicability has used 5.1.1.5. |
|  |
|  |

Note: To save time on typing the comments one by one, companies can also directly revise the draft CR and upload the revision in the draft inbox.

## 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** |
|  |  |

*Suggestion on WF/LS assignment*

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

### 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”* |
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## Discussion on 2nd round

### Way forward

### Draft CRs

## Summary on 2nd round

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

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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# Topic #5: NR CA CQI reporting requirements

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2014500 | China Telecom | Observation 1: At least FDD 15 kHz +TDD 30 kHz is a very typical CA scenario, and some UE only supports this scenario.  Proposal 1: For the duplex mode and SCS, use option 1 + option B as the first priority. |
| R4-2014673 | China Telecom | DraftCR: Adding applicability and requirements for FR1 and FR2 CA CQI reporting test |
| R4-2015662 | Huawei, HiSilicon | Proposal 1: Use Duplex mode and SCS combinations as following:   * FR1: FDD + FDD with 15 kHz SCS and TDD + TDD with 30 kHz SCS * FR2: TDD + TDD with 120 kHz SCS |
| R4-2015821 | Ericsson | Proposal 1: For CA CQI reporting tests, define the test cases with Option 3, i.e.,   * FR1: FDD 15kHz + FDD 15 kHz, TDD 30kHz + TDD 30 kHz, and FDD 15kHz + TDD 30kHz   + For FDD + TDD, configure both FDD 15kHz and Pcell and TDD 30kHz as PCell * FR2: TDD 120 kHz + TDD 120kHz   Proposal 2: For CA CQI reporting tests with FDD 15kHz + TDD 30kHz with FDD PCell,   * CA capability where the tests apply: Test any of one of the supported CA capabilities with FDD PCell with largest aggregated CA bandwidth combination * CA configuration from the selected CA capability where the tests apply: Test any one of the supported CA configurations with largest aggregated CA bandwidth combination   Proposal 3: For CA CQI reporting tests with TDD 30kHz + FDD 15kHz with TDD PCell,   * CA capability where the tests apply: Test any of one of the supported CA capabilities with TDD PCell with largest aggregated CA bandwidth combination * CA configuration from the selected CA capability where the tests apply: Test any one of the supported CA configurations with largest aggregated CA bandwidth combination |

## Open issues summary

### Sub-topic 5-1: Duplex mode and SCS combinations

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

* *Agreement in RAN4 #96e (R4-2012692, WF)*
  + *Duplex mode and SCS combinations*
    - *For the performance requirements:*
      * *Option 1: Reuse the duplex mode and SCS combination of PDSCH normal CA requirements*
      * *Option 2:*
* *FR1: FDD + FDD with 15 kHz SCS and TDD + TDD with 30 kHz SCS*
* *FR2: TDD + TDD with 120 kHz SCS*
  + - * *Option 3:*
* *FR1: FDD + FDD with 15 kHz SCS, TDD + TDD with 30 kHz SCS, FDD 15 kHz +TDD 30kHz*
* *FR2: TDD + TDD with 120 kHz SCS*
  + - *Test applicability rule if the above proposed WF is agreed for FR1:*
      * *Option A: Test 3 cases*
      * *Option B: Test 2 cases*
* *Candidate option for detailed applicability rule:*
* *Test #1: FDD 15 kHz + TDD 30 kHz > FDD 15 kHz + FDD 15 kHz > FDD 15 kHz + TDD 15 kHz*
* *Test #2: TDD 30 kHz + TDD 30 kHz > TDD 15 kHz + TDD 30 kHz*
  + - * *Option C: Test 1 cases*
* Proposals
  + For the performance requirements:
    - Option 1: Reuse the duplex mode and SCS combination of PDSCH normal CA requirements (CTC 1st priority)
      * CTC: Option 1 should be the first priority, option 3 can be acceptable. Option 2 is not acceptable since FDD 15 kHz +TDD 30 kHz is not covered, some UE only supports this scenario.
    - Option 2: (Huawei)
      * FR1: FDD + FDD with 15 kHz SCS and TDD + TDD with 30 kHz SCS
      * FR2: TDD + TDD with 120 kHz SCS
* Huawei: FDD CA and TDD CA with same duplex mode and numerology is mandatory for UE to support, there is no scenario that one UE only supports FDD-TDD CA
  + - Option 3: (Ericsson, CTC 2nd priority)
      * FR1: FDD + FDD with 15 kHz SCS, TDD + TDD with 30 kHz SCS, FDD 15 kHz +TDD 30kHz
      * FR2: TDD + TDD with 120 kHz SCS
* Ericsson: 1) We don’t expect any significant performance difference between TDD SCS=15kHz and TDD SCS=30kHz. We therefore prefer to consider SCS=30kHz only for TDD. 2) Considering the interests from operators and the existing CA CQI reporting requirements in LTE (i.e., TS 36.101), we can consider the case FDD 15kHz + TDD 30kHz.
  + Test applicability rule for option 1 of performance requirement definition:
    - Option A: Test 3 cases
    - Option B: Test 2 cases (CTC)
      * Candidate option for detailed applicability rule:
* Test #1: FDD 15 kHz + TDD 30 kHz > FDD 15 kHz + FDD 15 kHz > FDD 15 kHz + TDD 15 kHz
* Test #2: TDD 30 kHz + TDD 30 kHz > TDD 15 kHz + TDD 30 kHz
  + - Option C: Test 1 case
  + Test applicability rule for option 3 of performance requirement definition:
    - Option A: For FDD 15 kHz +TDD 30kHz, configure both FDD 15kHz as Pcell and TDD 30kHz as PCell. (Ericsson)
* Recommended WF
  + TBA based on further discussion. Make decision in this meeting.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Company A | Issue 5-1: Duplex mode and SCS combinations |
| China Telecom | Issue 5-1: Duplex mode and SCS combinations  First priority: option 1; second priority: option 3. |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2014673, CTC, draft CR on applicaability and requiremets |  |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
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*Suggestion on WF/LS assignment*

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

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

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

## Discussion on 2nd round

## Summary on 2nd round

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

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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# Topic #6: BS demodulation maintenance

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2015845 | Ericsson | adding FRC table description in Annex in 38.104 |

## Open issues summary

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2015845, E///, adding FRC table description in Annex in 38.104 | *Moderator’s note:*  CR number is missing in the coversheet, and there are change marks in the coversheet. |
| China Telecom: ok with the proposed technical change in the CR. Suggest to also add “for FR1 PUSCH” in the sub-bullet for table A.4-2B (see below).  - FRC parameters are specified in table A.4-2B **for FR1 PUSCH** with transform-precoding disabled, *Additional DM-RS position = pos2* and 1 transmission layer |
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## Summary for 1st round

### Open issues

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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## Discussion on 2nd round

## Summary on 2nd round

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

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