**3GPP TSG-RAN WG4 Meeting #94-e R4-200xxxx**

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

**Agenda item:** 8.9.1.2 & 8.9.1.3

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

**Title:** Email discussion summary for RAN4#94e\_#91\_NR\_L1enh\_URLLC\_Demod\_Requirements

**Document for:** Information

# Introduction

The discussions in this thread include URLLC UE and BS demodulation requirements for high reliability but with higher BLER and/or lower confidence level and low latency and UE CQI reporting requirements for high reliability. The discussion about UE and BS demodulation requirements for high reliability with BLER 10^-5 and confidence level 99.999% will happen in another thread RAN4#94e\_#90\_NR\_L1enh\_URLLC\_Demod\_Test:

* Topic #1: UE demodulation requirements for high reliability with higher BLER and/or lower confidence level.
* Topic #2: UE PDSCH demodulation requirements for low latency.
* Topic #3: UE CQI reporting requirements for support of CQI table 3.

*Note: As per the discussion about the test feasibility and methodology in thread RAN4#94e\_#90\_NR\_L1enh\_URLLC\_Demod\_Test for ultra-low BLER CQI requirement is concluded, RAN4 can discuss whether other high BLER CQI reporting test is needed or not if possible.*

* Topic #4: BS demodulation requirements for high reliability with higher BLER and/or lower confidence level.
* Topic #5: BS demodulation requirements for low latency.
* Topic #6: PUCCH demodulation requirements for high reliability.

**Background:**

As per the approved WF R4-1915913, the following open issues will be discussed in this email thread:

|  |
| --- |
| UE demodulation requirements for high reliability   * Other test cases will be defined with higher BLER and/or lower confidence level   + Other parameter combinations of HARQ, aggregation, channel etc. and further requirements will be considered.   + When further requirements are specified, it will be decided case by case whether to test them at 10^-5 BLER and CL 99.999% or other conditions   + These test cases will include PDSCH aggregation     - FFS PDSCH aggregation level   UE CQI reporting requirements for high reliability   * Introduce CQI reporting requirements to verify the support of CQI Table 3   + Option 1: CQI test in AWGN   + Option 2: CQI test in fading channel   + FFS:     - Target BLER     - Test metrics   UE demodulation requirements for low latency   * Introduce PDSCH demodulation performance requirements to verify PDSCH processing capability 2   + UL-DL configuration     - FFS on TDD pattern     - FFS on which slots will be scheduled * Introduce performance requirements to verify PDSCH mapping Type B with non-slot configured with fewer symbols than Rel-15 demod   + Option 1: define the additional PDSCH demodulation performance requirements   + Option 2: no specific requirement and verify it in the other introduced performance requirements * Introduce PDSCH demodulation performance requirements for pre-emption   + Verify the performance of UE flushing the URLLC PDSCH REs which is scheduled by DCI transmitted after that URLLC PDSCH   + FFS whether to define the demodulation requirements to verify decoding performance of PDSCH transmitted ahead of corresponding DCI   BS demodulation requirements for high reliability   * Other test cases will be defined with higher BLER and/or lower confidence level   + Other parameter combinations of HARQ, aggregation, channel etc. and further requirements will be considered.   + When further requirements are specified, it will be decided case by case whether to test them at 10^-5 BLER and CL 99.999% or other conditions   + Other test cases will include PUSCH aggregation     - FFS PUSCH aggregation level   BS demodulation requirements for high reliability   * FFS on introduction of PUCCH demodulation performance requirements   BS demodulation requirements for low latency   * Introduce PUSCH demodulation requirements to verify the support of PUSCH mapping Type B with non-slot configured with fewer symbols than Rel-15 * FFS requirements for UL transmission with grant free/UL configured grant |

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

* 1st round:
  + UE demodulation requirements:
* Key parameters for test cases to be defined for higher BLER and/or lower confidence level
* Conclude whether to define CQI reporting test with higher BLER
* Low latency
  + PDSCH processing capability 2
    - Initial agreements about some key parameters
  + PDSCH mapping Type B
    - Conclude how to verify the PDSCH mapping type B with non-slot configured with fewer symbols than Rel-15 demod features, i.e. individual test or combine with other requirements
      * If no individual test needed, verify with processing capability 2 or pre-emption
  + Pre-emption
    - Key parameters for eMBB demodulation requirements
    - Whether to define demodulation requirements for URLLC service
  + BS demodulation requirements:
* Cases with higher BLER and/or lower confidence level
* Key parameters
* PUCCH demodulation requirements
* Whether to define
* Low latency
* PUSCH mapping Type B
* Key parameters
* UL transmission grant free
  + - Whether to define
* 2nd round:
  + Agree on the initial simulation assumptions for those agreed test cases to facilitate further investigations or alignments.

# Topic #1: UE performance requirements for high reliability

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000371**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000371.zip) | Intel Corporation | Proposal #3: Introduce PDSCH demodulation test cases PDSCH slot aggregation with [1]% BLER requirement. |
| [**R4-2000944**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000944.zip) | NTT DOCOMO, INC. | Proposal 1: Following TDD configs should be supported for URLLC in order to avoid CLI.   * 1st priority   + 30kHz SCS: DDDSUUDDDD, S=6D:4G:4U   + 120kHz SCS: DDDSU, S=10D:2G:2U * 2nd priority   + 30kHz SCS: DSUU, S=12D:2G |
| [**R4-2001484**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001484.zip) | Huawei, HiSilicon | Proposal 4: We propose to test fading channel TDLA30-10.  Proposal 5: We propose to use lower BLER target of 10-3 when define other test cases.  Proposal 6: For test case TDLA30-10, we propose PDSCH aggregation level is 4. |
| [**R4-2001738**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001738.zip) | Ericsson | Proposal: Evaluate performance simulations for slot aggregation feature before setting BLER test point. |
| [**R4-2002142**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002142.zip) | Qualcomm Incorporated | Proposal 5: Only consider aggregation factor of 1 for low BLER high confidence level test. Define a separate test case for testing aggregation factor. |

## Open issues summary

In this section, the test parameters, such as target BLER, aggregation level and HARQ etc., for the cases of fading channels are discussed.

### Sub-topic 1-1: UE demodulation requirements with higher BLER and/or lower confidence level

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *Other test cases will be defined with higher BLER and/or lower confidence level* 
  + *Other parameter combinations of HARQ, aggregation, channel etc. and further requirements will be considered.*
  + *When further requirements are specified, it will be decided case by case whether to test them at 10^-5 BLER and CL 99.999% or other conditions*
  + *These test cases will include PDSCH aggregation if that is not included in the low BLER/high reliability testing.*

*FFS PDSCH aggregation level*

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: Target BLER**

* Proposals
  + Option 1: 1% BLER requirement (Intel, Ericsson)
  + Option 2: 10% (Ericsson)
  + Option 3: 0.1% (Ericsson, Huawei)
* Recommended WF
  + TBA

**Issue 1-1-2: PDSCH aggregation level**

*Note: This also depends on if the aggregation level is included in the low BLER/high reliability testing under discussion in email thread of URLLC testing.*

* Proposals
  + Option 1: 2, 4, 8 for FR1 FDD. (Ericsson)
  + Option 2: 4 and/or 7 for FR1 TDD (Ericsson)
  + Option 3: 2 and/or 3 for FR2 TDD (Ericsson)
  + Option 4: 4 (Huawei)
* Recommended WF
  + As per TS 38.331: *pdsch-AggregationFactor ENUMERATED { n2, n4, n8 }* , default value n1, so only aggregation level 2, 4 or 8 is applicable.

**Issue 1-1-3: TDD pattern**

* Proposals
  + FR1 30 kHz SCS:
    - Option 1: 7D1S2U, S=6D:4G:4U (Huawei, Ericsson)
    - Option 2: DDDSUUDDDD, S=6D:4G:4U (1st priority), DSUU, S=12D:2G (2nd priority) (DoCoMo)
  + FR2 120 kHz SCS:
    - Option 1: DDDSU, S=10D:2G:2U (Ericsson, DoCoMo)
* Recommended WF
  + Aggregation level and TDD pattern need to be discussed together, as per TS 38.214 section 5.1.2.1: *if the UE is configured with pdsch-AggregationFactor, the same symbol allocation is applied across the pdsch-AggregationFactor consecutive slots. The UE may expect that the TB is repeated within each symbol allocation among each of the pdsch-AggregationFactor consecutive slots and the PDSCH is limited to a single transmission layer.*

**Issue 1-1-4: Number of HARQ transmission**

* Proposals
  + Option 1: 1 (Ericsson)
  + Option 2: 4 (Huawei)
* Recommended WF
  + TBA

**Issue 1-1-5: MCS**

* Proposals
  + Option 1: MCS 4 in table 3 (Ericsson)
  + Option 2: MCS 5 in table 3 (Huawei)
* Recommended WF
  + TBA

Moderator’s observation: except the above test parameters, RAN4 can reuse all other test parameters from the existing requirements for PDSCH mapping Type A or B, FDD with 10MHz/15kHz SCS, TDD of FR1 with 40MHz/30kHz SCS, FR2 with 100MHz/120kHz SCS, 2Rx and 4Rx?

**Issue 1-1-6: Propagation condition**

* Proposals
  + FR1
    - Option 1: TDLC300-100 (Ericsson)
    - Option 2: TDLA30-10 (Huawei, Ericsson)
  + FR2
    - Option 1: TDLC60-300 (Ericsson)
    - Option 2: TDLA30-300 (Ericsson)
* Recommended WF
  + TBA

**Issue 1-1-7: SCS &CBW**

* Proposals
  + FDD
    - Option 1: 15 kHz & 10MHz (Huawei)
  + TDD
    - FR1: 30 kHz & 40MHz (Huawei, DoCoMo)
    - FR2: 120 kHz SCS (DoCoMo)
* Recommended WF
  + TBA

**Issue 1-1-8: PDSCH Mapping type**

* Proposals
  + Option 1: Type A (Ericsson)
  + Option 2: Type B (Huawei)
* Recommended WF
  + TBA

**Issue 1-1-9: Starting symbol (S)**

* Proposals
  + Option 1: 2 (Huawei, Ericsson)
* Recommended WF
  + TBA

**Issue 1-1-10: Length (L)**

* Proposals
  + Option 1: 12 (Ericsson)
  + Option 2: 4 (Huawei)
* Recommended WF
  + TBA

**Issue 1-1-11: Antenna configuration**

* Proposals
  + FR1
    - Option 1: 2x2, ULA low (Huawei)
    - Option 2: 2x2 and 2x4, ULA low (Ericsson)
  + FR2
    - Option 1: 2x2, ULA low (Ericsson)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 1-1:  Issue 1-1-1: We think it is better to wait with setting a strict BLER value until we have performance curves. Given different aggregation factors, and MCSs we need to set BLER requirements at not too low SNR values. Therefore, we are ok to leave BLER target metric open until we have simulated with a common set of simulation assumptions.  Issue 1-1-2: Our proposal with 3, and 7 is the practical values when configuring aggregation factor 4, and 8. For TDD patterns which are shorter than the aggregation factor will truncate the number of consecutive slots aggregated to 3, and 7 given DDDSU, and 7D1S2U respectively.  Issue 1-1-4: What’s the motivation behind having both HARQ and PDSCH aggregation factor configured together?  Issue 1-1-5: We are ok with either MCS4 or MCS5 but we think that we should not test with too high MCS given that PDSCH aggregation factor feature is intended for high reliability, not high throughput.  Issue 1-1-7: We are fine with using 10MHz/15kHz FDD, 40MHz/30kHz TDD FR1, 100MHz/120kHz TDD FR2  Issue 1-1-8: I don’t follow why we would allocate fewer than the maximum number of symbols and then do slot aggregation? If aggregation is needed to achieve sufficient SINR, why not use all slots?  ….  Others: |
| NTT DOCOMO | **Issue 1-1-2: PDSCH aggregation level**  We prefer to have at least 8, since it can guarantee the maximum performance benefit for PDSCH aggregation.  **Issue 1-1-3: TDD pattern**  We are generally fine to have 7D1S2U but we’d like to shifted it as DDDSUUDDDD (S=6d4g4u). For FR2, DDDSU (S=10d2g2u) is preferred.  **Issue 1-1-7: SCS &CBW**  FR1: 30 kHz & 40 MHz; FR2: 120 kHz & 100 MHz  **Issue 1-1-8: PDSCH Mapping type**  Option 1: Type A. But we are also fine to have type B, if type A is used for the test on high reliability with BLER 10^-5 and confidence level 99.999%.  **Issue 1-1-10: Length (L)**  Option 1: 12  **Issue 1-1-11: Antenna configuration**  Option 2: 2x2 and 2x4, ULA low |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #2: UE demodulation requirements for low latency

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000371**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000371.zip) | Intel Corporation | Proposal #6: Use PDSCH mapping Type B with 2 symbols in PDSCH processing capability 2 test case  Proposal #7: Introduce test case with PDSCH processing capability 2 with the following parameters:  PDSCH Mapping Type B with 2 symbols For TDD mode – TDD pattern: SU; S=12D+2G  Number of HARQ processes: 2  Proposal #8: Introduce requirement to test DL preemption indication on eMBB UE |
| [**R4-2000944**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000944.zip) | NTT DOCOMO, INC. | Proposal 1: Following TDD configs should be supported for URLLC in order to avoid CLI.   * 1st priority   + 30kHz SCS: DDDSUUDDDD, S=6D:4G:4U   + 120kHz SCS: DDDSU, S=10D:2G:2U * 2nd priority   + 30kHz SCS: DSUU, S=12D:2G   Proposal 2: For non-slot based transmission, L= 2 and 4 should be supported. |
| [**R4-2001485**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001485.zip) | Huawei, HiSilicon | Observation 1: PDSCH mapping Type B of 2-symbol and 4-symbol can be supported by the special slot of ‘DDDSU’ pattern.  Observation 2: PDSCH mapping Type B of 2-symbol and 4-symbol can be supported by the special slot of ‘7D1S2U’ pattern.  Proposal 1: No specific requirement is needed for PDSCH mapping Type B, it can be verified with UE processing capability 2 requirements.  Proposal 2: To define UE processing capability 2, we propose to use ‘DDDSU’ pattern and use the PDSCH mapping Type B with 2-symbol configuration on the special slot to verify the performance requirements.  Proposal 3: we propose to use combination of {14, 1} for PI and periodicity T­INT =1.  Proposal 4: Define the RAN5 test to verify URLLC performance for pre-emption. |
| [**R4-2001739**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001739.zip) | Ericsson | Observation 1: URLLC UEs using pre-emption to transmit data do not need new demodulation requirements to ensure pre-emption functionality.  Observation 2: eMBB UEs which are affected by DL pre-emption need new demodulation requirements to support URLLC data pre-emption indication from DCI format 2\_1.  Observation 3: Rel-15 eMBB UE requirements do not have any performance requirements for DL data pre-emption. Therefore, if this feature is introduced, legacy Rel-15 eMBB demodulation performance cannot be guaranteed in a Release heterogenous network including pre-emption capable gNBs and UEs.  Proposal 1: Introduce a selected number of test cases for eMBB scheduled UEs with REs punctured for the URLLC pre-empted UE.  Proposal 2: Capture eMBB demodulation requirements for DL pre-emption by reusing three Rel-15 test cases (FR1 FDD, FR1 TDD, and FR2 TDD) and applying additional configurations from Table 1, and Table 2.  Proposal 3: Capture new demodulation requirements for Type B non-slot transmission based on the parameters found in Table 3, and Table 4.  Proposal 4: Introduce UE demodulation test case with k1 HARQ timing value which corresponds to PDSCH processing Capability 2. Base demodulation test cases off tests from Table 6. This is applicable for both FDD and TDD and for TDD, RAN4 reuse the existing TDD UL/DL configuration. |
| [**R4-2002142**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002142.zip) | Qualcomm Incorporated | Proposal 6: Use 2 symbol PDSCH Type B grant and set HARQ parameter k1 = 0 for testing URLLC low latency feature.  Proposal 7: Use FR1.30-2 (DDDSU, S = 10D+2G+2U) slot pattern and schedule grant only on S slot for testing URLLC low latency feature for TDD. |

## Open issues summary

In this section, views about the features related to low latency are summarised that include PDSCH mapping Type B, PDSCH processing capabiltiy 2 and pre-emption. How to verify these three features, devise individual test case or verify two features in one test cases need to be discussed firstly before the dicussion for the detailed test parameters.

### Sub-topic 2-1: PDSCH processing capability 2

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

*UE demodulation requirements for low latency*

* *Introduce PDSCH demodulation performance requirements to verify PDSCH processing capability 2*
  + *UL-DL configuration* 
    - *FFS on TDD pattern*
    - *FFS on which slots will be scheduled*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: How to verify PDSCH processing capability 2**

* Proposals
  + Option 1: Verify it with PDSCH mapping Type B (Intel, Huawei, Qualcomm)
  + Option 2: Individual test by reusing the Rel-15 eMBB test cases with change of the HARQ timing K1 values (Ericsson)

|  |  |  |  |
| --- | --- | --- | --- |
| **Test cases** | **FR1 FDD** | **FR1 TDD** | **FR2 TDD** |
| 38-101-4 v.15.4.0 Table | 5.2.2.1.1-4 | 5.2.2.2.1-4 | 7.2.2.2.1-4 |
| Test number | 2-1 | 2-1 | 2-2 |
| TDD UL-DL pattern | N/A | FR1.30-1 (7D1S2U) | FR2.120-1 (DDDSU) |
| FRC | R.PDSCH.1-3.1 FDD | R.PDSCH.2-3.1 TDD | R.PDSCH.5-2.2 TDD |

* Recommended WF
  + TBA

***Note：If verify PDSCH processing capability 2 with mapping Type B, proposals from companies are captured below:***

**Issue 2-1-2: Slots to be scheduled**

* Proposals
  + Option 1: S slot (Intel, Huawei, Qualcomm)
* Recommended WF
  + TBA

**Issue 2-1-3: TDD pattern**

* Proposals
  + FR1 TDD 30kHz SCS:
    - Option 1: 7D1S2U, S=6D:4G:4U (Ericsson)
    - Option 2: DDDSUUDDDD, S=6D:4G:4U (1st priority), DSUU, S=12D:2G (2nd priority) (DoCoMo)
    - Option 3: DDDSU, S=10D+2G+2U (Huawei, Qualcomm)
    - Option 4: SU, S=12D+2G (Intel)
  + FR2 120 kHz SCS:
    - Option 1: DDDSU, S=10D:2G:2U (Ericsson, DoCoMo)
* Recommended WF
  + TBA

**Issue 2-1-4: Number of HARQ processes**

* Proposals
  + Option 1: 2 (Intel)

**Issue 2-1-5: Parameter K1**

* Proposals
  + Option 1: 0 (Qualcomm)

### Sub-topic 2-2: PDSCH mapping Type B

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *Introduce performance requirements to verify PDSCH mapping Type B with non-slot configured with fewer symbols than Rel-15 demod*
  + *Option 1: define the additional PDSCH demodulation performance requirements*
  + *Option 2: no specific requirement and verify it in the other introduced performance requirements*

Note: this open issue is captured in Issue 2-1-1, here discuss the specific test parameters related to mapping Type B.

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: Slots scheduled with data**

* Proposals
  + Option 1: All available DL slots/symbols, i.e. same as the existing Rel-15 Type B requirements
  + Option 2: Verify it every 10th with agreed parameter set (Ericsson)
* Recommended WF
  + TBA

**Issue 2-2-2: Symbol length (L)**

* Proposals
  + Option 1: 2 and 7os (Ericsson)
  + Option 2: 2os (Huawei, Intel, Qualcomm)
  + Option 3: 2 and 4os (DoCoMo)
* Recommended WF
  + TBA

**Issue 2-2-3: Starting symbol (S)**

* Proposals
  + Option 1: 3 (Ericsson)
  + Option 2: 2 (Huawei, Intel)
* Recommended WF
  + TBA

**Issue 2-2-4: Other test parameters**

* Proposals
  + Option 1: (Ericsson)

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| --- | --- | --- | --- |
| **Test cases** | **FR1 FDD** | **FR1 TDD** | **FR2 TDD** |
| Channel model | TDLC300-100 | TDLC300-100 | TDLA30-300 |
| Antenna configuration | 2x2, ULA low | 2x2, ULA low | 2x2, ULA low |
| MCS | 4 | 4 | 4 |
| Scheduling type | Type B 2 and 7os | Type B 2 and 7os | Type B 2 and 7os |
| Starting symbol (S) | 3 | 3 | 3 |
| Slots allocated with data | 1 slot per 10 slots | 1 slot per 10 slots | 1 slot per 10 slots |
| Number of contiguous PRB | Maximum transmission bandwidth and smaller allocation | Maximum transmission bandwidth and smaller allocation | Maximum transmission bandwidth and smaller allocation |
| FRC | TBD | TBD | TBD |

* + Option 2: Reuse the test parameters of the existing Rel-15 PDSCH Type B requirements.
* Recommended WF
  + TBA

### Sub-topic 2-3: Pre-emption indication

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *Introduce PDSCH demodulation performance requirements for pre-emption*
  + *Verify the performance of UE flushing the URLLC PDSCH REs which is scheduled by DCI transmitted after that URLLC PDSCH*
  + *FFS whether to define the demodulation requirements to verify decoding performance of PDSCH transmitted ahead of corresponding DCI*

*Open issues and candidate options before e-meeting:*

**Issue 2-3-1: Test parameters to verify DL pre-emption indication for eMBB UE**

1. Pre-emption periodicity
   * + Proposals
       - Option 1: 10% probability within 1 radio frame (Ericsson)
       - Option 2: 1 slot (Huawei)
     + Recommended WF
       - TBA
2. Time frequency set
   * + Proposals
       - Option 1: 14x1 (Huawei, Ericsson)
     + Recommended WF
       - TBA
3. Number of symbols to be pre-empted
   * + Proposals
       - Option 1: 2 and 7 (Ericsson)
     + Recommended WF
       - TBA
4. Starting symbol to be pre-empted
   * + Proposals
       - Option 1: 3 (Ericsson)
     + Recommended WF
       - TBA
5. Reuse the existing Rel-15 test cases for all other test parameters
   * + Proposals
       - Option 1: (Ericsson)

|  |  |  |  |
| --- | --- | --- | --- |
| **Test cases** | **FR1 FDD** | **FR1 TDD** | **FR2 TDD** |
| Channel model | TDLC300-100 | TDLC300-100 | TDLA30-300 |
| Antenna configuration | 2x2, ULA low | 2x2, ULA low | 2x2, ULA low |
| FRC (modified for every 10th slot) | R.PDSCH.1-2.1 FDD | R.PDSCH.2-2.1 TDD | R.PDSCH.5-2.1 TDD |

* + - * Option 2:
    - Recommended WF
      * TBA

**Issue 2-3-2: Impact on legacy Rel-15 eMBB UE by this Rel-16 eMBB UE requirements for PI**

* Observations
* Observation 3: Rel-15 eMBB UE requirements do not have any performance requirements for DL data pre-emption. Therefore, if this feature is introduced, legacy Rel-15 eMBB demodulation performance cannot be guaranteed in a Release heterogenous network including pre-emption capable gNBs and UEs. (Ericsson)
* Recommended WF
  + PI is a feature of optional with UE capability signalling, test applicability should be defined for eMBB UE performance requirements.

**Issue 2-3-3: Whether to define URLLC demodulation requirements for PI**

* Proposals
  + Option 1: No. (Ericsson, Huawei)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
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| **Company** | **Comments** |
| Ericsson | Sub-topic 2-1:  Issue 2-1-1: We think that pre-emption indication and Type B non-slot scheduling tests should be tested separately but with similar parameters. Pre-emption flushing data in certain eMBB UE REs, Type B non-slot URLLC UEs instead being scheduled in the eMBB flushed REs. In both cases the UE is not expected to be scheduled continuously. So for pre-emption and non-slots we propose to pre-empt 10% of slots. For PDSCH processing capability 2, we propose to test every slot as this is more realistic. In summary:  • Pre-emption test with 2os, and 7os pre-empted at symbol 3 (10% of slots; i.e. 1 in every 10)  • Type B non-slot test with 2os, and 7os starting at symbol 3 (10% of slots; i.e. 1 in every 10)  • PDSCH capability 2 test case design by changing K1 HARQ timing values based off existing eMBB tests  We see that other companies propose to combine the non-slot and PDSCH processing capability 2 test; we will further consider this. We welcome other companies views on these tests.  Sub-topic 2-2:  Issue 2-2-3: If we start at symbol 2, the first DMRS symbol for eMBB will not be scheduled making demodulation performance for eMBB suffer.  Issue 2-2-4:  ….  Others: |
| NTT DOCOMO | **Issue 2-1-1: How to verify PDSCH processing capability 2**  Option 1: Verify it with PDSCH mapping Type B  **Issue 2-1-2: Slots to be scheduled**  Option 1: S slot  **Issue 2-1-3: TDD pattern**  For FR1, we prefer DDDSUUDDDD, S=6D:4G:4U. However we are open to have different TDD patterns between high reliability and low latency. In addition, we prefer to have DSUU. For FR2, we prefer Option 1: DDDSU, S=10D:2G:2U.  **Issue 2-1-4: Number of HARQ processes**  We understand that # of necessary processes can be 2 in the test, since DL packet is scheduled in S slot only. However in the real low latency system, we need larger # of HARQ processes, since DL data is multiplexed also for D slot. If number of HARQ processes can be guaranteed with eMBB test cases, we can allow small number of HARQ processes.  **Issue 2-2-1: Slots scheduled with data**  Option 1: All available DL slots/symbols  **Issue 2-2-2: Symbol length (L)**  Option 3: 2 and 4os. Because 7 os is supported in eMBB test. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #3: CQI reporting requirements for support of CQI table 3

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000371**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000371.zip) | Intel Corporation | Proposal #5: Introduce CQI reporting test case with CQI table 3 for fading channel conditions |
| [**R4-2001486**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001486.zip) | Huawei, HiSilicon | Proposal 1: Introduce CQI reporting requirements to verify the support of CQI Table 3 in AWGN.  Proposal 2: Consider a higher BLER target, e.g. 1-10-3.  Proposal 3: The BLER criteria test metrics presented in TS38.101-4 Section 6 can be reused.  Proposal 4: Define CQI reporting tests for 2Rx with FDD and TDD modes. |
| [**R4-2001739**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001739.zip) | Ericsson | Observation 4: the eMBB designed CQI tests does not satisfy the criteria needed for UEs supporting CQI table 3.  Proposal 5: New CQI should be designed with either lower BLER target metric (e.g. 1%, or 1‰ BLER) or using a different metric e.g. percentage based of the maximum theoretical throughput (per MCS). |
| [**R4-2002142**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2002142.zip) | Qualcomm Incorporated | Proposal 1: Define CQI reporting tests for testing 99.999% reliability under AWGN condition.  Proposal 2: Define a lower bound for median reported CQI in the CQI reporting tests for 99.999% reliability.  Observation 1: Only one long test needs to be run for testing CQI reporting under AWGN condition for 1e-5 BLER with 99.999% confidence level.  Proposal 3: Define CQI reporting test under AWGN condition with 99.999% confidence level.  Observation 2: It is possible to have an applicability rule between CQI reporting test and FMCS test under AWGN.  Proposal 4: Consider evaluating the UE performance with and without HARQ. If they are similar, we can have an applicability rule between CQI reporting test and FMCS test under AWGN to reduce the number of tests. |

## Open issues summary

*From the approved WF R4-1915913 in RAN4 #93 meeting, following were agreed:*

* *Introduce CQI reporting requirements to verify the support of CQI Table 3*
  + *Option 1: CQI test in AWGN*
  + *Option 2: CQI test in fading channel*
  + *FFS:*
    - *Target BLER*
    - *Test metrics*

*Open issues and candidate options before e-meeting:*

### Sub-topic 3-1: Propagation channel

**Issue 3-1: Propagation channel for CQI reporting**

* Proposals
  + Option 1: AWGN (Qualcomm, Huawei)
  + Option 2: Fading channel (Intel)
* Recommended WF
  + TBA

### Sub-topic 3-2: Target BLER and test metric

**Issue 3-2-1: Target BLER**

* Proposals
  + Option 1: 10^-3 (Huawei, Ericsson)
  + Option 2: 10^-2 (Ericsson)
  + Option 3: 10^-5 (Qualcomm)
* Recommended WF
  + TBA

**Issue 3-2-2: Test metric**

* Proposals
  + Option 1: Reuse existing BLER criteria test metrics (Huawei, Ericsson)
  + Option 2: Percentage based of the maximum theoretical throughput (per MCS) (Ericsson)
* Recommended WF
  + TBA

### Sub-topic 3-3: Test applicability for CQI reporting and FMCS

**Issue 3-3-1: Feasibility to define CQI reporting test case and FMCS case at the same SNR**

* Proposals
  + Option 1: Consider evaluating the UE performance with and without HARQ. If they are similar, we can have an applicability rule between CQI reporting test and FMCS test under AWGN to reduce the number of tests. (Qualcomm)
  + Option 2:
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #4: BS demodulation requirements for high reliability

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000371**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000371.zip) | Intel Corporation | Proposal #4: Introduce PUSCH demodulation test cases for PUSCH slot aggregation with [1]% BLER requirement. |
| [**R4-2000313**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000313.zip) | Samsung | Proposal 3: The following test parameters for PUSCH with high BLER requirement could be considered:  PUSCH aggregation Factor: 2  SCS &BW: 15 KHz, 10 MHz; 30 KHz, 40 MHz;  HARQ: 4  Antenna configuration: 1x2  Mapping type: type A  DMRS symbol: 1+1  Channel condition: TDLB100-400  Symbol length: 14  Waveform: CP-OFDM  MCS: 5 |
| [**R4-2001179**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001179.zip) | Ericsson | *Parameters are listed in tables, please see the documents for details.* |
| [**R4-2001197**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001197.zip) | NTT DOCOMO, INC. | Proposal 1: For URLLC requirements, consider the following SCS:   * 15/30/60(FR2)/120kHz SCS   NOTE: For FR1, the same requirements are applicable to both TDD and FDD.  Proposal 2: For URLLC requirements, the following TDD UL-DL patterns are used as simulation assumptions:   * 15kHz SCS: 3D1S1U, S=10D:2G:2U * 30kHz SCS: 7D1S2U, S=6D:4G:4U * 60kHz SCS: 3D1S1U, S=10D:2G:2U * 120kHz SCS: 3D1S1U, S=10D:2G:2U   Proposal 3: If no performance difference among different TDD UL-DL patterns is observed, the same requirements are applicable to any TDD UL-DL patterns. Otherwise, RAN4 to study how to support other TDD UL-DL patterns.  NOTE: From our perspective, at least the following TDD UL-DL patterns need to be supported.   * 1st priority   + 30kHz SCS: DDDSUUDDDD, S=6D:4G:4U   + 120kHz SCS: DDDSU, S=10D:2G:2U * 2nd priority   + 30kHz SCS: DSUU, S=12D:2G |
| [**R4-2001487**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001487.zip) | Huawei, HiSilicon | Proposal 4: We propose to test TDLB100-400 and TDLC300-100.  Proposal 5: We propose to use lower BLER target of 10-3 when define other test cases.  Proposal 6: For test case TDLB100-400 and TDLC300-100, we propose PUSCH aggregation level is 4. |
| [**R4-2001696**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001696.zip) | Nokia, Nokia Shanghai Bell | PUSCH relaxed high reliability requirements  Proposal 2: For any relaxed high reliability requirements defined for PUSCH, the confidence level and BLER target need to be on the same order of magnitude (CL ~= 1-BLER) or better.  Proposal 3: RAN4 to introduce relaxed high reliability requirements for PUSCH slot aggregation factor n4, with HARQ activated at the same time.  Proposal 4: RAN4 to introduce relaxed high reliability requirements using the low spectral efficiency table with an MCS having a lower coding rate than what would be possible without the low SE table, i.e., MCS 5 or lower.  Proposal 5: RAN4 to agree on relaxed high reliability requirements being not more test time intensive than BLER = 1e-2 with CL = 1-1e-2.  MCS table to be used  **Observation 2:** It is not clear from the adhoc minutes of RAN4#93, if PUSCH MCS was agreed to be chosen from the low SE table or not. The captured discussion and agreements seem to not align.  Proposal 6: RAN4 to clarify that the low spectral efficiency MCS tables are to be used for feasibility evaluation and eventual requirement definition.  Choice of static channel  **Observation 3:** Choosing the propagation condition of static channel (AWGN) eliminates the need for larger bandwidths to protect against systematic deep fading effects in fading channel models via frequency diversity.  Proposal 7: RAN4 to consider stat channel (AWGN) propagation conditions only, for all requirements with BLER <= 1e-3.  Proposal 11: If high reliability will be tested with BLER metric, add the following note to the test specification: “Note that this test procedure will only provide an indication to a certain confidence level that the target reliability requirements are likely to be satisfied, and it is assumed that for critical applications further testing would be done to ensure suitability of the equipment for the intended application.” |

## Open issues summary

In this section, the target BLER and confidence level for cases of fading channels with slot aggregation, HARQ, etc. are discussed. The views of slot aggregation factor are provided. After the 1st round, we should decide how many cases will be defined and the key parameters should be decided for each case.

### Sub-topic 4-1: PUSCH performance requirements with higher BLER and/or lower confidence level

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *Other test cases will be defined with higher BLER and/or lower confidence level* 
  + *Other parameter combinations of HARQ, aggregation, channel etc. and further requirements will be considered.*
  + *When further requirements are specified, it will be decided case by case whether to test them at 10^-5 BLER and CL 99.999% or other conditions*
  + *Other test cases will include PUSCH aggregation* 
    - *FFS PUSCH aggregation level*

*Open issues and candidate options before e-meeting:*

**Issue 4-1-1: Target BLER**

* Proposals
  + Option 1: 1% (Intel, Samsung, Nokia)
  + Option 2: 10% (Ericsson)
  + Option 3: 0.1% (Huawei)
* Recommended WF
  + TBA

**Issue 4-1-2: Target confidence level**

* Proposals
  + Option 1: 99% , i.e. 1-BLER or better (Nokia)
  + Option 2: 95% (Ericsson)
* Recommended WF
  + TBA

**Issue 4-1-3: PUSCH aggregation level**

* Proposals
  + FDD
    - Option 1: 2 (Samsung)
    - Option 2: 4 (Nokia, Huawei)
    - Option 3: 4, 8 (Ericsson)
  + TDD
    - Option 1: 2 (Samsung, Ericsson)
    - Option 2: 4 (Nokia, Huawei)
* Recommended WF
  + TBA

**Issue 4-1-4: Number of HARQ transmission**

* Proposals
  + Option 1: 1 (Ericsson)
  + Option 2: 4 (Samsung, Huawei)
  + Option 3: HARQ activated (Nokia)
* Recommended WF
  + TBA

**Issue 4-1-5: Waveform**

* Proposals
  + Option 1: CP-OFDM (Ericsson, Huawei, Samsung)
* Recommended WF
  + TBA

**Issue 4-1-6: MCS**

* Proposals
  + Option 1: MCS 5 in table 3 (Huawei, Nokia, Samsung)
  + Option 2: MCS 8 in table 3 (Ericsson)
* Recommended WF
  + TBA

**Issue 4-1-7: SCS&BW**

* Proposals for SCS
  + FR1:
    - FDD:
      * Option 1: 15 kHz (Samsung)
      * Option 2:
    - TDD
      * Option 1: 15 kHz and 30 kHz (Ericsson)
      * Option 2: 30 kHz (Huawei, DoCoMo, Samsung)
  + FR2:
    - TDD
      * Option 1: 60 kHz and 120 kHz (Ericsson)
* Proposals for BW
  + FR1:
    - FDD:
      * Option 1: 10MHz/15kHz (Samsung)
    - TDD
      * Option 1: 40MHz/30kHz (Samsung)
  + FR2:
    - TDD
      * Option 1:
* Recommended WF
  + TBA

**Issue 4-1-8: Number of PRBs**

* Proposals
  + Option 1: 25 (Ericsson)
  + Option 2:
* Recommended WF
  + TBA

**Issue 4-1-9: TDD pattern**

* Proposals
  + 15kHz SCS: 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
  + 30kHz SCS:
    - Option 1: 7D1S2U, S=6D:4G:4U (DoCoMo, Huawei, Ericsson, DCM)
    - Option 2: DDDSUUDDDD, S=6D:4G:4U(1st priority), DSUU, S=12D:2G (2nd priority) (DoCoMo)
  + 60kHz SCS (FR2): 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
  + 120kHz SCS: 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
* Recommended WF
  + TBA

**Issue 4-1-10: Mapping type**

* Proposals
  + Option 1: Type A (Samsung)
  + Option 2: Type B (Huawei)
  + Option 3: Type A and B (Ericsson)
* Recommended WF
  + TBA

**Issue 4-1-11: Symbol length**

* Proposals
  + Option 1: 14 (Samsung, Ericsson)
  + Option 2: 4 (Huawei)
* Recommended WF
  + TBA

**Issue 4-1-12: Starting symbol**

* Proposals
  + Option 1: 0 (Ericsson)
  + Option 2:
* Recommended WF
  + TBA

**Issue 4-1-13: DM-RS configuration**

* Proposals
  + Option 1: Type 1 with single-symbol：1+1 (Ericsson)
  + Option 2:
* Recommended WF
  + TBA

**Issue 4-1-14: Antenna configuration**

* Proposals
  + Option 1: 1x2, ULA low (Ericsson, Samsung)
  + Option 2: 2x2, ULA low (Huawei)
* Recommended WF
  + TBA

**Issue 4-1-15: Propagation condition**

* Proposals
* FR1:
  + Option 1: TDLB100-400 (Samsung, Ericsson, Huawei)
  + Option 2: AWGN with BLER <= 1e-3 (Nokia)
* FR2: TDLA30-300 (Ericsson)
* Recommended WF
  + TBA

### Sub-topic 4-2: Others

Safety critical aspects:

* Proposals
* Proposal 11: If high reliability will be tested with BLER metric, add the following note to the test specification: “Note that this test procedure will only provide an indication to a certain confidence level that the target reliability requirements are likely to be satisfied, and it is assumed that for critical applications further testing would be done to ensure suitability of the equipment for the intended application.” (Nokia)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 4-1-1: It is not clear whether this BLER, in case of HARQ is 1st transmission BLER or BLER after all transmissions. In our paper on PUCCH, we justify not needing new PUCCH requirements by assuming that the 1st transmission BLER on HARQ should be 10^-3 or lower. So in our view this BLER should be the 1st transmission BLER. We do not have a very strong opinion about the BLER value; any of the proposed values are OK with us.  Issue 4-1-2: We do not have a strong opinion on the confidence level and are OK with either suggestion.  Issue 4-1-3: For the basestation, an important question relating to the aggregation factor is whether we use the same TDD pattern for the demod requirements, or another TDD pattern or FDD. If we us the same TDD pattern, only aggregation 2 contiguous or 4 with not contiguous aggregated slots is possible.  Issue 4-1-4: If we have a high aggregation factor (e.g. 8) and up to 4 transmissions then the scenario seems a bit unlikely from a resource usage perspective; it could take 32 slots worst case to transmit 1 packet! If we have aggregation 4, then HARQ may also be needed, although possibly fewer than 4 max transmissions otherwise the resource usage could still be high. If we agree only aggregation factor 2 then HARQ with 4 transmissions seems reasonable.  As discussed in our paper on PUCCH, if really operating at 10^-5 BLER, then the 1st transmission BLER would need to be around 10^-3. If we agree a reasonably low 1st transmission BLER then anyhow the average resource usage will be OK and we can consider HARQ.  Issue 4-1-6: We are also OK with MCS 5  Issue 4-1-7 (SCS): This topic is also a bit linked with whether we define requirements with a TDD pattern like in rel-15 or for both FDD and TDD patterns. Our assumption is that we define requirements like today, which is why we suggest both SCS. We can use an applicability rule and only test 1 SCS.  Issue 4-1-7 (BW), 4-1-8: We think that we just need to agree the number of PRBs. Since the scenario is one in which the UE is power limited (i.e. aggregation is needed to achieve sufficient SINR to reach the target BLER), we do not see a need for more PRBs than 25. Otherwise, in a scenario where more than 25 PRBs would be allocated, it would be better for the network to assign fewer PRBs, hence getting higher PSD and not do aggregation.  Issue 4-1-9: Apart from the TDD pattern, nobody seems to have proposed to use FDD. So should we agree that the requirements are defined based on a TDD pattern ? This has implications to some of the other questions above.  Issue 4-1-11: I don’t follow why we would allocate fewer than the maximum number of symbols and then do slot aggregation ? If aggregation is needed to achieve sufficient SINR, why not use all slots ?  Issue 4-1-14: It is not clear why to do 2x2 instead of 1x2 like we use for other requirements.  Sub-topic 4-2: We support to add some kind of clarification on how to interpret the requirements; we would need to work on the exact wording. The same should be done for the ultra-low BLER test.  ….  Others: |
| NTT DOCOMO | Issue 4-1-3: Our preference is to include at least 8. As a base line, maximum aggregation level should be used to verify the functionality of PUSCH aggregation.  Issue 4-1-4: We prefer Option 2 since it is more typical assumption.  Issue 4-1-5: Our preference is to introduce DFT-s-OFDM. This is a typical assumption in URLLC scenario since DFT has a lower PAPR and is more reliable than CP-OFDM.  Issue 4-1-6: We support Option 1.  Issue 4-1-7: Regarding SCS, our original proposal is to introduce 15/30/60/120kHz SCS. (i.e., For FR1, 15kHz and 30kHz for FDD/TDD, for FR2, 60kHz and 120kHz). If we can have common requirements for both TDD and FDD, we don't need to split the requirements to TDD and FDD for FR1 (NOTE: this principle is the same as existing normal demodulation requirements). However, if this principle cannot be used for high reliability requirements, we would like to prioritize 15kHz for FR1 FDD, 30kHz for FR1 TDD and 120kHz for FR2.  Regarding CBW, the same sets as existing normal PUSCH demodulation can be used. i.e., 5/10/20MHz for FR1 15kHz SCS, 10/20/40/100MHz for FR1 30kHz SCS, 50/100MHz for 60kHz SCS, 50/100/200MHz for 120kHz SCS.  Issue 4-1-8: Basically, number of PRB depends on CBW. We prefer to use full PRB allocation.  Issue 4-1-9: For 30kHz SCS, if the requirements are applicable for any TDD patterns including DDDSUUDDDD, S=6D:4G:4U and DSUU, S=12D:2G, we are OK with Option 1. If not applicable, we need further discussion on how to support other TDD patterns.  Issue 4-1-10: We prefer Option 3 for FR1 and Option 2 for FR2.  Issue 4-1-11: It depends on mapping types. For mapping type A, we are OK with 14 symbols. For mapping type B, we need further discussion.  Issue 4-1-13: We prefer 1+1 for FR1 and 1+0 for FR2.  Issue 4-1-14: We support Option 1.  Issue 4-1-15: We support Option 1. The performance of AWGN channel can be considered in other requirement with 10^-5 BLER and 99.999% CL, so we should focus on fading channel in this requirement. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Recommendations on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #5: BS demodulation requirements for low latency

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000371**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000371.zip) | Intel Corporation | Proposal #9: For BS demodulation introduce requirements with PUSCH mapping Type B with 4 symbols |
| [**R4-2000313**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000313.zip) | Samsung | Proposal 5: No BS demodulation requirements for UL transmission with grant free/UL configured grant.  Proposal 6: Non-slot scheduling with 2 symbols can be considered for the lower latency requirement.  Proposal 7: The following test parameters for PUSCH with lower latency requirement could be considered:  PUSCH aggregation Factor: 1  SCS &BW: 120 KHz, 50 MHz;  HARQ: 4  Antenna configuration: 1x2  Mapping type: type B  DMRS symbol: 1  Channel condition: TDLB100-400  Symbol length: 2  Waveform: CP-OFDM  MCS: 5 |
| [**R4-2001180**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001180.zip) | Ericsson | *Parameters are listed in tables, please see the documents for details* |
| [**R4-2001181**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001181.zip) | Ericsson | Proposal: No need to introduce new demodulation performance requirements in RAN4 to test the reception of the PUSCH grant free transmissions. |
| [**R4-2001197**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001197.zip) | NTT DOCOMO, INC. | Proposal 1: For URLLC requirements, consider the following SCS:   * 15/30/60(FR2)/120kHz SCS   NOTE: For FR1, the same requirements are applicable to both TDD and FDD.  Proposal 2: For URLLC requirements, the following TDD UL-DL patterns are used as simulation assumptions:   * 15kHz SCS: 3D1S1U, S=10D:2G:2U * 30kHz SCS: 7D1S2U, S=6D:4G:4U * 60kHz SCS: 3D1S1U, S=10D:2G:2U * 120kHz SCS: 3D1S1U, S=10D:2G:2U   Proposal 2: For URLLC requirements, the following TDD UL-DL patterns are used as simulation assumptions:   * 15kHz SCS: 3D1S1U, S=10D:2G:2U * 30kHz SCS: 7D1S2U, S=6D:4G:4U * 60kHz SCS: 3D1S1U, S=10D:2G:2U * 120kHz SCS: 3D1S1U, S=10D:2G:2U   Proposal 3: If no performance difference among different TDD UL-DL patterns is observed, the same requirements are applicable to any TDD UL-DL patterns. Otherwise, RAN4 to study how to support other TDD UL-DL patterns.  NOTE: From our perspective, at least the following TDD UL-DL patterns need to be supported.   * 1st priority   + 30kHz SCS: DDDSUUDDDD, S=6D:4G:4U   + 120kHz SCS: DDDSU, S=10D:2G:2U * 2nd priority   + 30kHz SCS: DSUU, S=12D:2G   Proposal 4: For non-slot based PUSCH, L = 2, 4, 7 should be considered.  Proposal 5: Introduce BS performance requirements for UL configured grant (grant-free). |
| [**R4-2001488**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001488.zip) | Huawei, HiSilicon | Proposal 1: To verify mapping Type B, we propose to use symbol length is 4 and start symbol is 0.  Proposal 2: 15 KHz SCS is configured for FDD mode, and 30KHz SCS is configured for TDD mode.  Proposal 3: UL-DL pattern ‘7D1S2U (S=6D+4G+4U)’ is used for TDD.  Proposal 4: We propose the number of Tx antennas is 2 and the number of Rx antennas is 2.  Proposal 5: Only requirements for PUSCH with transform precoding disabled is defined.  Proposal 6: We propose to use MCS5 from MCS table 3.  Proposal 7: There is no need to introduce the new demodulation performance requirements to verify uplink grant free transmissions. |
| [**R4-2001696**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001696.zip) | Nokia, Nokia Shanghai Bell | Low latency BS demodulation requirements  Type B PUSCH time domain resource allocation can provision 2 DM-RS symbols starting from an allocation length of 5 symbols.   1. RAN4 to introduce PUSCH Type B demodulation requirements with an allocation length of 5 symbols and using the R15 PUSCH KPIs.   Demodulation performance is expected to be independent from the grant choice.   1. RAN4 to not introduce requirements for UL transmission with grant free/UL configured grant. |

## Open issues summary

Two sub-topics are included in this section: demodulation requirements for PUSCH mapping mapping Type B and conclusions about whether to define the demodulation requirements for UL transmission grant free.

### Sub-topic 5-1: PUSCH mapping Type B

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *Introduce PUSCH demodulation requirements to verify the support of PUSCH mapping Type B with non-slot configured with fewer symbols than Rel-15*

The demodulation requirements for PUSCH mapping Type B has already been decided to be defined in #93. In this meeting, parameters of the test case should be discussed and decided.

*Open issues and candidate options before e-meeting:*

**Issue 5-1-1: Symbol length (L)**

* Proposals
  + Option 1: 4os (Intel, Huawei)
  + Option 2: 2os (Samsung)
  + Option 3: 2os, 4os and 7os (DoCoMo)
  + Option 5: 5os (Nokia)
  + Option 7: 2os or 7os (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-2: Starting symbol (S)**

* Proposals
  + Option 1: 0 (Huawei, Ericsson)
  + Option 2:
* Recommended WF
  + TBA

**Issue 5-1-3: DM-RS configuration**

* Proposals
  + Option 1: Type 1 with single-symbol 1+0 for 2os, 1+1 for 7os (Ericsson)
  + Option 2:
* Recommended WF
  + TBA

**Issue 5-1-4: PUSCH aggregation factor**

* Proposals
  + Option 1: 1 (Samsung)
  + Option 2: 2 (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-5: Number of HARQ transmission**

* Proposals
  + Option 1: 4 (Samsung, Huawei)
  + Option 2: 1 (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-6: Waveform**

* Proposals
  + Option 1: CP-OFDM (Samsung, Huawei)
  + Option 2: DFT-s-OFDM (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-7: MCS**

* Proposals
  + Option 1: MCS 5 from Table 3 (Samsung, Huawei)
  + Option 2: MCS 21 (658/1024) from Table 2 (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-8: SCS &BW**

* Proposals for SCS
  + FR1
    - FDD: 15 kHz SCS (Huawei)
    - TDD
      * Option 1: 15 kHz and 30 kHz (DoCoMo, Ericsson)
      * Option 2: 30 kHz (Huawei)
  + FR2
    - TDD
      * Option 1: 60 kHz and 120 kHz (DoCoMo, Ericsson)
      * Option 2: 50MHz/120 kHz (Samsung)
* Proposals for BW
  + FR1
    - FDD:
    - TDD:
  + FR2
    - TDD
      * Option 1: 50MHz/120 kHz (Samsung)
* Recommended WF
  + TBA

**Issue 5-1-9: Number of PRB**

* Proposals
  + Option 1: full bandwidth (Huawei)
  + Option 2: 8 (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-10: TDD patterns**

* Proposals
  + 15kHz SCS: 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
  + 30kHz SCS:
    - Option 1: 7D1S2U, S=6D:4G:4U (DoCoMo, Huawei, Ericsson)
    - Option 2: 30kHz SCS: DDDSUUDDDD, S=6D:4G:4U (1st priority), DSUU, S=12D:2G (2nd priority) (DoCoMo)
  + 60kHz SCS: 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
  + 120kHz SCS: 3D1S1U, S=10D:2G:2U (DoCoMo, Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-11: Antenna configuration**

* Proposals
  + Option 1: 2x2 (Huawei)
  + Option 2: 1x2 (Samsung, Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-12: Channel condition**

* Proposals
  + FR1: TDLC300-100 Low (Huawei, Ericsson)
  + FR2:
    - Option 1: TDLA30-300 Low (Ericsson)
    - Option 2: TDLB100-400 Low (Samsung)
* Recommended WF
  + TBA

**Issue 5-1-13: Test metrics**

* Proposals
  + Option 1: 70% throughput (Huawei)
  + Option 2: 10% BLER (Ericsson)
* Recommended WF
  + TBA

**Issue 5-1-14: PT-RS for FR2**

* Proposals
  + Option 1: with and without PT-RS configured (Ericsson)
  + Option 2: without
  + Option 3: with
* Recommended WF
  + TBA

### Sub-topic 5-2: UL transmission with grant free/configured grant

From the WF in RAN4 #93 meeting, following were agreed:

* *FFS requirements for UL transmission with grant free/UL configured grant*

*Open issues and candidate options before e-meeting:*

**Issue 5-2-1: Whether to define PUSCH performance requirements for UL transmission with grant free/UL configured grant**

* Proposals
  + Option 1: No (Samsung, Nokia, Huawei, Ericsson)
  + Option 2: Yes (DoCoMo)
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Sub topic 5-1-4: There is a mistake in our paper; the proposal should be 1 (i.e. option 1)  Sub topic 5-1-5: We don’t follow the logic of using 4 HARQ transmissions for low latency; if the aim is to test the most stringent latency criteria and use mini-slots, wouldn’t a packet retransmitted 3 times be too late ?  Subtopic 5-1-6: We propose transform precoding *disabled* ; i.e. option 1.  Subtopic 5-1-7: The rationale behind proposing 16QAM here is that for low latency, few symbols are transmitted but it is not clear that the payload will be so extremely small (e.g. with 2 symbols, the payload would only be 1/7 of the size with 14 symbols). There may be situations in which low latency transmissions are not link budget limited. So, we think that 16QAM is a quite possible and more robust scenario to test in than QPSK.  Subtopic 5-1-11: In general, we don’t follow the rational for 2x2 for PUSCH for these URLLC scenarios (both for aggregation and PDSCH with fewer symbols) and kindly request Huawei to explain further the proposal.  Subtopic 5-1-12: The channel condition should correspond to the modulation scenario, so we should decide MCS first.  Subtopic 5-1-13: The difference here relates to HARQ or no HARQ. Regarding HARQ, as commented above our question is whether HARQ would be configured for a latency critical service for which short subframes are required. |
| NTT DOCOMO | Issue 5-1-1: Our proposal is Option 3 since only PUSCH requirements with 14 symbol length were introduced in Rel.15, which does not cover small number of symbols. If we need to reduce test cases, We prefer 2os and 7os.  Issue 5-1-3: This issue can be discussed after PUSCH symbol length is agreed.  Issue 5-1-5: We prefer Option 2 since it is more typical assumption.  Issue 5-1-6: Our preference is to introduce DFT-s-OFDM (i.e., Option 2). This is a typical assumption in URLLC scenario since DFT has an advantage on PAPR perspective and is more reliable than CP-OFDM.  Issue 5-1-7: For URLLC test, Option 1 should be prioritized first. If we consider high data rate scenarios such as VR/AR, we might be able to consider Option2.  Issue 5-1-8: Regarding duplex mode, if there is no performance difference between FDD and TDD, we can define common requirements for FDD and TDD. It would be noted that this approach is the same as existing normal PUSCH demodulation requirements.  Regarding CBW, the same sets as existing normal PUSCH demodulation can be used. i.e., 5/10/15/20MHz for FR1 15kHz SCS, 10/40/100MHz for FR1 30kHz SCS, 50/100MHz for 60kHz SCS, 50/100/200MHz for 120kHz SCS.  Issue 5-1-9: We prefer Option 1  Issue 5-1-10: For 30kHz SCS, if the requirements are applicable for any TDD patterns including DDDSUUDDDD, S=6D:4G:4U and DSUU, S=12D:2G, we are OK with Option 1. If not applicable, we need further discussion on how to support other TDD patterns.  Issue 5-1-11: We support Option 2.  Issue 5-1-13: We support Option 1.  Issue 5-1-14: We support Option 1.  Issue 5-2-1: We prefer Option 2. We need the functional tests to verify to blindly receive and demodulate data. Otherwise, the function and the performance of grant free reception are not guaranteed. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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

# Topic #6: PUCCH demodulation requirements for high reliabiltiy

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2000313**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2000313.zip) | Samsung | Proposal 4: No PUCCH demodulation performance requirements for ULRRC. |
| [**R4-2001182**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001182.zip) | Ericsson | Proposal 1: Do not create new PUCCH requirements for URLLC |
| [**R4-2001489**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001489.zip) | Huawei, HiSilicon | Proposal 1: More discussion is need for defining the URLLC PUCCH performance requirements.  Proposal 2: Only PUCCH performance requirements for format 0 and 2 are considered if the requirements will be defined. |
| [**R4-2001696**](http://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_94_e/Docs/R4-2001696.zip) | Nokia, Nokia Shanghai Bell | PUCCH demodulation performance requirements  PUCCH DTX to ACK probability is to be kept one order of magnitude lower than the BLER target of the corresponding data transmission. Issues are currently observed in testing down to such targets.   1. RAN4 to not introduce PUCCH demodulation performance requirements for high reliability. |

## Open issues summary

### Sub-topic 6-1: PUCCH performance requirements

*From the approved WF R4-1915913 in RAN4#93 meeting, following were agreed:*

* *FFS on introduction of PUCCH demodulation performance requirements*

*Open issues and candidate options before e-meeting:*

**Issue 6-1-1: Whether to define the PUCCH performance requirements for high reliability**

* Proposals

No need to define. (Samsung, Nokia, Ericsson, Huawei)

* Recommended WF

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 2-1:  Sub topic 2-2:  ….  Others: |
| NTT DOCOMO | Sub topic 6-1: For multi-slot PUCCH, Duplex mode/SCS/CBW sets are limited. The necessity of other test cases should be discussed. For PUSCH requirement for URLLC, 15kHz SCS for FDD is also discussed. We prefer to discuss on the necessity of the following test cases:   * multi-slot PUCCH format 1 with 15kHz SCS (NOTE: The requirement with 30kHz SCS is already defined.) * multi-slot PUCCH format 3 with 15/30kHz SCS |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

*Suggestion on WF/LS assignment*

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

## Summary on 2nd round (if applicable)

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

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