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

**Electronic Meeting, 2nd Nov - 13th Nov, 2020**

**Agenda item:** 7.8.1.2

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

**Title:** Email discussion summary for [97e][323] NR\_L1enh\_URLLC\_Demod\_Part2

**Document for:** Information

# Introduction

The discussions in this thread include URLLC UE and BS demodulation performance requirements for high reliability with higher BLER and low latency. The discussion about UE and BS demodulation requirements for high reliability with BLER 10^-5 and confidence level 99.999% and CQI reporting test will happen in another thread RAN4 [97e][321] NR\_L1enh\_URLLC\_Demod\_Part1.

Besides, there are some CRs which contain contents of both thread [321] and [323]. In this thread, the common issues (such as FRCs, applicability rules etc.) will be discussed. In thread [321], the test methodology for ultra-low BLER and CQI reporting test will be discussed. Please comment the following issues in this summary:

CR structures for UE and BS.

1. Discuss CRs for all common issues (such as FRCs, applicability rule etc.)
2. Discuss CRs for the PDSCH repetition, mapping type B and processing capability 2 and pre-emption.
3. Discuss CRs for the PUSCH repetition type A and low latency (i.e. type B) requirements.

**Topics in this summary:**

***URLLC UE:***

* Topic #1: UE demodulation performance requirements for high reliability
  + Sub-topic 1-1: High reliability for FR1
  + Sub-topic 1-2: High reliability for FR2
* Topic #2: UE demodulation performance requirements for low latency
  + Sub-topic 2-1: PDSCH mapping Type B and processing capability 2 for FR1
  + Sub-topic 2-2: PDSCH mapping Type B for FR2
  + Sub-topic 2-3: UE demodulation requirements for pre-emption
* Topic #3: URLLC UE Rel-16 features and release independent.
  + Sub-topic 3-1: Rel-16 URLLC UE features
  + Sub-topic 3-2: Release independent

***URLLC BS:***

* Topic #4: BS demodulation requirements for high reliability.
  + Sub-topic 4-1: BS demodulation requirements of high reliability for FR1
  + Sub-topic 4-2: BS demodulation requirements of high reliability for FR2
* Topic #5: BS demodulation requirements for low latency.
  + Sub-topic 4-1: PUSCH mapping Type B for FR1
  + Sub-topic 4-2: PUSCH mapping Type B for FR2
* Topic #6: URLLC BS Rel-16 features

*Start of UE discussion*

# Topic #1: UE demodulation performance requirements for high reliability

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014242**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014242.zip) | Apple | Proposal #1: Define requirements with PDSCH slot aggregation in FR1 with MCS 19  Proposal #2: Define requirements in FR2 with PDSCH slot aggregation re-using most of the parameters from FR1 test, and the following:  Propagation condition: TDLA30-75  TDD Pattern: DDDSU with S=10D:2G:2U  CBW and SCS: 100MHz/ 120KHz  Proposal #3: Define requirements with PDSCH slot aggregation in FR2 with MCS 16 |
| [**R4-2014243**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014243.zip) | Apple | Draft CR on requirements with slot aggregation in FR2 |
| [**R4-2014544**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014544.zip) | Intel Corporation | Proposal 1: Use MCS13 for FR1 High reliability PDSCH requirements.  Proposal 2: Use the following assumptions for FR2 PDSCH high reliability requirements:   * CBW/SCS: 100 MHz/120 kHz * TDD pattern: DDDSU with S = 10D:2G:2U * PDSCH configuration: Mapping Type A, Start symbol 1, Duration 13 * PDSCH scheduling: slot i, if mod(i, 5) = {1,2} for i from {1,…,159}.within 20 ms * Aggregation factor 2 * Number of HARQ process: 2 * MCS 13 from Table 3 * Channel model: TDLA30-75 * Antenna configuration: 2x2, ULA low |
| [**R4-2015616**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015616.zip) | Huawei, HiSilicon | Simulation results on UE PDSCH demodulation requirements with higher BLER and low latency |
| [**R4-2015617**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015617.zip) | Huawei, HiSilicon | Proposal 1: We propose to use MCS19 for FR1 PDSCH high reliability test with higher BLER.  Proposal 2: For FR2 high reliability with higher BLER test, we propose the duplex mode is TDD with pattern of “DDDSU”; bandwidth and SCS are 100 MHz/120 kHz; the antenna configuration is 2x2, ULA low; Channel model is TDLA30-75.  Proposal 3: For FR2 high reliability with higher BLER test, we propose the PDSCH mapping type is Type A, starting symbol is 1 and symbol length is 13. PDSCH aggregation factor is 2.  Proposal 4: For FR2 high reliability with higher BLER test, we propose the DMRS type is Type 1 and the number of additional DMRS is 1.  Proposal 5: For FR2 high reliability with higher BLER test, we propose the number of HARQ processes is 8 and the maximum number of HARQ transmissions is 4. |
| [**R4-2015620**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015620.zip) | Huawei, HiSilicon | CR to TS 38.101-4 Addition of UE performance requirements for FR1 URLLC PDSCH repetitions over multiple slots |
| [**R4-2016005**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016005.zip) | Intel Corporation | CR on FRC for UE Higher BLER requirements |
| [**R4-2016103**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016103.zip) | Ericsson | Slot aggregation FR1  Proposal 1: Configure MCS 19 for slot aggregation test.  Slot aggregation FR2  Observation 1: TDD pattern DDSU with aggregation factor 2 causes less overhead from a scheduling perspective given RAN4 agreed scheduling constraints  Proposal 2: Define TDD pattern DDSU for FR2 slot aggregation test.  Proposal 3: Exclude PDSCH scheduling in slots i, where mod(i, 160) = 0 and mod(i, 160) = 1.  Proposal 4: Select an MCS which gives higher or equal to -4 dB for final 2 Rx requirement definition (average ideal SNR alignment result + IM)  Proposal 5: Define FR2 PDSCH slot aggregation test with the configurations summarized in Table 1 below.  Table 1 FR2 PDSCH slot aggregation test configurations   |  | | --- | | * *TDD pattern: DDSU* * *AL = 2* * *Propagation condition: TDLA30-75, TDLA30-300* * *SCS & CBW*   + *120kHz & 100MHz* * *MCS: {13, 16, 19} from table 3* * *PDSCH configuration: Mapping type A, symbol length 13, starting symbol 1.* * *DMRS configuration: Type 1, 1 additional DMRS, Single symbol* * *Antenna configuration 2x2, ULA low* * *Target BLER 1%* * *Scheduling for PDSCH:*   + *No scheduling in D slot i, where mod(i,160) = 0 and mod(i, 160) = 1, and S slots* * *PTRS on* * *Overhead for TBS determination: 6* | |
| [**R4-2016104**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016104.zip) | Ericsson | Simulation results on UE URLLC demodulation performance requirements with higher BLER |
| [**R4-2016106**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016106.zip) | Ericsson | CR to TS 38.101-4: Performance requirements for URLLC High BLER feature tests |
| [**R4-2016462**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016462.zip) | Qualcomm Incorporated | Proposal 1: Define high reliability high BLER tests with MCS 16 or 19 in Low SE MCS Table. |

## Open issues summary

During the last meeting, most of the test parameters for FR1 were agreed. In this section, the MCS for FR1 will be selected based on the simulation results (R4-2015628).

Parameters for FR2 will be discussed in sub-topic 1-2.

### Sub-topic 1-1: UE demodulation requirements for high reliability for FR1

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements of #96-e***

* *HARQ process number: 2 for FDD and 4 for TDD*
* *Higher or equal to -4 dB for final 4 Rx requirement definition (average ideal SNR alignment result + IM)*
* *BLER calculation method*
* *BLER = NpacketFail/NpacketTx, where NpacketFail is the number of packets with CRC fail after all transmissions (initial and retransmissions), NpacketTx is the total number of packets transmitted during the test.*

***Open issues of #96-e:***

* *MCS for FR1:* 
  + *Option 1: MCS13*
  + *Option 2: MCS16*
  + *Option 3: MCS19*

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

**Issue 1-1-1: MCS (table 3)**

* Proposals
  + Option 1: MCS13 (Intel)
  + Option 2: MCS16 (QC)
  + Option 3: MCS19 (Huawei, Apple, Ericsson, QC)
* Recommended WF
  + Based on the simulation results (R4-2015628) and agreements of “Higher or equal to -4 dB for final 4 Rx requirement definition (average ideal SNR alignment result + IM)”. Moderator recommend MCS19 as the conclusion as MCS19 is the only option meets the agreements. (Apple)

**Issue 1-1-2: SNR values for 38.101-4 (based on R4-2015628)**

* Proposals

FDD 2x2:

Option 1: [0.9] dB

Option 2:

FDD 2x4:

Option 1: [-2.9] dB

Option 2:

TDD 2x2:

Option 1: [1.2] dB

Option 2:

TDD 2x4:

Option 1: [-3.3] dB

Option 2:

* Recommended WF
  + Qualcomm: please indicate impairment results for MCS19 in R4-2015628.
  + Intel: Please double check your simulation results as it seems there is larger span between yours and others’ results. And please indicate impairments results for MCS19 in R4-2015628.

Issues raised from CR R4-2015620:

The number of slots between PDSCH and corresponding HARQ-ACK information for FDD has not been discussed. The number of HARQ processes for TDD has not been discussed. Please provide your opinions on these two parameters:

**Issue 1-1-3: The number of slots between PDSCH and corresponding HARQ-ACK information for FDD**

* Proposals
  + Option 1: 4 (Huawei)
  + Option 2:
* Recommended WF
  + As the PDSCH aggregation factor is n2, and the setting for this parameter in Rel-15 is 2. Here, we can double the number. (Apple)

**Issue 1-1-4: The number of HARQ processes for TDD (7D1S2U)**

* Proposals
  + Option 1: 4 (Huawei)
  + Option 2:
* Recommended WF
  + As the PDSCH aggregation factor is n2, and no PDSCH scheduling in D slots i, where mod(i, 10) = 0, and S slots. Thus, 4 HARQ processes is enough for 7D1S2U. (Apple)

### Sub-topic 1-2: UE demodulation requirements for high reliability for FR2

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements of #96-e***

* *Companies are encouraged to provide view on detailed test parameters for FR2 in the next RAN4 meeting:*
  + *Aggregation factor, MCS, Channel bandwidth, SCS, Channel model, TDD pattern, PDSCH Mapping type etc.*

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

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

* Proposals
  + Option 1: n2 (Huawei, Apple, Intel, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

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

* Proposals
  + Option 1: DDDSU, S=10:2:2 (Huawei, Intel, Apple)
  + Option 2: DDSU (Ericsson)
* Recommended WF
  + TBD

**Issue 1-2-3: SCS/BW**

* Proposals
  + Option 1: 120 kHz / 100 MHz (Huawei, Apple, Intel, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-4: Frequency domain resource allocation**

* Proposals
  + Option 1: Full bandwidth (Huawei, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-5: Channel model**

* Proposals
  + Option 1: TDLA30-75 (Huawei, Apple, Intel, Ericsson)
  + Option 2: TDLA30-300 (Ericsson)
* Recommended WF
  + TBD

**Issue 1-2-6: Antenna configuration**

* Proposals
  + Option 1: 2x2, ULA low (Apple, Intel, Ericsson, Huawei)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-7: PDSCH mapping type**

* Proposals
  + Option 1: Type A (Huawei, Apple, Intel, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-8: PDSCH starting symbol**

* Proposals
  + Option 1: 1 (Huawei, Intel, Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-9: PDSCH symbol length**

* Proposals
  + Option 1: 13 (Huawei, Intel, Ericsson, Apple)
* Recommended WF
  + TBD

**Issue 1-2-10: PDSCH scheduling**

* Proposals
  + Option 1: Scheduling PDSCH on slot i, if mod(i, 5) = {1,2} for i from {1,…,159}.within 20 ms (Intel, Apple)
  + Option 2: No scheduling in D slot i, where mod(i,160) = 0 and mod(i, 160) = 1, and S slots (Ericsson)
* Recommended WF
  + TBD

**Issue 1-2-11: DM-RS type**

* Proposals
  + Option 1: Type 1 (Huawei, Apple, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-12: DM-RS duration**

* Proposals
  + Option 1: Single-symbol DM-RS (Huawei, Apple, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-13: Additional DM-RS**

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

**Issue 1-2-14: PTRS**

* Proposals
  + Option 1: on (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-15: Overhead for TBS determination**

* Proposals
  + Option 1: 6 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-16: HARQ process**

* Proposals
  + Option 1: 8 (Huawei, Apple)
  + Option 2: 2 (Intel, Apple)
* Recommended WF
  + TBD

**Issue 1-2-17: Maximum number of HARQ re-transmission**

* Proposals
  + Option 1: 4 (Huawei, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-18: Test metric**

* Proposals
  + Option 1: 1% BLER (Huawei, Apple, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 1-2-19: MCS**

* Proposals
  + Option 1: MCS19 from Table 3 (Huawei)
  + Option 2: MCS16 from Table 3 (Apple)
  + Option 3: MCS13 from Table 3 (Intel)
* Recommended WF
  + TBD

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 1-1-1:  Issue 1-1-2:  Issue 1-1-3: |
| Ericsson | Issue 1-1-2: There is a fairly large span between the results; we should check as it is >3dB in places |
| Apple | Issue 1-1-1: We agree with the recommended WF.  Issue 1-1-2: We cannot agree on SNR values/ requirements without good alignment in results. Span is as high as 4 dB in some cases.  Issue 1-1-3, 1-1-4: We support the recommended WF.  Issue 1-2-8/1-2-9: We are fine with PDSCH starting symbol 1 and 13 symbols in D slots.  Issue 1-2-10: option 1  Issue 1-2-14/1-2-15: Option1  Issue 1-2-16: Option 2 |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2015620**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015620.zip)  (Huawei)  CR to TS 38.101-4  Addition of UE performance requirements for FR1 URLLC PDSCH repetitions over multiple slots. | Company A |
| Company B |
| [**R4-2016005**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016005.zip)  (Intel)  CR on FRC for UE Higher BLER requirements | Ericsson: The SE table should be referred to as 64QAM-MCS-TableAlt to align to Huawei CRs and should be declared in a note below the table. |
| Apple: The max Throughput should account for PDSCH repetition. But the test metric is BLER and not TP, should we still specify it? |
|  |
| [**R4-2016106**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016106.zip)  (Ericsson)  CR to TS 38.101-4: Performance requirements for URLLC High BLER feature tests | Apple: The test parameters should also configure PDCCH DCI format 2-1 with corresponding PI as payload.  In Test parameters table, Note 1 suggests that UE flushes buffer upon NACK, irrespective of slot that was pre-empted. It should be upon receiving PI on PDCCH with DCI format 2-1. |
| Company B |
| [**R4-2014243**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014243.zip)  (Apple)  Draft CR on requirements with slot aggregation in FR2 | Ericsson: TDD pattern not yet agreed. Incorrect cover sheet version. |
| Apple: [To Ericsson] Will fix coversheet version and update parameters based on agreements. |
| [**R4-2015622**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015622.zip)  (Huawei)  CR to TS38.101-4 Applicability rules for URLLC UE demodulation requirements | Apple: Suggest to have different feature for CQI Table 3 in Table 5.1.1.3-1. Also, different feature for Processing capability 2 in Table 5.1.1.4-1 |
| 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** |
|  |  |  |

# Topic #2: UE demodulation performance requirements for low latency

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014242**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014242.zip) | Apple | Proposal #4: Define requirements with PDSCH mapping Type-B in FR2 with MCS 4  Proposal #5: Introduce requirements for pre-emption indication with 20% pre-empted slots and MCS of 13.  Proposal #6: Define requirements for pre-emption indication at 70% of maximum throughput. |
| [**R4-2014544**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014544.zip) | Intel Corporation | Proposal 3: Use the following assumptions for FR2 PDSCH requirements with mapping Type B:   * MCS 4 * Channel model: TDLA30-75   Proposal 4: Define Pre-emption indication requirements under one of the following conditions:   * Option 1:   + Number of eMBB retransmissions: 4   + eMBB MCS 13   + Pre-emption probability 20%   + Test metric: 70% of max T-put or 1% of BLER * Option 2:   + Number of eMBB retransmissions: 2   + eMBB MCS 13   + Pre-emption probability 10%   + Test metric: 10% or 1% of BLER |
| [**R4-2015129**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015129.zip) | MediaTek inc. | *Proposal*: Only configure 10% pre-emption probability for pre-emption tests. |
| [**R4-2015616**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015616.zip) | Huawei, HiSilicon | Simulation results on UE PDSCH demodulation requirements with higher BLER and low latency |
| [**R4-2015617**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015617.zip) | Huawei, HiSilicon | Proposal 6: Use MCS4 from Table 1 for FR2 PDSCH mapping Type B test case.  Proposal 7: We propose to use MCS16 from Table 1 for pre-emption test case.  Proposal 8: We propose to configure 20% pre-emption probability. |
| [**R4-2015620**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015620.zip) | Huawei, HiSilicon | CR to TS 38.101-4 Addition of UE performance requirements for FR1 URLLC PDSCH repetitions over multiple slots |
| [**R4-2016005**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016005.zip) | Intel Corporation | CR on FRC for UE Higher BLER requirements |
| [**R4-2016103**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016103.zip) | Ericsson | PDSCH mapping type B FR2  Proposal 6: Define max number of HARQ transmissions to be 1 for FR2 PDSCH mapping type B test.  Proposal 7: Define FR2 PDSCH mapping type B test with the configurations summarized in Table 2 below.  Table 2 FR2 PDSCH mapping type B test configurations   |  | | --- | | *SCS/CBW: 120 kHz/100 MHz*  *TDD pattern: DDDSU with S = 10D:2G:2U*  *Scheduling: No PDSCH in slot 0 within 20 ms*  *MCS: {MCS4} from table 1.*  *Max number of HARQ transmissions: 1*  *Number of HARQ process: 8*  *Antenna configuration: 2x2, ULA low*  *Channel model:*  *Option 1: TDLA30-75*  *PTRS on*  *Overhead for TBS determination: 6*  *Test metrics: 70% throughput*  *PDSCH Configuration: Start symbol 1, Symbol length 7*  *DMRS configuration: Type 1, 1 additional DMRS, Single symbol*  *PTRS configuration: Frequency density (KPT-RS) 2, Time density (LPT-RS) 1, resource element offset* |   PDSCH pre-emption FR1  Proposal 8: Configure MCS13 for pre-emption tests.  Proposal 9: Only configure 10% pre-emption probability for pre-emption tests |
| [**R4-2016104**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016104.zip) | Ericsson | Simulation results on UE URLLC demodulation performance requirements with higher BLER |
| [**R4-2016106**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016106.zip) | Ericsson | CR to TS 38.101-4: Performance requirements for URLLC High BLER feature tests |
| [**R4-2016462**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016462.zip) | Qualcomm Incorporated | Proposal 2: Define DL pre-emption test for eMBB with 10% pre-emption probability, fixed scheduling and MCS 4. |
| [**R4-2016504**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016504.zip) | Qualcomm Incorporated | CR on FR1 PDSCH Mapping Type B and Processing Capability 2 Requirements |

## Open issues summary

This section includes three sub-topic:

* Sub-topic 2-1: PDSCH mapping Type B and processing capability 2 for FR1
* Sub-topic 2-2: PDSCH mapping Type B for FR2
* Sub-topic 2-3: UE demodulation requirements for pre-emption

### Sub-topic 2-1: PDSCH mapping Type B and processing capability 2 for FR1

The SNR values will be aligned based on the simulation results provided by companies.

**Issue 2-1-1: SNR values for 38.101-4 (based on R4-2015628)**

* Proposals

FDD 2x2:

Option 1: [0.2] dB

Option 2:

FDD 2x4:

Option 1: [-2.8] dB

Option 2:

TDD 2x2:

Option 1: [0] dB

Option 2:

TDD 2x4:

Option 1: [-2.9] dB

Option 2:

* Recommended WF
  + Intel, Huawei: Please double check your results as Intel provided the highest SNR values and Huawei provides the lowest SNR values. Results can be updated.

### Sub-topic 2-2: PDSCH mapping Type B for FR2

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements from #96:***

* *Test applicability rule for FR2: No need to define the applicability rule.*
* *Test applicability rule for FR1 and FR2: No test applicability rule is needed.*
* *SCS/CBW: 120 kHz/100 MHz*
* *TDD pattern: DDDSU with S = 10D:2G:2U*
* *PDSCH Configuration*
  + *Scheduling: No PDSCH in slot 0 within 20 ms*
  + *MCS: [MCS4] from table 1. Confirming the MCS depends on the simulation results to ensure a proper SNR value.*
  + *Start symbol: 1*
  + *Symbol length: 2*
  + *Max number of HARQ transmissions: 4​*
  + *Number of HARQ process: 8*
* *Antenna configuration: 2x2, ULA low*
* *Channel model:* 
  + *Option 1: TDLA30-75*
  + *Other options are not precluded*
* *Test metrics: 70% throughput*

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

**Issue 2-2-1: Symbol length (2os has been agreed)**

* Proposals
  + Option 1: 7 (Ericsson)
  + Option 2: 2 (Apple)
* Recommended WF
  + TBD

**Issue 2-2-2: Maximum number of HARQ re-transmission (4 has been agreed)**

* Proposals
  + Option 1: 1 (Ericsson)
  + Option 2: 4 (Apple)
* Recommended WF
  + TBD

**Issue 2-2-2a: Number of HARQ process (8 has been agreed)**

* Proposals
  + Option 1: 4 (Huawei)
  + Option 2:
* Recommended WF
  + Although 8 has been agreed, as this is a low latency test and 4 is enough for the test case. Please provide your views on change 8 to 4.

**Issue 2-2-3: DM-RS type**

* Proposals
  + Option 1: Type 1 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-4: DM-RS duration**

* Proposals
  + Option 1: Single-symbol DM-RS (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-5: Additional DM-RS**

* Proposals
  + Option 1: 1 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-6: PTRS**

* Proposals
  + Option 1: on (Ericsson, Apple)
  + Option 2: off
* Recommended WF
  + TBD

**Issue 2-2-7: PTRS frequency density (KPT-RS)**

* Proposals
  + Option 1: 2 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-8: PTRS time density (LPT-RS)**

* Proposals
  + Option 1: 1 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-9: PTRS resource element offset**

* Proposals
  + Option 1: 2 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-10: Overhead for TBS determination**

* Proposals
  + Option 1: 6 (Ericsson, Apple)
  + Option 2:
* Recommended WF
  + TBD

**Issue 2-2-11: MCS**

* Proposals
  + Option 1: MCS4 from Table 1. (Huawei, Apple, Intel)
  + Option 2:
* Recommended WF
  + TBD

### Sub-topic 2-3: UE demodulation requirements for pre-emption

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements from #96:***

* *The assumption of UE behaviours for buffer flushing and decoding*
  + *If UE cannot decode the PDCSH correctly, UE feeds back NACK to gNB. Then UE flushes the buffer and waits for the next re-transmission for LLR combing to decode the PDSCH.*
* *URLLC interference modelling*
  + *SNR: Same as for eMBB transmission*
  + *Structure: Some random data*

*Open issues:*

***Open Issues:***

* *Pre-emption probability*
  + *Option 1: 10% within 1 radio frame*
  + *Option 2: 20% within 1 radio frame*
* *eMBB MCS* 
  + *Option 1: MCS13 in Table 1*
  + *Option 2: MCS4 in Table 1*
* *Test metric*
  + *Option 1: 70% of max T-put*
  + *Other options are not precluded*
* *Companies are encouraged to prepare comparison analysis of UE with and without HARQ buffer flushing of pre-empted bits to decide on options above*

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

**Issue 2-3-1: Simulation results observation (based on R4-2015628):**

The gain between with and without buffer flushing is

MCS13 with 20% probability:

* About 0.5 dB (Ericsson, Huawei, MTK)
* More than 2.5 dB (Intel, Apple)

MCS13 with 10% probability:

* Less than 0.5 dB (Ericsson, Huawei, MTK, Intel)
* More than 1 dB (Apple)

MCS4 with 20% probability:

* Less than 0.1 dB (Ericsson, Huawei, MTK, Intel, Apple)

MCS4 with 10% probability:

* Less than 0.03 dB (Ericsson, Huawei, MTK, Intel, Apple)
* More than 1 dB (QC)
* Recommended WF
  + QC: Please double check your simulation results as it seems there is larger span between yours and others’ results.
  + Please update your results if necessary.

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

* Proposals
  + Option 1: 70% maximum throughput with gain larger than 1dB. (Huawei, Apple, Ericsson)
  + Option 2: 1% or 10% BLER for scenarios with 2 re-transmissions. (Intel)
  + Option 3: 1% BLER or 70% maximum throughput for scenarios with 4 re-transmissions. (Intel)
  + Option 4: Other test metric not precluded.
* Recommended WF
  + The main intention for this case is to find the performance difference between with and without buffer flushing. So the test metric should be defined based on this intention. By considering the limited time left, the moderator does not recommend to change the test metric but to define the agreed test metric (70% maximum throughput) with gain larger than 1dB. Based on the current simulation results, there is a large span between companies and the gain between with and without buffer flushing is fairly small. To achieve gain larger than 1dB, one suggestion is to increase the MCS value. E.g. MCS16 or higher. Please update your simulation results if new results are available.

**Issue 2-3-2a: Maximum HARQ re-transmission (4 has been agreed):**

* Proposals
  + Option 1: 2 with BLER test metric. (Intel)
* Recommended WF
  + TBD

**Issue 2-3-3: MCS**

* Proposals
  + Option 1: MCS16 from Table 1. (Huawei)
  + Option 2: MCS13 from Table 1 (Apple, Ericsson, Intel)
  + Option 3: MCS 4 from Table 1 (QC)
* Recommended WF
  + TBD

**Issue 2-3-4: Pre-emption probability**

* Proposals
  + Option 1: 20%. (Huawei, Apple, Intel in case of 4 re-transmissions)
  + Option 2: 10% (Ericsson, QC, Intel in case of 2 re-transmissions and BLER test metric)
* Recommended WF
  + TBD

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 2-1-1:  Issue 2-1-2:  Issue 2-1-3: |
| Ericsson | Issue 2-1-1: The span is lower than for the high reliability results but still 3dB in one case  Issue 2-3-1: We plan to update our simulation results.  Issue 2-3-2: Option 1 is OK as long as the gain is more than 1dB. We plan to update our results in the summary; for MCS13 we see more than 1dB gain with 10% pre-emption.  Issue 2-3-3: We see more than 1dB for MCS13, let’s see how it looks with all company results. We should take an MCS with >1dB gain averaged across all companies. |
| Apple | Issue 2-1-1: Need to look into span in results especially for 4RX before defining requirements.  Issue 2-2-1/ 2-2-2: Prefer to keep the agreed parameters  Issue 2-2-3 – 2-2-10: Fine with proposals from Ericsson.  Issue 2-3-1: Large span in results for this case as well. Our results are with the agreed UE behavior in 96e.  Issue 2-3-2: Prefer to have requirement based on 70% max TP. The BLER requirement is not justified for eMBB UE. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2016504**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016504.zip)  (QC)  CR on FR1 PDSCH Mapping Type B and Processing Capability 2 Requirements | 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** |  |

*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”* |

# Topic #3: URLLC UE Rel-16 features

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014544**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014544.zip) | Intel Corporation | Proposal 5: Do not define demodulation performance requirements to verify Rel-16 URLLC PDCCH enhancements. |
| [**R4-2015617**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015617.zip) | Huawei, HiSilicon | Proposal 9: UE URLLC requirements for Rel-15 features are release independent from Rel-15.  Proposal 10: Requirements for PDCCH enhancement should be specified for URLLC. |
| [**R4-2016103**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016103.zip) | Ericsson | Rel-16 URLLC UE features  Proposal 10: Define new PDCCH demodulation test for DCI format 1\_2 and discuss the payload size in RAN4.  Proposal 11: Do not need to define new URLLC PDCCH demodulation test for covering multiple PDCCH monitoring occasions per slot. |

## Open issues summary

### Sub-topic 3-1: Rel-16 URLLC UE features

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements：***

* *Requirements for Multi-TRP URLLC transmission schemes are covered by Rel-16 e-MIMO WI, no discussion in URLLC thread.*

***Open Issues:***

* *Rel-16 features need to be discussed* 
  + *PDCCH enhancement*
  + *Other features not precluded.*

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

**Issue 3-1-1: Rel-16 features need to be discussed**

* Proposals
  + PDCCH enhancement (Huawei)
  + Other features not precluded.
* Recommended WF
  + TBD

**Issue 3-1-2: Whether to define performance requirements for PDCCH enhancement.**

* Proposals
  + Option 1: Yes (Huawei, Ericsson)
  + Option 2: No (Intel, Apple)
* Recommended WF
  + TBD

**Issue 3-1-2a: Whether to define PDCCH performance requirements for DCI format 1\_2**

* Proposals
  + Option 1: Yes (Ericsson)
  + Option 2: No , Apple
* Recommended WF
  + TBD

**Issue 3-1-2b: Whether to define PDCCH performance requirements for covering multiple PDCCH monitoring occasions per slot.**

* Proposals
  + Option 1: Yes
  + Option 2: No (Ericsson, Apple)
* Recommended WF
  + TBD

### Sub-topic 3-2: Release independent

*From the approved WF R4-2012648 in RAN4 #96 e-meeting, following were agreed:*

***Agreements:***

* *No additional features and capability needed for URLLC Demod and CSI requirements introduced for Rel-15 feature under Rel-16 URLLC WI.*

***Open issues:***

* *FFS whether UE URLLC requirements for Rel-15 features are release independent from Rel-15.*

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

**Issue 3-2-1: UE URLLC requirements for Rel-15 features release independent from Rel-15**

* Proposals
  + Option 1: Yes (Huawei)
  + Option 2: No
* Recommended WF
  + TBD

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue 3-1-1: |
| Ericsson | Issue 3-1-1: Our understanding is that in earlier discussions, the generic need for testing PDCCH at lower BLER was not seen. We believe that testing of the new formats could be useful though. |
| Apple | Issue 3-1-1: We don’t see strong motivation to introduce requirements with PDCCH enhancements as demodulation performance is not impacted.  We don’t support introducing requirements for either DCI format 1-2 or multiple PDCCH monitoring occasions. |

## 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** |
|  |  |  |

*End of UE discussion*

*Start of BS discussion*

# Topic #4: BS demodulation requirements for high reliability

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014545.zip) | Intel Corporation | Proposal 1: Use the following applicability rule for FR1 PUSCH high reliability requirements definition: The requirements for PUSCH with aggregation for 15kHz can be tested either by configuring n8 and the DDDSU TDD pattern or by configuring FDD with aggregation level n2  Proposal 2: Use the following assumptions for FR2 BS High reliability requirements:   * TDD UL/Dl pattern: DDDSU with S=10D:2G:2U * Aggregation factor = n8 * Applicability rule: The same requirements are applicable to TDD with different UL-DL patterns and different aggregation factor configurations under assumption that two effective transmissions of the transport block are generated * DMRS configuration: 1+1 * Channel model: TDLA30-300 |
| [**R4-2014820**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014820.zip) | NTT DOCOMO, INC. | CR for TS 38.141-2: Introduction of performance requirements of PUSCH repetition type A and PUSCH mapping type B for URLLC |
| [**R4-2014821**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014821.zip) | NTT DOCOMO, INC. | Proposal 1: For high reliability test, the requirements for PUSCH with aggregation for 15 kHz can be tested either by configuring n8 and the DDDSU TDD pattern or by configuring FDD with aggregation level n2 (Option 2).  Proposal 2: The value of SNR for TDD 15kHz SCS with PUSCH aggregation level n8 can be applied for the value of SNR for FDD 15kHz SCS with PUSCH aggregation level n2.  Proposal 3: Adopt DDDSU, S=10:2:2 as TDD pattern (Option 1).  Proposal 4: Adopt n8 for DDDSU as aggregation factor for TDD with note (Option 3).  Proposal 5: Adopt TDLA30-300 Low as channel model (Option 1).  Proposal 6: Introduce DM-RS with 1+1 (Option 2). |
| [**R4-2015023**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015023.zip) | Ericsson | FRCs for URLLC |
| [**R4-2015095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015095.zip) | Nokia, Nokia Shanghai Bell | Discussion on high reliability - FR1  Applicability rule for FDD and TDD   1. The agreement to add the explicatory note to the aggregation level configuration, makes an applicability rule unnecessary. 2. RAN4 to not include and applicability rule for FDD and TDD, which would be redundant due to agreed note.   Whether to clarify the safety statement   1. RAN4 to discuss the inclusion of a statistical testing disclaimer in the online session/GtW.   TDD pattern   1. RAN4 to agree on DDDSU, S=10:2:2.   Aggregation factor for TDD  The agreement to add the explicatory note to the aggregation level configuration, already decides the question of the aggregation factor for TDD as option 3.   1. RAN4 to confirm the choice of n8 for DDDSU with note that testing can be performed with a different TDD pattern, as long as the intention of the configuration is preserved.   Channel model  A 300Hz (UL) Doppler corresponds to 6kph (jogging speed) at 28GHz.   1. RAN4 to not specify requirement for higher UE speed than 1.5kph, i.e., to choose TDLA30-75.   DM-RS   1. RAN4 to choose option 2 (DM-RS 1+1) for highest reliability in the agreed 10 symbol TDRA. |
| [**R4-2015122**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015122.zip) | Samsung | Proposal 1: Define the PUSCH high reliability requirement for FR2 with the following configurations:   * TDD pattern: DDDSU, S=10:2:2 * Aggregation for TDD: n8 for DDDSU TDD pattern with note * Channel Model: TDLA30-300 Low * Waveform: CP-OFDM * DM-RS configuration: 1+1 * PT-RS configuration: without PT-RS   Proposal 2: The same requirements are applicable to FDD for PUSCH aggregation level n2 and TDD 15 KHz with DDDSU pattern for PUSCH aggregation level n8. The BS conformance test can be declared, either configuring DDDSU TDD with PUSCH aggregation level n8 or configuring FDD with PUSCH aggregation level n2. |
| [**R4-2015123**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015123.zip) | Samsung | Draft CR on PUSCH repetition type A and PUSCH mapping type B radiated performance requirement for TS 38.104 |
| [**R4-2015124**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015124.zip) | Samsung | Draft CR on FRC for URLLC BS radiated performance requirement for TS 38.141-2 |
| [**R4-2015618**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015618.zip) | Huawei, HiSilicon | Proposal 1: Applicability rule of PUSCH repetition over multiple slots for FDD and TDD: The requirements for PUSCH with aggregation for 15kHz TDD can be tested by configuring aggregation factor is n8 for DDDSU or configuring aggregation factor is n2 for 30kHz FDD.  Proposal 2: No need to specify any safety statements in specification.  Proposal 3: We propose to configure DDDSU for FR2 PUSCH repetition over multiple slots performance requirements.  Proposal 4: We propose to use TDLA30-300 Low as the configuration for FR2 PUSCH repetition over multiple slots performance requirements.  Proposal 5: We propose to configure DM-RS 1+1 for symbol length of 10.  Proposal 6: Define 60 kHz/120 kHz for 50 MHz and 100 MHz as SCS and bandwidth for FR2 PUSCH repetition over multiple slots performance requirements.  Proposal 7: Define applicability rule for different SCS and BW: Only 1 SCS and 1 BW need to be tested based on the base station declaration. |
| [**R4-2015619**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015619.zip) | Huawei, HiSilicon | Simulation results on PUSCH demodulation reuqirements with higher BLER and low latency |
| [**R4-2015623**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015623.zip) | Huawei, HiSilicon | CR to TS38.104 Addition of BS performance requirements for URLLC FR1 PUSCH repetition Type A |
| [**R4-2015624**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015624.zip) | Huawei, HiSilicon | CR to TS38.141-1 Addition of BS conformance testing for URLLC demodulation requirements with higher BLER |
| [**R4-2015626**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015626.zip) | Huawei, HiSilicon | CR to TS38.141-2 Addition of BS conformance testing for FR2 URLLC PUSCH repetition Type A |
| [**R4-2015865**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015865.zip) | Ericsson | Proposal 1: Define the FR2 high reliability requirement using DDDSU and n8. Note that the same requirement is applicable for any TDD pattern where 2 UL slots are aggregated.  Proposal 2: Apply DM-RS 1+1 for the FR2 high reliability requirement |
| [**R4-2015866**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015866.zip) | Ericsson | Simulation results for BS high BLER URLLC |

## Open issues summary

In this section, two sub-topic will be discussed:

* BS demodulation requirements of high reliability for FR1
* BS demodulation requirements of high reliability for FR2

For FR1 requirements, applicability rule for FDD and TDD will be defined. And the safety statement in specification is better to be discussed during the online meeting. The SNR values for the specs will be aligned based on the simulation results.

### Sub-topic 4-1: BS demodulation requirements of high reliability for FR1

*The agreements and remaining open issues of #96 e-meeting for PUSCH FR1 high reliability are listed below:*

***Agreements:***

* *PUSCH aggregation factor for TDD 15 kHz SCS with pattern DDDSU: Configure n2 for FDD and n8 for TDD with note.* 
  + *Note: The intention of this configuration is to have two effective transmissions of the transport block. To achieve this for the standard TDD pattern captured in this table, a value of n8 is necessary, while for FDD a value of n2 is necessary.*
  + *RV sequence with 4 HARQ transmission：{0,3,0,3} with note* 
    - *Note: The effective RV sequence is {0,2,3,1} with slot aggregation*

***Open issues:***

* *Applicability rule for FDD and TDD*
  + *Option 1: The requirement with PUSCH aggregation level n8 for TDD with 15 KHz SCS can be applied with FDD or TDD 30 KHz SCS with PUSCH aggregation level n2.*
  + *Option 2: The requirements for PUSCH with aggregation for 15kHz can be tested either by configuring n8 and the DDDSU TDD pattern or by configuring FDD with aggregation level n2.*
* *Whether to clarify the safety statement*
  + *Option 1: No need to specify any safety statements in specification*
  + *Option 2: Yes*
    - *Option 1a: Since the URLLC features of 5G NR will potentially be used in safety critical applications, the ultimately chosen statistical testing methodology for testing of these features must be verified by an independent body of experts/statisticians, before requirements and test can be used as basis for safety critical implementations. All statistical analysis and discussions provided in this meeting are to be taken as a best effort and is not to be taken as due diligence*
    - *Option 1b: If the URLLC features of 5G NR would be used in safety or mission critical applications, the ultimately chosen statistical testing methodology for testing of these features must be verified by an independent body of experts/statisticians. It is also important to bear in mind that the demodulation requirements do not take account of all aspects of system operation (for example RF, transmitter, internal interfaces, higher layer protocol software etc.).*

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

**Issue 4-1-1: Applicability rule for FDD and TDD:**

* PUSCH aggregation factor for 15 kHz SCS:
  + Option 1: The requirements for PUSCH with aggregation for 15kHz can be tested either by configuring n8 and the DDDSU TDD pattern or by configuring FDD with aggregation level n2. (Intel, DoCoMo, Ericsson, Huawei)
  + Option 2: Same requirements are applicable to FDD for PUSCH aggregation level n2 and TDD 15 KHz with DDDSU pattern for PUSCH aggregation level n8. The BS conformance test can be declared, either configuring DDDSU TDD with PUSCH aggregation level n8 or configuring FDD with PUSCH aggregation level n2. (Samsung)
  + Option 4: No applicability rule. (Nokia)
* Recommended WF
  + TBD

**Issue 4-1-2: Whether to clarify the safety statement in specification**

* Proposals
  + Option 1: No need to specify any safety statements in specification (Huawei)
  + Option 2: Yes (Nokia)
    - Option 1a: Since the URLLC features of 5G NR will potentially be used in safety critical applications, the ultimately chosen statistical testing methodology for testing of these features must be verified by an independent body of experts/statisticians, before requirements and test can be used as basis for safety critical implementations. All statistical analysis and discussions provided in this meeting are to be taken as a best effort and is not to be taken as due diligence
    - Option 1b: (Ericsson)

If the URLLC features of 5G NR would be used in safety or mission critical applications, the ultimately chosen statistical testing methodology for testing of these features must be verified by an independent body of experts/statisticians. It is also important to bear in mind that the demodulation requirements do not take account of all aspects of system operation (for example RF, transmitter, internal interfaces, higher layer protocol software etc.).

* Recommended WF
  + TBD

**Issue 4-1-3: SNR values in specs (based on simulation results in R4-2015629)**

* Proposals

38.104:

15 kHz/5 MHz:

* Option 1: [-8.2] dB
* Option 2:

15 kHz/10 MHz:

* Option 1: [-9.3] dB
* Option 2:

30 kHz/10 MHz:

* Option 1: [-8.2] dB
* Option 2:

30 kHz/40 MHz:

* Option 1: [-10.2] dB
* Option 2:

38.141:

15 kHz/5 MHz:

* Option 1: [-7.6] dB
* Option 2:

15 kHz/10 MHz:

* Option 1: [-8.7] dB
* Option 2:

30 kHz/10 MHz:

* Option 1: [-7.6] dB
* Option 2:

30 kHz/40 MHz:

* Option 1: [-9.6] dB
* Option 2:
* Recommended WF
  + There is large span between results, please double check your simulation results and update.

### Sub-topic 4-2: BS demodulation requirements of high reliability for FR2

*The agreements and remaining open issues of #96 e-meeting for PUSCH FR2 high reliability are listed below:*

***Agreements:***

* *Test applicability rule for FR2 for different SCS: Only 1 SCS need to be tested*
* *Test applicability rule for FR1 and FR2: If BS declare to support both FR1 and FR2, the tests shall be done both.*
* *Antenna configuration: 1x2, ULA low*
* *SCS/BW for FR2: 60 kHz/50MHz, 120 kHz/ 50MHz*
* *Mapping type: Type B*
* *MCS: MCS5 from table 3*
* *Start symbol: 0*
* *Symbol length: 10*
* *DM-RS Type: Type 1*
* *DM-RS duration: Single-symbol DM-RS*
* *Bandwidth allocation: Full bandwidth*
* *Maximum number of HARQ re-transmissions: 4*
* *Test metric: 1% BLER (Calculated after all re-transmissions)*

***Open issues:***

* *TDD pattern*
  + *Option 1: DDDSU, S=10:2:2*
  + *Option 2: DSUU, S=12:2*
* *Aggregation factor for TDD*
  + *Option 1: n8 for DDDSU*
  + *Option 2: n2 for DSUU*
  + *Option 3: n8 for DDDSU with note* 
    - *Note: The testing can be performed with a different TDD pattern*
* *Channel model*
  + *Option 1: TDLA30-300 Low*
  + *Option 2: TDLA30-75*
* *DM-RS*
  + *Option 1: 1+0 and 1+1.*
  + *Option 2: 1+1*

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

**Issue 4-2-1: Waveform**

* Proposals
  + Option 1: CP-OFDM (Samsung, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-2: TDD pattern**

* Proposals
  + Option 1: DDDSU, S=10:2:2 (Huawei, Intel, DoCoMo, Nokia, Samsung, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-3: Aggregation factor for TDD**

* Proposals
  + Option 1: n8 for DDDSU with note (Huawei, Intel, DoCoMo, Nokia, Samsung, Ericsson)
    - Note: The intention of this configuration is to have two effective transmissions of the transport block. To achieve this for the standard TDD pattern captured in this table, a value of n8 is necessary.
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-4: Applicability rule for TDD with different UL-DL patterns**

Proposals

* + Option 1: The same requirements are applicable to TDD with different UL-DL patterns and different aggregation factor configurations under assumption that two effective transmissions of the transport block are generated (Intel, Samsung)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-5: Channel model**

* Proposals
  + Option 1: TDLA30-300 Low (Huawei, Intel, DoCoMo, Samsung)
  + Option 2: TDLA30-75 (Nokia)
* Recommended WF
  + TBD

**Issue 4-2-6: SCS/BW (60 kHz/120 kHz for 50 MHz has been agreed)**

* Proposals
  + Option 1: Both of 60 kHz and 120 kHz for both of 50 MHz and 100 MHz with applicability rule (Huawei)
  + Option 2: 60 kHz for 50 MHz and 120 kHz for 100 MHz
* Recommended WF
  + TBD

**Issue 4-2-7: Applicability rule for different SCS and BW**

* Proposals
  + Option 1: Only 1 SCS and 1 BW need to be tested based on the base station declaration.
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-8: DM-RS**

* Proposals
  + Option 1: 1+1 (Huawei, Intel, DoCoMo, Nokia, Samsung, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-9: PTRS**

* Proposals
  + Option 1: No PTRS (Samsung)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-10: HARQ process number**

* Proposals
  + Option 1: 4 (Samsung)
  + Option 2:
* Recommended WF
  + TBD

**Issue 4-2-11: RV sequence for 4 HARQ re-transmission**

* Proposals
  + Option 1: {0,3,0,3} with note
    - Note: The effective RV sequence is {0,2,3,1} with slot aggregation (Samsung)
  + Option 2:
* Recommended WF
  + TBD

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson: | Issue 4-1-2: We are OK with option 1b. There are a few text problems with 1a (“in this meeting”…)  Issue 4-2-1: Option 1  Issue 4-2-6: Could we clarify does this mean both 50 and 100MHz for both SCS ? |
| Samsung | Issue 4-1-1: Applicability rule for FDD and TDD:  Just one clarification for option 1, whether two requirements will be introduced for 15KHz, one is n2 for FDD, another is n8 for TDD, or only one requirement will be introduced, the requirement specified is based on either configured aggregation level n2 for FDD or n8 for TDD?  If only define one requirement, we think option 2 should have the same meaning with option 1.  Issue 4-1-2: Whether to clarify the safety statement in specification  Issue 4-1-3: SNR values in specs (based on simulation results in R4-2015629)  The current simulation results for each companies still have large gap with 2.5dB, further align is needed.  Issue 4-2-1: Waveform  We prefer Option 1. It was agreed to not introduce lower latency requirement for DFT-s-OFDM waveform in FR1. To reduce the test efforts, we prefer to only define the requirement with CP-OFDM waveform  Issue 4-2-2: TDD pattern  OK with option 1  Issue 4-2-3: Aggregation factor for TDD  OK with option1  Issue 4-2-4: Applicability rule for TDD with different UL-DL patterns  OK with option 1  Issue 4-2-5: Channel model  We are prefer option 1. It was agreed to introduce the requirement with MCS5 for high reliability in FR2, similar with FR2 requirement in Rel-15, we prefer to apply the channel model with TDLA30-300Hz  Issue 4-2-6: SCS/BW (60 kHz/120 kHz for 50 MHz has been agreed)  We prefer to not define the additional SCS/BW requirement for FR2. We have defined the minimum CBW requirement for each SCS in FR2, we can apply the same test applicability rule defined in Rel-15 for eMBB.  Meanwhile, the performance different will be minor based on the previous results for different CBW in each SCS. Thus, we prefer to not define additional requirement only 60KHz/120KHz for 50MHz  Issue 4-2-7: Applicability rule for different SCS and BW  We prefer to not define the additional SCS/BW requirement for FR2  Issue 4-2-8: DM-RS  Ok with option1  Issue 4-2-9: PTRS  We prefer to not configure PTRS in FR2. In Rel-15 eMBB, with PTRS on and off are considered for requirement with 16 QAM and 64QAM, there is no PTRS configuration for QPSK requirement. The impact of phase noise on low modulation order is minor.  Issue 4-2-10: HARQ process number  Ok with option 1  Issue 4-2-11: RV sequence for 4 HARQ re-transmission\  Ok with option 1 |
|  |  |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2014820**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014820.zip)  NTT DOCOMO, INC  Draft CR for TS 38.141-2: Introduction of performance requirements of PUSCH repetition type A and PUSCH mapping type B for URLLC | Company A |
| Company B |
|  |
| [**R4-2015023**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015023.zip)  Ericsson  FRCs for URLLC | Company A |
| Company B |
|  |
| [**R4-2015123**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015123.zip)  Samsung  Draft CR on PUSCH repetition type A and PUSCH mapping type B radiated performance requirement for TS 38.104 | Ericsson: Several TBD on transform precoding, PT-RS etc. need to be fixed in the parameters table. |
| Samsung: To Ericsson, these parameters are not discussed in previous meeting, the CR will be updated based on the agreement in this meeting for these parameters |
|  |
| [**R4-2015124**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015124.zip)  Samsung  Draft CR on FRC for URLLC BS radiated performance requirement for TS 38.141-2 | Company A |
| Company B |
| [**R4-2015623**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015623.zip)  Huawei  CR to TS38.104 Addition of BS performance requirements for URLLC FR1 PUSCH repetition Type A | Company A |
| Company B |
| [**R4-2015624**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015624.zip)  Huawei  CR to TS38.141-1 Addition of BS conformance testing for URLLC demodulation requirements with higher BLER | Company A |
| Company B |
| [**R4-2015625**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015625.zip)  Huawei  CR to TS38.141-1 Test applicability for URLLC BS demodulation requirements | Company A |
| Company B |
| [**R4-2015626**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015626.zip)  Huawei  CR to TS38.141-2 Addition of BS conformance testing for FR2 URLLC PUSCH repetition Type A | Ericsson: Some TBDs in the parameter tables need fixing |
| 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** |
|  |  |  |

### 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”* |

# Topic #5: BS demodulation requirements for low latency

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014545.zip) | Intel Corporation | Proposal 3: Use the following assumptions for FR2 PUSCH mapping Type B requirements:   * PUSCH configuration: Mapping Type B, Start symbol 0, Duration 2 or 4. * MCS 10 from Table 3 * DMRS 1+0 |
| [**R4-2014820**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014820.zip) | NTT DOCOMO, INC. | CR for TS 38.141-2: Introduction of performance requirements of PUSCH repetition type A and PUSCH mapping type B for URLLC |
| [**R4-2014821**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014821.zip) | NTT DOCOMO, INC. | Proposal 7: Adopt MCS 10 from table 3 (Option 1).  Proposal 8: Adopt 2 as symbol length (Option 1) and DM-RS with 1+0 (Option 2). |
| [**R4-2015023**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015023.zip) | Ericsson | FRCs for URLLC |
| [**R4-2015095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015095.zip) | Nokia, Nokia Shanghai Bell | Discussion on low latency - FR2  MCS   1. RAN4 to chose MCS10 from table 3.   DM-RS   1. RAN4 to choose addPos=0, if TDRA=2 or 4 OS is chosen, and addPos=1, if TDRA= 7 OS is chosen.   Symbol length (TDRA)   1. RAN4 to choose the same TDRA as for FR1, i.e., 2 symbols.   PT-RS   1. RAN4 to match the Rel-15 FR2 PUSCH eMBB PT-RS configuration for FR2 low latency testing, i.e., K=2 and L=1, at least for TDRAs >=4 symbols. |
| [**R4-2015097**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015097.zip) | Nokia, Nokia Shanghai Bell | CR for 38.104: Low latency BS demodulation requirements |
| [**R4-2015122**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015122.zip) | Samsung | Observation 1: The combination sets for (2 OS, MCS10, 1 DMRS), (4 OS, MCS5, 1 DMRS) and (7 OS, MCS 2 and 1 DMRS) are not feasible for date packet size with 32 bytes as least for 120 KHz SCS and 50 MHz CBW.  Observation 2: The combination sets for (4 OS, MCS 6, 1 DMRS) has less padding bits compared with other potential feasible combination sets.  Observation 3: Compared with 2 OS, 4 OS or 7 OS can achieve better gain from the coding rate perspective.  Observation 4: 4 or 7 OS is assumption for baseline performance evaluation for most of URLLC use cases.  Observation 5: Mini-slot repetition with 4OS is the typical scenario in RAN1 discussion to supporting dynamic switch between mini-slot repetition and multi-segments  Observation 6: Minor performance difference existed for DMRS configuration with 1 and 1+1 for eMBB in FR2  Observation 7: From the target SNR value with 70% TP perspective, there is no significant difference with configured 2, 4 and 7 OS for PUSCH mini-slot transmission.  Proposal 3: The following combination for MCS, number of DMRS and symbol length are preferred for low latency requirement for FR2 either with (4 OS, MCS6, and 1 DMRS) or (7 OS, MCS 4 and 2 DMRS).  Proposal 4: No PT-RS configuration for FR2 low latency requirement  Proposal 5: No low latency requirement for FR2 with DFT-s-OFDM waveform. |
| [**R4-2015123**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015123.zip) | Samsung | Draft CR on PUSCH repetition type A and PUSCH mapping type B radiated performance requirement for TS 38.104 |
| [**R4-2015124**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015124.zip) | Samsung | Draft CR on FRC for URLLC BS radiated performance requirement for TS 38.141-2 |
| [**R4-2015618**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015618.zip) | Huawei, HiSilicon | Proposal 8: Define 60 kHz/120 kHz for 50 MHz and 100 MHz as SCS and bandwidth for FR2 PUSCH mapping Type B performance requirements.  Proposal 9: Define applicability rule for different SCS and BW: Only 1 SCS and 1 BW need to be tested based on the base station declaration.  Proposal 10: We propose symbol length of 7 for FR2 PUSCH mapping Type B.  Proposal 11: We propose DM-RS is 1+1 for FR2 PUSCH mapping Type B.  Proposal 12: We propose to configure MCS5 from table 3 for FR2 PUSCH mapping Type B. |
| [**R4-2015619**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015619.zip) | Huawei, HiSilicon | Simulation results on PUSCH demodulation reuqirements with higher BLER and low latency |
| [**R4-2015865**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015865.zip) | Ericsson | Proposal 3: Adopt the following wording for the 15kHz aggregation requirement for FR1: The requirements for PUSCH with aggregation for 15kHz can be tested either by configuring n8 and the DDDSU TDD pattern or by configuring FDD with aggregation level n2.  Proposal 4: For the FR2 low latency requirement, assume (2 symbols, MC10) or (4 symbols, MCS5)  Proposal 5: For 2 or 4 symbols, assume single DM-RS for FR2 low latency requirement |
| [**R4-2015866**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015866.zip) | Ericsson | Simulation results for BS high BLER URLLC |
| [**R4-2016006**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016006.zip) | Intel Corporation | CR on FR2 requirements for PUSCH mapping Type B with low number of symbols |

## Open issues summary

In this section, two sub-topic will be discussed:

* PUSCH mapping Type B for FR1
* PUSCH mapping Type B for FR2

For FR1 requirements, the SNR values in specs will be aligned. For FR2 requirements, open issues will be discussed further.

### Sub-topic 5-1: PUSCH mapping Type B for FR1

**Issue 5-1-1: SNR values in specs (based on simulation results in R4-2015629)**

* Proposals

38.104: (Samsung)

15 kHz/5 MHz: [0.6] dB

15 kHz/10 MHz: [0.2] dB

30 kHz/10 MHz: [0.4] dB

30 kHz/40 MHz: [-0.1] dB

38.141: (Samsung)

15 kHz/5 MHz: [1.2] dB

15 kHz/10 MHz: [0.8] dB

30 kHz/10 MHz: [1.0] dB

30 kHz/40 MHz: [0.5] dB

* Recommended WF
  + TBD

### Sub-topic 5-2: PUSCH mapping Type B for FR2

*The agreements and remaining open issues of #96 e-meeting for PUSCH FR2 mapping Type B are listed below:*

***Agreements from #96e-meeting:***

* *Test applicability rule for FR1 and FR2 if both are supported by BS: Tests shall be done for both, and only 1 SCS will be tested for each frequency band with test applicability rule.*
* *SCS/CBW for FR2: 60kHz/50 MHz, 120 kHz/ 50 MHz*
* *TDD pattern: DDDSU, S=10:2:2*
* *Aggregation factor for TDD: n1*
* *Channel model：TDLA30-300*
* *Antenna configuration：1x2, ULA low*
* *Bandwidth allocation：Full bandwidth*
* *Maximum number of HARQ re-transmissions: 1*
* *DM-RS Type: Type 1*
* *DM-RS duration: Single-symbol DM-RS*
* *Start symbol: 0*
* *Test metric: 70% TP*
* *Section numbers and title for TS38.104: (TS 38.141-1/2 will follow the agreements.)*
* *8.2.6 Requirements for PUSCH 0.001% BLER*
* *8.2.7 Requirements for PUSCH repetition Type A*
* *8.2.8 Requirements for PUSCH mapping Type B with non-slot transmission*
* *FRC numbers in Annex A for TS38.104: (TS38.141-1 and TS38.141-2 will follow the agreements.)*
* *A.3A Fixed Reference Channels for performance requirements (QPSK, R=99/1024)*
* *A.3B Fixed Reference Channels for performance requirements (QPSK, R=308/1024)*

***Open issues from #96e-meeting::***

* *MCS*
  + *Option 1: MCS10 from table 3*
  + *Option 2: MCS 5 or MCS 2 from table 3*
* *DM-RS*
  + *Option 1: 1+0 and 1+1.*
  + *Option 2: 1+0*
  + *Option 3: 1+1 if symbol length larger than 4*
* *Symbol length*
  + *Option 1: 2*
  + *Option 2: 4*
  + *Option 3: 7*

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

**Issue 5-2-1: Waveform**

* Proposals
  + Option 1: CP-OFDM only (Samsung, Ericsson)
  + Option 2:
* Recommended WF
  + TBD

**Issue 5-2-2: SCS/BW (60 kHz/120 kHz for 50 MHz has been agreed)**

* Proposals
  + Option 1: Both of 60 kHz and 120 kHz for both of 50 MHz and 100 MHz with applicability rule (Huawei)
  + Option 2: 60 kHz for 50 MHz and 120 kHz for 100 MHz.
* Recommended WF
  + TBD

**Issue 5-2-3: Applicability rule for different SCS and BW**

* Proposals
  + Option 1: Only 1 SCS and 1 BW need to be tested based on the base station declaration.
  + Option 2:
* Recommended WF
  + TBD

**Issue 5-2-4: Symbol length**

* Proposals
  + Option 1: 2 (Intel, DoCoMo, Nokia, Ericsson)
  + Option 2: 4 (Intel, Samsung, Ericsson)
  + Option 3: 7 (Huawei, Samsung)
* Recommended WF0
  + TBD

**Issue 5-2-5: DM-RS (depends on symbol length)**

* Proposals
  + 1+1 for symbol length of 7
  + 1+0 for symbol length of 2 or 4
* Recommended WF
  + TBD

**Issue 5-2-6: PTRS**

* Proposals
  + Option 1: With PTRS configuration for symbol length is 4 or 7 (Nokia)
  + Option 2: No PTRS configuration (Samsung, Ericsson)
* Recommended WF
  + TBD

**Issue 5-2-7: PTRS frequency density (KPT-RS)**

* Proposals
  + Option 1: 2 for symbol length is 4 or 7 (Nokia)
  + Option 2:
* Recommended WF
  + TBD

**Issue 5-2-8: PTRS time density (LPT-RS)**

* Proposals
  + Option 1: 1 for symbol length is 4 or 7 (Nokia)
  + Option 2:
* Recommended WF
  + TBD

**Issue 5-2-9: HARQ process number**

* Proposals
  + Option 1: 4
  + Option 2: 1 (Samsung)
* Recommended WF
  + TBD

**Issue 5-2-10: MCS**

* Proposals
  + Option 1: MCS5 from Table 3 (Huawei, , Ericsson for 4os)
  + Option 2: MCS10 from Table 3 (Intel, DoCoMo, Nokia, Ericsson for 2os)
  + Option 3: MCS6 for 4os or MCS4 for 7os (Samsung)
* Recommended WF
  + TBD

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue |
| Ericsson | Issue 5-1-2: Option 1  Issue 5-2-2: This is both SCS for both BW ?  Issue 5-2-6: There is no need for a PTRS at the considered MCSs  Regarding the channel model: The agreed assumptions for last time, repeated here show the model as TDLA30-300. However, the results spreadsheet shows TLDC300-100. I presume the spreadsheet needs updating; has everyone used the TDLA channel ? |
| Samsung | Issue 5-1-1: SNR values in specs (based on simulation results in R4-2015629)  We are ok the SNR value with keeping [] in this meeting and remove the [] in the next meeting if no more results updated or no technical issue identified.  Issue 5-2-1: Waveform  Option 1  Similar with FR1 requirement, we prefer to only define the low latency requirement for CP-OFDM waveform  Issue 5-2-2: SCS/BW (60 kHz/120 kHz for 50 MHz has been agreed)  We prefer to not define the additional SCS/BW requirement. We have defined the minimum CBW requirement for each SCS in FR2, we can apply the same test applicability rule defined in Rel-15 for eMBB.  Meanwhile, the performance different will be minor based on the previous results for different CBW in each SCS. Thus, we prefer to not define additional requirement only 60KHz/120KHz for 50MHz  Issue 5-2-3: Applicability rule for different SCS and BW  Related with Issue 5-2-2, we do not think it is necessary to define additional SCS/BW requirement.  Issue 5-2-4: Symbol length  We prefer either option 2 or option 3  In terms of requirement, we think RAN4 should focus on the typical scenario with possible network scheduling.  Base on the requirement of low latency, the targeting is to satisfy the latency (i.e., 1ms air interface latency), where the applicable data packet size 32 bytes and 200 bytes.  As agreed in the last meeting, the minimum CBW for each SCS in FR2 with full bandwidth was agreed to introduce low latency requirement. The following is the feasibility checking for each combination set.  Table 1. Padding bits for each combination set of (OS, MCS and DMRS) for 50MHz with 60 KHz SCS, and 50MHz with 120 KHz SCS   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Combination set** | **Number of RB** | **TBS** | **Coding Rate** | **Padding bits compared with 32bytes (256 bits)** | | (2 OS, MCS10, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 480 | 0.3 | 224 | | 32 (120KHz SCS/ 50 CBW) | 224 | 0.3 | N.A | | (2 OS, MCS11, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 608 | 0.37 | 352 | | 32 (120KHz SCS/ 50 CBW) | 288 | 0.37 | 32 | | (4 OS, MCS5, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 456 | 0.097 | 200 | | 32 (120KHz SCS/ 50 CBW) | 224 | 0.097 | N.A | | (4 OS, MCS6, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 552 | 0.12 | 296 | | 32 (120KHz SCS/ 50 CBW) | 272 | 0.12 | 16 | | (4 OS, MCS7, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 736 | 0.15 | 480 | | 32 (120KHz SCS/ 50 CBW) | 352 | 0.15 | 96 | | (7 OS, MCS2, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 480 | 0.05 | 224 | | 32 (120KHz SCS/ 50 CBW) | 224 | 0.05 | N.A | | (7 OS, MCS3, 1 DMRS) | 66 (60KHz SCS/ 50 CBW) | 608 | 0.0625 | 352 | | 32 (120KHz SCS/ 50 CBW) | 288 | 0.0625 | 32 | | (7 OS, MCS3, 2 DMRS) | 66 (60KHz SCS/ 50 CBW) | 504 | 0.0625 | 248 | | 32 (120KHz SCS/ 50 CBW) | 240 | 0.0625 | N.A | | (7 OS, MCS4, 2 DMRS) | 66 (60KHz SCS/ 50 CBW) | 608 | 0.0762 | 352 | | 32 (120KHz SCS/ 50 CBW) | 288 | 0.0762 | 32 |   Based on the feasibility checking, the combination sets for (2OS, MCS10, 1 DMRS), (4OS, MCS5) are not feasible for data packet size with 32 bytes at least for 120khZ SCS and 50 MH CBW  The combination sets for (4OS, MCS6, 1 DMRS) has less padding bits compared with other potential feasible combination sets.  Compared with 2OS, 4OS or 7OS can achieve better gain from the coding rate perspective.  Meanwhile, as indicated in the specification 38.824, most of URLLC use cases (i.e. Rel-15 enabled use case, factory automation, transport industry and electrical power distribution), 4 or 7 OS is assumption for baseline performance evaluation.  Again, from the test coverage perspective, 2 OS has already covered in the FR1 for low latency. From the receiver processing perspective, there is no different foreseen with 2OS in FR2.  Thus, we think 4 OS or 7 OS is more feasible for lower latency requirement from padding bits, coding rate, use cases, and test coverage perspective.  Issue 5-2-5: DM-RS (depends on symbol length)  We are ok with 1 DMRS for 4 OS and 2 DMRS for 7OS.  In current Rel-15 BS demodulation requirement for eMBB, RAN4 has already defined with 10 symbols requirement with type B in FR2. In terms for performance, we do not think there is too much different between 7OS and 10OS. Meanwhile, both 1 DMRS and 1+1 DMRS are configured for requirement for mapping type B in FR2. As indicated, the requirement between 1 DMRS and 2 DMRS configuration is minor.  Issue 5-2-6: PTRS  We prefer to not configure PTRS in FR2. In Rel-15 eMBB, with PTRS on and off are considered for requirement with 16 QAM and 64QAM, there is no PTRS configuration for QPSK requirement. The impact of phase noise on low modulation order is minor.  Meanwhile, with PTRS configuration, the number of available REs for data transmission is reduced, which will result in the increasing effective coding rate for targeting information bits.  Issue 5-2-7: PTRS frequency density (KPT-RS)  As for issue 5-2-6, we prefer to not define PTRS in FR2  Issue 5-2-8: PTRS time density (LPT-RS)  As for issue 5-2-6, we prefer to not define PTRS in FR2  Issue 5-2-9: HARQ process number  We prefer to define FR2 requirement without HARQ transmission, similar with requirement defined in FR1.  Issue 5-2-10: MCS  With analyzed in issue 5-2-4, and 5-2-5, we think the current MCS 5 or 10 is not feasible, we prefer MCS6 for 4OS or MCS4 for 7OS. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2015097**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015097.zip)  Nokia  CR for 38.104: Low latency BS demodulation requirements | Ericsson: For the requirements tables, additional DM-RS position should be pos0 not pos1. |
| Company B |
|  |
| [**R4-2016006**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2016006.zip)  Intel  CR on FR2 requirements for PUSCH mapping Type B with low number of symbols | 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** |
|  |  |  |

### 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”* |

# Topic #6: URLLC BS Rel-16 features

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2014545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2014545.zip) | Intel Corporation | Proposal 4: Define Rel-16 URLLC BS demodulation requirements to verify PUSCH repetition Type B.  Proposal 5: Do not define Rel-16 URLLC BS demodulation requirements to verify enhanced inter UE Tx prioritization/multiplexing and enhanced UL configured grant transmission. |
| [**R4-2015095**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015095.zip) | Nokia, Nokia Shanghai Bell | Discussion on Rel-16 URLLC BS features  PUSCH repetition type B  The current TU request excel (bundled with RP-191584) has run out of allocated time in the last meeting. No update to this WID was agreed in the last plenary as far as we are aware: The submitted SR (RP-201661) did not contain the TU allocation excel, just a suggestion to extend to RAN#92, and it was ultimately noted.   1. RAN4 to not treat PUSCH repetition type B demodulation performance requirements in this WI.   Inter-UE multiplexing  No impact on BS demodulation performance is expected from dynamic power boosting or UL cancellation indication.   1. RAN4 to not treat inter-UE multiplexing, as no demodulation impact is expected. |
| [**R4-2015122**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015122.zip) | Samsung | Proposal 6: No BS demodulation requirement need to be specified for Rel-16 URLLC feature: PUSCH repetition type B  Proposal 7: No BS demodulation requirement need to be specified for Rel-16 URLLC feature: inter-UE multiplexing feature. |
| [**R4-2015618**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015618.zip) | Huawei, HiSilicon | Proposal 13: PUSCH repetition type B performance requirements should be specified.  Proposal 14: Parameters for PUSCH repetition Type B:   |  |  |  | | --- | --- | --- | | Parameter | | Value | | Frequency range | | FR1 | | Transform precoding | | Disabled | | Antenna configuration | | 1x2, ULA Low | | PUSCH configuration | Mapping type | Type B | | Starting symbol (S) | 0 | | Length (L) | 7 | | PUSCH aggregation factor | n2 | | PUSCH DMRS configuration | DMRS Type | Type 1 | | DMRS duration | Single-symbol DM-RS | | Number of additional DMRS | 1 | | Propagation condition | | TDLB100-400 | | MCS Table | | Table 3, [MCS 5] | | SCS and BW | | 15 kHz / 10 MHz  30 kHz / 40 MHz | | Frequency domain resource | | Full Bandwidth | | TDD pattern | | 15 kHz SCS: 3D1S1U, S=10:2:2  30 kHz SCS: 7D1S2U, S=6:4:4 | | Maximum number of HARQ transmissions | | 4 | | Testing metric | | Target BLER: 10-2  (Calculate the target BLER after all transmission) |   Proposal 15: No need to define the performance requirements for inter-UE multiplexing. |
| [**R4-2015626**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015626.zip) | Huawei, HiSilicon | CR to TS38.141-2 Addition of BS conformance testing for FR2 URLLC PUSCH repetition Type A |
| [**R4-2015865**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_97_e/Docs/R4-2015865.zip) | Ericsson | Proposal 6: Do not create further BS requirements for Rel-16 features as the demodulation aspects are captured with existing requirements. |

## Open issues summary

### Sub-topic 6-1: Rel-16 URLLC BS features

In this section, URLLC Rel-16 features for BS will be discussed.

*The open issues of #96 e-meeting for Rel-16 URLLC BS features are listed below:*

***Open issues:***

* *Features need to be discussed*
  + *PUSCH repetition type B*
  + *Inter-UE multiplexing*
  + *Other features not precluded.*
* *Whether to define performance requirements for PUSCH repetition type B*
  + *Option 1: Yes*
  + *Option 2: No*
* *Whether to define performance requirements for Inter-UE multiplexing*
  + *Option 1: Yes*
  + *Option 2: No*

**Issue 6-1-1: Features need to be discussed**

* Proposals
  + PUSCH repetition type B
  + Inter-UE multiplexing
  + Other features not precluded.

**Issue 6-1-2: Whether to define performance requirements for PUSCH repetition type B**

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

**Issue 6-1-3: Whether to define performance requirements for Inter-UE multiplexing**

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

### Sub-topic 6-2: PUSCH repetition Type B (only if this is agreed to be defined)

**Issue 6-2-1: Parameters for PUSCH repetition Type B**

* Proposals
  + Option 1: (Huawei)

|  |  |  |
| --- | --- | --- |
| **Parameter** | | **Value** |
| Frequency range | | FR1 |
| Transform precoding | | Disabled |
| Antenna configuration | | 1x2, ULA Low |
| PUSCH configuration | Mapping type | Type B |
| Starting symbol (S) | 0 |
| Length (L) | 7 |
| PUSCH aggregation factor | n2 |
| PUSCH DMRS configuration | DMRS Type | Type 1 |
| DMRS duration | Single-symbol DM-RS |
| Number of additional DMRS | 1 |
| Propagation condition | | TDLB100-400 |
| MCS Table | | Table 3, [MCS 5] |
| SCS and BW | | 15 kHz / 10 MHz  30 kHz / 40 MHz |
| Frequency domain resource | | Full Bandwidth |
| TDD pattern | | 15 kHz SCS: 3D1S1U, S=10:2:2  30 kHz SCS: 7D1S2U, S=6:4:4 |
| Maximum number of HARQ transmissions | | 4 |
| Testing metric | | Target BLER: 10-2  (Calculate the target BLER after all transmission) |

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Issue |
| Samsung | Issue 6-1-1: Features need to be discussed  We are ok to discuss the Rel-16 URLLC functionalities with PUSCH repetition type B and Inter-UE multiplexing  Issue 6-1-2: Whether to define performance requirements for PUSCH repetition type B  We prefer to option 2. Compared with PUSCH repetition type A, only different is the mini-slot repetition can cross the slot boundary, where the number of repetition can be supported with {n1, n2, n4, n7, n12 and n16}.  From the BS receiver processing perspective, we don't think the combination of multiple repetition transmission blocks with PUSCH repetition A and repetition will be different. The performance is very minor, only the transmission delay can be reduced for repetition type B.  Issue 6-1-3: Whether to define performance requirements for Inter-UE multiplexing  We are ok with option 1. This feature is related with scheduling and power control, no impact on the receiver foreseen  Issue 6-2-1: Parameters for PUSCH repetition Type B  The issue depends on the issue 6-1-2. |

### 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** |
|  |  |  |