Final summary
Variant of [102-e][327] NR_exto71GHz_Demod_NWM Version 0.0.5
RAN4

3GPP TSG-RAN WG4 Meeting # 102-e R4-2207446

Electronic Meeting, 21 February – 03 March 2022

Agenda item: 10.16.10

Source: Moderator (Intel Corporation)

Title: Email discussion summary for [102-e][327] NR_exto71GHz_Demod_NWM

Document for: Information

Introduction

This thread will be used to guide and summarize the email discussion for the topic of Rel-17 extending current NR operation to 71GHz demodulation and CSI requirements (AI 10.16.10), with the email thread identifier [102-e][327] NR_exto71GHz_Demod_NWM".

The scope of this email discussion is definition of Rel-17 NR FR2-2 demodulation and CSI performance requirements, and in particular the agenda items:

10.16.10 Demodulation and CSI requirements [NR_ext_to_71GHz-Perf]

10.16.10.1 General [NR_ext_to_71GHz-Perf]

10.16.10.2 UE Demodulation and CSI requirements [NR_ext_to_71GHz-Perf]

10.16.10.3 BS Demodulation and CSI requirements [NR_ext_to_71GHz-Perf]

RAN4#102-e has 0.5 TU allocated to performance part of NR_ext_to_71GHz-Perf [RP-212990].

Priority topics for the discussion are marked directly in the open issues' summaries.

Discussion guidelines

- Please follow the "RAN4#102-e E-meeting Arrangements and Guidelines", available on the reflector, for fundamental guidelines and deadlines.
- Delegates are strongly encouraged to provide comments/concerns asap.
- Silence within a reasonable timeframe means no objection.
- It is encouraged to give at least a short reasoning for each expressed view.

1 Topic #1: General

1.1 Companies' contributions summary

T-doc number	Company	Proposals / Observations
R4-2203530	Nokia, Nokia Shanghai Bell	**Observation 1:** Operation in FR2-2 includes support of 120, 480, and 960 kHz SCS. **Observation 2:** Channel bandwidths of up to 2000 MHz are supported in FR2-2. **Observation 3:** In order to support FR2-2 operation, a UE has to support at least 120 kHz SCS. **Observation 4**: Initial access can be supported with SSBs using 120 kHz and 480 kHz SCS. **Observation 5**: In order to support one SCS in UL, the UE has to at least support the same SCS in DL. **Observation 6:** Support of one SCS in DL does not imply support of the same SCS in UL. **Proposal 1**: Specify new demodulation performance requirements for UE and BS for SCS 480 kHz and 960 kHz **Observation 7:** Scheduling and link adaptation typically allocates large SCS and MCS in situations with low delay spread. **Observation 8:** Distribution of the delay spread in typical scenarios for operation in FR2-2 are mostly concentrated bellow 30 ns, with a large part of the samples experiencing delay spread between 10 and 20 ns. **Observation 9:** Existing RAN4 requirements include TDLA30 as the minimum delay spread for fading channels. **Proposal 2:** RAN4 to study the use of TDLA10 and TDLA20 for demodulation requirements with large SCS and high MCS. **Observation 10:** Doppler shift is directly proportional to the carrier frequency; Hence, it should be higher in FR2-2 compared to FR2-1. **Observation 11:** Simulation assumption for FR2 was 30 GHz. **Proposal 3:** We propose to double the doppler shifts in FR2-2 than the ones already used for FR2-1. i.e., TDLAxx-150, and TDLAxx-300. **Observation 12:** Deployment scenarios agreed in RF and RRM already include FR2-2 only standalone and CA/NR-DC with FR1 anchor. **Proposal 4:** RAN4 to consider demodulation requirements including the following scenarios: • Standalone FR2-2 only • CA and NR-DC with FR1 anchor and FR2-2
R4-2204031	Ericsson	**Proposal 1:** Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise. Phase noise model could use model set 1 defined in TR38.808. **Proposal 2:** Companies deliver trial simulation results based on channel model TDLA30, TDLA10 and TDLA5. Consider define new channel model TDLA10 or TDLA5 for FR2-2 demodulation requirement if they are feasible. **Proposal 3:** Companies deliver trial simulation results based on different maximum Doppler shift 200Hz (UE speed at 3km/h) and 2000Hz (UE at 30km/h) at 70GHz for further discussion. **Proposal 4:** Regarding possible outdoor deployment for FR2-2 BS, consider higher UE speed with more DM-RS configuration, such as 30km/h with 1+1 DM-RS, for the requirement if it is feasible. **Proposal 5:** Prioritize 120kHz SCS for both BS and UE demodulation requirement discussion. 480kHz and 960kHz SCS could be lower priority. **Proposal 6:** Prioritize the minimum and maximum supported bandwidth for each supported SCS for the demodulation discussion. **Observation 1:** If LBT is considered, test setup for shared spectrum access is different from NR SA, but there wouldn't be much performance difference from demodulation perspective. **Observation 2:** If LBT is not considered, only TDD patterns for 120kHz SCS are available.

		Proposal 7: Define one set of FR2-2 demodulation requirements to cover both NR SA deployment and shared spectrum access deployment if possible.
		
		Proposal 8: Define new TDD patterns for 480kHz and 960kHz SCS. Following patterns can be considered:
		• Option 1: Same as FR2-120-1, 3D1S1U, S=10D:2G:2U.
		• Option 2: Use the same DL/UL duration as 120kHz SCS to keep sufficient processing timeline.
		  o 480kHz SCS: 12D4S4U, S1=S2=14D:0G:0U, S3=12D:2G:0U, S4=0D:6G:8U
		  o 960kHz SCS: 24D8S8U, S1=S2=S3=S4=S5=14D:0G:0U, S6=10D:4G:0U, S7=0D:12G:2U, S8=0D:0G:14U
		
		Proposal 9: Follow RF FR2-2 requirement structure, capture FR2-2 demodulation requirement into same section as FR2-1 but with different tables if possible. Adding extra phrase as "for FR2-1" and "for FR2-2" to requirement tables for differentiation.

R4-2205916	Intel Corporation	**Work plan:** **RAN4#102-e:** 1. Discussion and agreement on work plan 2. Discussion on performance requirements scope 3. Initial discussion on work split 4. Initial discussion on simulation assumptions **RAN4#102-bis-e:** 1. Finish discussions on performance requirements scope per each physical channel 2. Finish discussions on simulation assumptions per each physical channel 3. Finish discussions on work split 4. Initial round of simulation results collection and alignment 5. Initial draft CRs for TS 38.104 Base Station (BS) radio transmission and reception 6. Initial draft CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing 7. Initial draft CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements **RAN4#103-e** 1. Final round of simulation results collection and alignment 2. CRs for TS 38.104 Base Station (BS) radio transmission and reception 3. CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing 4. CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements **Proposal 1:** RAN4 to discuss and approve the above work plan.
R4-2205917	Intel Corporation	**Proposal #1:** Reuse existing sections in TS 38.104 and TS 38.141-2 for FR2-2 BS performance requirements definition. **Proposal #2:** Reuse existing sections in TS 38.104-1 for FR2-2 UE performance requirements definition.

Figure 2: Topic #1: General - Companies' contribution summary: part 2

1.2 Open issues summary

Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies' contributions.

1.2.1 Sub-topic 1-1: Work plan

Sub-topic description:

The latest TU request for NR_ext_to_71GHz can be found in RP-212990, "Status Report to TSG; rapporteur: Qualcomm; Intel Corporation", WI status report, RAN#94-e]. The target completion date for performance (NR_ext_to_71GHz-Perf) is September 2022. The following amount of TUs are allocated for this work:

- 0.5 TU at RAN4#102-e
- 0.5 TU at RAN4#103-e
- 1 TU at RAN4#104

Open issues and candidate options before e-meeting:

Issue 1-1: Work plan

- Proposals
  - Proposal 1 (Intel): Suggested workplan:
    - RAN4 #102e
      - Discussion and agreement on work plan
      - Discussion on performance requirements scope
      - Initial discussion on work split
      - Initial discussion on simulation assumptions
    - RAN4 #103e
      - Finish discussions on performance requirements scope per each physical channel
      - Finish discussions on simulation assumptions per each physical channel
      - Finish discussions on work split
      - Initial round of simulation results collection and alignment
      - Initial draft CRs for TS 38.104 Base Station (BS) radio transmission and reception
      - Initial draft CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing

- Initial draft CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements

- RAN4 #104
  - Final round of simulation results collection and alignment
  - CRs for TS 38.104 Base Station (BS) radio transmission and reception
  - CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing
  - CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements

- Recommended WF
  - Collect views in 1st round

Feedback Form 1: Issue 1-1: Work plan

1 – Samsung Electronics Benelux BV Samsung: In general, we are fine with work plan based ono target completion date. For this meeting, we should focus on scope and general test setup, for details simulation assumption , we are not sure whether the agreement can be achieved,
2 – Intel Corporation (UK) Ltd Based on the current schedule we do not see another possible way how to complete performance part on time. Baseline set of simulation assumptions should be discussed this meeting to provide initial results next meeting. This meeting we have a good set of proposed assumptions for each physical channel. Some selection can be made already. Also, since this is the first meeting, companies might need more time to check, so a note that “other options are not precluded” can be added for each assumption.
3 – Apple GmbH Given the target completion date, we are fine with the work plan.
4 – HiSilicon Technologies Co. Ltd we are fine with the work plan.
5 – Ericsson LM Ericsson: We think it’s an ambitious plan to finish all discussion in 3 meetings regarding there are potentially many requirements would be defined. The initial round of simulation results collection planned for 103e meetings will depend on how and which agreements will be set in this meeting (102e)

6 – Qualcomm Technologies Int We see that given the timeline the schedule has to be compressed as proposed in the work plan, but we share other companies' concern regarding completing the discussion in time

1.2.2 Sub-topic 1-2: General aspects of demodulation requirement definition

Sub-topic description

The purpose of this sub-topis is to define the general set of demodulation and CSI reporting requirements. Whether to define completely new set of requirements or reuse existing FR2-1 requirements, and detail scope of requirements are discussed in another issues.

Open issues and candidate options before e-meeting:

Issue 1-2-1: General scope of BS demodulation performance requirements

All contributions have discussed introduction of requirements for PUSCH, PUCCH, and PRACH UL physical channels. There are no proposals to deprioritize or skip one these physical channels.

- Proposals
  - Option 1 (Huawei, Ericsson, Nokia, Intel): Define PUSCH, PUCCH, and PRACH performance requirements.
- Recommended WF
  - Check whether Option 1 is agreeable.

Feedback Form 2: Issue 1-2-1: General scope of BS demodulation performance requirements

1 – Nokia Belgium Nokia: we are fine with the WF
2 – Samsung Electronics Benelux BV Samsung: OK with recommended WF
3 – Intel Corporation (UK) Ltd Support Option 1.

4 – HiSilicon Technologies Co. Ltd

Support option 1

5 – Ericsson LM

Ericsson: Support Option 1.

Issue 1-2-2: General scope of UE demodulation and CSI reporting performance requirements

Based on the contribution review, it seems that all companies propose to define PDSCH, PDCCH, and CSI reporting requirements. There are different views on requirements introduction for PBCH and SDR. One important note that is mentioned in [R4-2205802] that there are no conformance test cases for PBCH due to some testability issues identified.

- Proposals
  - Option 1 (Ericsson, Nokia): Define PDSCH, PDCCH, PBCH, and SDR performance requirements.
  - Option 2 (Intel): Define PDSCH, PDCCH, and SDR performance requirements. Do not define PBCH performance requirements.
  - Option 3 (Huawei): Define PDSCH, PDCCH and PBCH requirements. Don't define SDR performance requirements.
- Recommended WF
  - Check whether it is agreeable to define PDSCH, PDCCH requirements.
  - Collect views on whether to define requirements for PBCH and SDR

Feedback Form 3: Issue 1-2-2: General scope of UE demodulation and CSI reporting performance requirements

1 – Nokia Belgium

We prefer Option 1.

We think it is important to include the PBCH requirements.

As for the SDR requirements we don't see the big gain in workload of precluding it.

2 – Intel Corporation (UK) Ltd

Data rate can be much higher in FR2-2 compared to FR2-1. Therefore, it is important to guarantee that L1 and L2 correctly process received packets corresponding to the maximum data rate. In this case we recommend defining SDR requirements for FR2-2. Similar test methodology as in FR2-1 can be reused with some required confirmation that is discussed in issue 3-6-1.

As for PBCH, we are not strongly against to define such requirements. We proposed to deprioritize them because PBCH test cases is just an informative requirement to show operating SNR points. RAN5 has not specified conformance test cases for PBCH neither for FR1 nor for FR2 because it is hard to define simple test due to lack of any feedback from UE on successful/non-successful PBCH decoding. Do we really need to spend RAN4 efforts right now to define the informative requirements?

3 – HiSilicon Technologies Co. Ltd We prefer option 3. RAN 1 has defined new SSB transmission pattern and new SCS for PBCH which are import feature for demodulation part. We support define PBCH requirements. As for SDR test, we don't see any motivation to introduce it.
4 – Apple GmbH We should define all requirements for FR2-2. It is important to define SDR requirements and PBCH demod. We can choose to only define PBCH decoding with unknown SSB index.
5 – Ericsson LM Ericsson supports Option 1. PBCH demodulation requirements should be defined for FR2-2. About SDR requirements, FR2-2 is challenging for high MCS and rank should be examined to see whether rank 2 could be supported or not.
6 – Qualcomm Technologies Int We are fine with Option 1, but we support Apple's opinion to define PBCH decoding only with unknown SSB index (and not with known SSB index)

Issue 1-2-3: Scenarios to be considered for requirements definition

- Proposals
  - Proposal 1 (Nokia): RAN4 to consider demodulation requirements including the following scenarios:
    - Standalone FR2-2 only
    - CA and NR-DC with FR1 anchor and FR2-2
  - Proposal 2 (Ericsson): RAN4 defines the UE demodulation and CSI reporting requirements with:
    - Both single carrier (FR2-2) and NR-DC FR1 + FR2-2 scenarios
  - Proposal 3 (Intel): Do not define DL performance requirements for CA in FR2-2 in Rel-17
- Recommended WF
  - Collect views in 1st round

Feedback Form 4: Issue 1-2-3: Scenarios to be considered for requirements definition

1 – Nokia Belgium We prefer proposal 1. This is in line with RF and RRM agreements. We would like to have demodulation requirements that are in line with the scenarios of proposal 1.

2 – Samsung Electronics Benelux BV Samsung: For BS demodulation , only focus on FR2-2
3 – Intel Corporation (UK) Ltd Definitely, RAN4 should address SA scenario. NR-DC with FR1 anchor performance can be also guaranteed by requirements defined for SA similar to FR2-1. Same time, it is premature to discuss CA requirements due to lack of the bands in FR2-2 and not clear max CBW that will be supported for demod test from testability perspective. Therefore, we suggest focusing on SA requirements, define applicability rule to guarantee NR-DC operation and postpone CA requirements definition to the next release.
4 – Apple GmbH Fro Rel-17 we should introduce requirements for SA and NR-DC. In NR-DC the requirements will only apply to FR2-2. CA requirements can be introduced in later release.
5 – HiSilicon Technologies Co. Ltd We propose to keep it open and discuss it next meeting
6 – Ericsson LM Ericsson: Proposal 2 also encloses Proposal 3, because the WID only includes CA between FR1 and FR2-2 (band 263), so we cannot talk right now on CA in FR2-2 (as stated in Proposal 3). Therefore, we believe that Proposal 2 is accurate and complete.

Issue 1-2-4: Shared spectrum access requirements

- Proposals
  - Proposal 1 (Huawei):
    - Not consider LBT failure for PUSCH, PUCCH and PRACH cases
    - Define two set of PDSCH requirements for license band without LBT mechanism and unlicensed band with LBT mechanism
  - Proposal 2 (Ericsson): Define one set of FR2-2 demodulation requirements to cover both NR SA deployment and shared spectrum access deployment if possible.
  - Proposal 3 (Intel): Define FR2-2 UE demodulation requirements that cover licensed and unlicensed operations
- Recommended WF
  - Collect views in 1st round

Feedback Form 5: Issue 1-2-4: Shared spectrum access requirement

1 – Nokia Belgium

For this issue we think it would be better to split the discussion in UE and BS demod.

For BS demod we don't see the reason to use LBT failure int eh requirements, and we could follow NR-U approach.

For UE demod NR-U has defined requirements with LBT failures. However, since in this frequency range the probability of failures is smaller there is no big need to define requirements considering failures, and we are mostly neutral about defining requirements with LBT for UE demod.

So I propose discussing based on Proposal 4:

- Proposal 4 (New):
  - For PUSCH, PUCCH and PRACH requirements, single set of requirements without LBT are defined
  - For PDSCH requirements
    - Option 1: define requirements without LBT
    - Option 2: define requirements with and without LBT

2 – Samsung Electronics Benelux BV

Samsung: Similar view with Nokia, for BS requirement, single set of requirements without LBT are defined

3 – Intel Corporation (UK) Ltd

For BS we agree to define requirements without LBT failure.

For UE we also propose to define requirements without LBT failure due to the following reasons:

1) LBT failure does not have impact on PDSCH performance. It was confirmed by many companies during the NR-U Rel-16 discussion.

2) LBT mechanism is not mandated in all regions for FR2-2.

3) LBT failure rate potentially quite small in FR2-2 due to quite directive beams. So it is not really critical to verify LBT procedure in FR2-2.

4 – Apple GmbH

Define the same requirements that are applicable to both licensed and unlicensed bands. We don't see huger performance impact due to LBT failure modeled. Hence we propose to only introduce requirements without LBT failure modeled.

5 – HiSilicon Technologies Co. Ltd

We understand some companies' concern that LBT failure may not be usually happened in FR2-2 with directional channel listening and no corresponding performance difference is observed. We can compromise to not consider LBT failure for both BS and UE side. Meanwhile, we should add the clarification that all the requirements can be apply for both licensed band and unlicensed band.

6 – Ericsson LM Ericsson: Support Option 2 and also think it could be better to define one set of requirements to cover licensed and unlicensed operations. We think LBT is not so relevant to demodulation performance and it is not typical for FR2-2 unlicensed operation considering very small cell and very narrow beam.
7 – Qualcomm Technologies Int For UE demod, the NR-U discussion in Rel.16 showed that for unlicensed operations LBT did not have a direct impact the demod performances, but in case of LBT failure the UE has to be able to skip periodic TRS scheduled (which was not transmitted over the air). This has a potentially unbound impact on performances, and it was a strong reason to introduce LBT in the test. Given that it can be controlled with a parameter that can be set to 0 for licensed tests for example, we can think of introducing requirements also with LBT.

1.2.3 Sub-topic 1-3: Channel model for requirements definition

Sub-topic description

Several contributions highlighted necessity of channel model revision for FR2-2 compared to FR2-1 in terms of RMS delay spread and max Doppler frequency.

Open issues and candidate options before e-meeting:

Issue 1-3-1: Propagation conditions

- Proposals
  - Proposal 1 (Nokia): Both static propagation condition and Multi-path fading propagation conditions could be considered when defining new requirements and test cases.
- Recommended WF
  - Collect views in 1st round

Feedback Form 6: Issue 1-3-1: Propagation conditions

1 – Nokia Belgium We would like to clarify that proposal. This proposal is based on the existing FR2-1 requirements for PRACH, which include AWGN and fading channel.
2 – Samsung Electronics Benelux BV Samsung: we are fine with option 1 for PRACH requirement

3 – Intel Corporation (UK) Ltd Support to consider multi-path fading + also static conditions that are required for PRACH performance verification
4 – Apple GmbH Consider static and multi-path propagation conditions.
5 – HiSilicon Technologies Co. Ltd We are fine with this proposal if refers to PRACH requirements
6 – Ericsson LM Ericsson: For PRACH and CQI report, both AWGN and multi-path fading channel can be applied if necessary. For other physical channels, only multi-path fading channel could be enough. [KT1] Likewise, for UE side, we will need static propagation condition only for CSI reporting requirements. [KT1]I agree on this as well.

Issue 1-3-2: RMS delay spread

- Proposals
  - Proposal 1 (Nokia): RAN4 to study the use of TDLA10 and TDLA20 for demodulation requirements with large SCS and high MCS.
  - Proposal 2 (Ericsson): Companies deliver trial simulation results based on channel model TDLA30, TDLA10 and TDLA5. Consider define new channel model TDLA10 or TDLA5 for FR2-2 demodulation requirement if they are feasible
  - Proposal 3 (Intel): Define FR2-2 performance requirements with TDLA 10ns RMS delay spread value and with 200 and 650 Hz max Doppler frequency.
- Recommended WF
  - Collect views on the applicable RMS delay spread in 1st round

Feedback Form 7: Issue 1-3-2: RMS delay spread

1 – Nokia Belgium We are fine with proposal 1 or 2. Maybe it is too early to decide on TDLA10 as in proposal 3.
2 – Samsung Electronics Benelux BV Samsung: We wonder if the actual channel of FR2-2 is similar to TDL-A. we would like to discuss the channel model of FR2-2 such as TDL-D.

3 – Intel Corporation (UK) Ltd

It is not clear for us how to choose RMS delay spread based on link-level results. Definitely, performance will be different due to different diversity gains and channel estimation qualities. The typical set for RMS delay spread for FR2-2 is from 30 to 5 ns according to RAN1 assumptions. Can we converge on some value from this range this meeting and safe time avoiding evaluation of several options? For higher SCS it is preferable to consider lower delay spread. For 120 kHz we are fine with 20,10 ns and for 480 and 960 kHz we suggest considering either 10 or 5 ns.

As for TDL channel model, according to RAN1 SI on supporting NR from 52.6 to 71 GHz (TR 38.808), TDL A channel model was considered for link-level analysis. We prefer to consider it also at least as a baseline. If some SNR limits will be identified for high CBWs, LOS channel model as TDL-D can used for these cases.

4 – Apple GmbH

We should define requirements with LOS channel model for FR2-2. If NLOS channel are used, the delay spread should be small ≤ 10ns as we can expect very narrow beams in FR2-2 that reduces the delay spread greatly.

5 – HiSilicon Technologies Co. Ltd

According to R4-2203079, RAN 4 session RF has agreed to consider TDL-A channel model with RMS delay spread as in range of 5-20ns and with 3km/h UE mobility as starting point for test methodology for FR2-2 UE modelation and CSI. Therefore, we don't see the need to consider LOS channel model and follow the RF agreements to limit the RMS into 5-20ns. As this is first meeting, we prefer to keep it open and discuss in the next meeting

6 – Ericsson LM

Ericsson: We suggest companies considering different delay spread and Doppler shift combinations to cover several typical scenarios, i.e., coverage scenario (large DS + medium Doppler + low MCS) and capacity scenario (small DS + low Doppler + high MCS). Simulations could be needed for further discussion.

We also want to bring up an issue about the delay resolution for delay profile. Currently, 5ns resolution is used for all channel model delay profile. It indicates the maximum correlation bandwidth is up to 200MHz. For larger BW with much higher sampling rate, the channel correlation will be repeated in frequency domain if we still use 5ns resolution. It would be better to scale the resolution based on larger BW (i.e, 0.5ns resolution for up to 2GHz BW) to get better delay profile.

Issue 1-3-3: Max Doppler frequency

- Proposals
  - Proposal 1 (Nokia): We propose to double the doppler shifts in FR2-2 than the ones already used for FR2-1. i.e., TDLAxx-150, and TDLAxx-300.
  - Proposal 2 (Ericsson): Companies deliver trial simulation results based on different maximum Doppler shift 200Hz (UE speed at 3km/h) and 2000Hz (UE at 30km/h) at 70GHz for further discussion
  - Proposal 3 (Ericsson): Regarding possible outdoor deployment for FR2-2 BS, consider higher UE speed with more DM-RS configuration, such as 30km/h with 1+1 DM-RS, for the requirement if it is feasible

- Proposal 4 (Intel): Define FR2-2 performance requirements with TDLA 10ns RMS delay spread value and with 200 and 650 Hz max Doppler frequency.

- Recommended WF
  - Collect views on the applicable max Doppler frequency in 1st round

Feedback Form 8: Issue 1-3-3: Max Doppler frequency

1 – Nokia Belgium We propose to double the doppler shifts and frequency shift in the test cases designed using previous use cases. regardless on the assumed UE speed and assumed frequency. For example for PRACH test cases for FR2-1, Table 11.4.2.2.2-2 of use TDLA30-300 and 4000 Hz frequency offset. Therefore we propose to use 8000 Hz as Frequency offset and TDLA30-600 as a propagation condition.
2 – Samsung Electronics Benelux BV Samsung: The maximum Doppler frequency value is pending on UE speed and Carrier frequency. We can apply the doppler value in FR2-1 as starting point
3 – Intel Corporation (UK) Ltd We are fine with Nokia proposal just to double max Doppler frequency for corresponding requirement. FR2-1 requirements are applicable up to 52.6 GHz. Since limit for FR2-2 is 71GHz, double Doppler frequency will cover the whole FR2-2 range even with some margin.
4 – Apple GmbH We think 650Hz Doppler is rather high. What is the assumed UE speed? We doubt if we can consider higher UE speeds for FR2-2. From the SI, the assumed speed is 3kmph. Assuming max carrier frequency of 71GHz, we think max Doppler should be 200 Hz.
5 – HiSilicon Technologies Co. Ltd We propose to at least consider 200Hz (3 km/h) and further discuss whether to consider higher Doppler spread in next meeting.
6 – Ericsson LM Ericsson: Suggest companies considering low and medium UE speed (3km/h and 30km/h) regarding indoor and outdoor deployment. Simulations should be needed for feasibility investigation.

1.2.4 Sub-topic 1-4: Phase noise

Sub-topic description

Several companies highlighted higher phase noise impact on demodulation performance in FR2-2 compared to FR2-1

Open issues and candidate options before e-meeting:

Issue 1-4-1: Study on phase noise impact for requirements derivation

- Proposals
  - Proposal 1 (Ericsson): Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise. Phase noise model could use model set 1 defined in TR38.808.
- Recommended WF
  - Collect views in 1st round regarding the proposed methodology in Proposal 1.

Feedback Form 9: Issue 1-4-1: Study on phase noise impact for requirements derivation

1 – Nokia Belgium

We are fine with the idea of Proposal 1, however we would like to make the choice of phase noise model flexible.

We agree that companies provide results without phase noise model and then results with phase noise without specifying which model each company is using

Therefore we propose an alternative option as Proposal 2:

- Proposal 2 (new): Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise. Phase noise model could use model set 1 or 2 defined in TR38.808.

2 – Samsung Electronics Benelux BV

Samsung: we think the PN model is important in this test cases. Current there are two kinds of PN model in TS38.808. For alignement purpose, we think it is better to select one of model either option 1 or option 2

3 – Intel Corporation (UK) Ltd

Two sets of results were delivered for definition of FR2-1 requirements : with and without phase noise. The main purpose is to define band agnostic requirements considering different phase noise impact on different carrier frequencies. To do this, RMC configuration that has less phase noise impact was selected. The following assumptions were used in FR2-1 discussion:

· No Tx phase noise is modelled

· Phase noise is explicitly modelled for Rx.

· Rx Phase noise is modelled only to find feasible FRC configuration (i.e. achieve maximum throughput and loss in comparison to scenarios without Rx phase noise is less than 1 dB).

We suggest using the similar methodology for FR2-2 with additional clarification that 70 GHz carrier frequency should be assumed. Our proposal is:

Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise

- No Tx phase noise is modelled
- Phase noise is explicitly modelled for Rx
- Rx Phase noise is modelled only to find feasible RMC configuration (i.e. achieve maximum throughput and loss in comparison to scenarios without Rx phase noise is less than 1 dB)
- 70 GHz carrier frequency is assumed

4 – Apple GmbH

We are fine with using the same methodology as FR2-1 as suggested by Intel.

5 – Ericsson LM

Ericsson: Prefer Option 1 to easily align companies' simulations.

6 – Qualcomm Technologies Int

We think we should follow FR2-1 methodology to select cases where the impact of Rx Phase Noise is limited

Issue 1-4-2: Phase noise model

- Proposals
  - Option 1 (Ericsson): PN model set 1 in TS 38.808.
  - Option 2 (Huawei): PN model example 2 defined in TS 38.803
- Recommended WF
  - Collect views in 1st round

Feedback Form 10: Issue 1-4-2: Phase noise model

1 – Nokia Belgium

Same view as in the previous issue.

Therefore we propose Option 3 and 4:

- Option 3: PN model set 2 in TR 38.808
- Option 4: Free choice between PN model set 1 and 2 from TR 38.808.

2 – Samsung Electronics Benelux BV Samsung: Similar comments in Issue 1-4-1
3 – Intel Corporation (UK) Ltd We do not support to consider phase noise models from TR 38.803 since they were proposed for FR2-1 long time ago. Free choice between PN model set 1 and 2 from TR 38.808 can lead to quite diverse results. For alignment we suggest considering only one model. Companies may add additional margin to their impairment results if they think that the real PN impact is higher. Either PN model set 1 or set 2 from TR 38.808 is fine for us.
4 – Apple GmbH PN model set 1 for study of phase noise impact on requirements and for down selection of simulation assumptions/ FRCs.
5 – Ericsson LM Ericsson: Prefer Option 1. However, we believe that companies can deliver ideal simulation results without phase noise to get alignment at the first. Then deliver results with phase noise model to see the impact. As a starting point, each company can opt for a PN model for initial results' assessment. However, we have to agree on a model for the sake of fairness in comparison.
6 – HiSilicon Technologies Co. Ltd We can compromise to option 1
7 – Qualcomm Technologies Int Given that this is the first meeting and we don't have results shared yet we are fine to follow other companies' view and start from model 1 for the alignment in the next meeting only, but we share the concern that these models were derived for FR2-1 and a long time ago, so we should keep other options open and discuss this once we get a round of results

Issue 1-4-3: TDD pattern

- Proposals
  - Proposal 1 (Ericsson): Define new TDD patterns for 480kHz and 960kHz SCS. Following patterns can be considered:
    - Option 1: Same as FR2-120-1, 3D1S1U, S=10D:2G:2U.
    - Option 2: Use the same DL/UL duration as 120kHz SCS to keep sufficient processing timeline.
      - 480kHz SCS: 12D4S4U, S1=S2=14D:0G:0U, S3=12D:2G:0U, S4=0D:6G:8U
      - 960kHz SCS: 24D8S8U, S1=S2=S3=S4=S5=14D:0G:0U, S6=10D:4G:0U, S7=0D:12G:2U, S8=0D:0G:14U.
- Recommended WF

- Collect views in 1st round

Feedback Form 11: Issue 1-4-3: TDD pattern

1 – Nokia Belgium We tend to prefer Option 2.
2 – Samsung Electronics Benelux BV Samsung: we should discuss whether requirements should be defined for 480KHz and 960KHz, we prefer to further discussion, other options are not precluded
3 – Intel Corporation (UK) Ltd TDD pattern does not really effect demodulation performance. We prefer more time to check which option is more appropriate. Same time, as a baseline simulation assumption for PN impact study, either Option 1 or 2 can be considered.
4 – Apple GmbH Option 1 as baseline. Option 2 for 480/960 SCS.
5 – HiSilicon Technologies Co. Ltd Same views with Samsung and Intel. We prefer to keep it open and for the simulation assumption for PN impact only, we can use option 1 for 120 kHz SCS and option 2 for 480/960 kHz SCS
6 – Ericsson LM Ericsson: We prefer to define new TDD pattern for 480/960kHz SCS which is helpful for requirement definition and test setup. We are open for the discussion.

1.2.5 Sub-topic 1-5: Implementation of FR2-2 requirements into specification

Sub-topic description

FR2-2 performance requirements should be integrated to the current specifications defined for the original FR2 frequency range. From WID:

Note 5: FR2 is extended to cover 24.25GHz to 71GHz with FR2-1 for 24.25-52.6GHz and FR2-2 for 52.6-71GHz.

- The related UE capabilities and their applicability to the frequency range 52.6 to 71 GHz will have to be analyzed on a case by case basis
- The application of any of the UE feature introduced for 52.6-71 GHz to existing FR1/FR2 should be discussed case by case.
- TSG RAN specifications shall make it very clear (to readers) that frequency bands in the 52.6-71GHz range are only Release-independent from Rel-17 onwards, to ensure that there is clear industry understanding about which FR2 features are applicable for operation in 52.6-71GHz range.

NOTE 5a: Whenever the FR2 is referred, both FR2-1 and FR2-2 frequency sub-ranges shall be considered in this release, unless otherwise stated.

NOTE 5b: The designations FR2-1 and FR2-2 should only be used when needed

Issue 1-5-1: Implementation of FR2-2 requirements into specification

- Proposals
  - For BS demodulation:
    - Proposal 1 (Intel): Reuse existing sections in TS 38.104 and TS 38.141-2 for FR2-2 BS performance requirements definition.
    - Proposal 2 (Ericsson): Follow RF FR2-2 requirement structure, capture FR2-2 demodulation requirement into same section as FR2-1 but with different tables if possible. Adding extra phrase as "for FR2-1" and "for FR2-2" to requirement tables for differentiation
  - For UE demodulation and CSI
    - Proposal 1 (Intel): Reuse existing sections in TS 38.104-1 for FR2-2 UE performance requirements definition.
    - Proposal 2 (Ericsson):

- Recommended WF
  - Collect views in 1st round

Feedback Form 12: Issue 1-5-1: Implementation of FR2-2 requirements into specification

1 – Nokia Belgium We are fine with both approaches. We slightly prefer to keep the same clauses as much as possible.
2 – Samsung Electronics Benelux BV Samsung: we suggest to disucss this issue later to check current RF FR2-2 strcuture
3 – Intel Corporation (UK) Ltd We prefer to reuse the same clauses for both UE and BS since we should avoid distinguishing on FR2-1 and FR2-2 as much as possible. In addition, if new sections will be defined, sections with FR2-1 should be re-named that is not encouraged by MCC.
4 – Apple GmbH We should introduce requirements in section 7 without separating requirements for FR2-1 and FR2-2 into different sections. The applicability of requirements, common test parameters should be updated accordingly.

Table 1 Specification structure for UE Demodulation performance requirements in FR2-2 (Radiated requirements).

Section number	Section name	Note
7.2	PDSCH demodulation requirements	
7.2.1	1RX requirements	
7.2.2	2RX requirements	
7.2.2.2	TDD	
7.2.2.2.[4]	Minimum requirements for UEs in FR2-2	New section
7.3	PDCCH demodulation requirements	
7.3.1	1RX requirements	
7.3.2	2RX requirements	
7.3.2.2	TDD	
7.3.2.2.1	1 Tx Antenna performances	Updates on FR2-2
7.3.2.2.2	2 Tx Antenna performances	Updates on FR2-2
7.4	PBCH demodulation requirements	
7.4.1	1RX requirements	
7.4.2	2RX requirements	
7.4.2.2	TDD	Updates on FR2-2 UEs

Table 2 Specification structure for UE CSI reporting requirements in FR2-2 (Radiated requirements).

Section number	Section name	Note
8.2	Reporting of Channel Quality Indicator (CQI)	
8.2.2	2RX requirements	
8.2.2.2	TDD	
8.2.2.2.1	CQI reporting definition under AWGN	Updates on FR2-2
8.2.2.2.2	CQI reporting underfading conditions	Updates on FR2-2

Figure 3: Proposal 2 (Ericsson): For UE demodulation and CSI

5 – Ericsson LM

Ericsson: There is no clear confliction between Option 1 and 2 in both BS and UE. We suggest to follow RF approach.

1.3 Summary for 1st round

1.3.1 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.

Table 1: First round summary for Topic #1

	Summary

Sub-topic #1-1: Work Plan	**Issue 1-1: Work Plan** All companies commented in 1st round that the proposed work plan can be agreed. Two companies suggested checking whether initial simulation results can be prepared next meeting considering progress of 2nd round discussion. **Tentative agreement:** Agree the work plan. **Recommendations for 2nd round:** Continue discussion on simulation assumptions and define initial set.
Sub-topic #1-2: General aspects of demodulation requirement definition	**Issue 1-2-1: General scope of BS demodulation performance requirements** All companies agreed with option 1. **Tentative agreement:** Define PUSCH, PUCCH, and PRACH performance requirements. **Candidate options: NA** **Recommendations for 2nd round: NA**

	Issue 1-2-2: General scope of UE demodulation and CSI reporting performance requirements All companies agreed to define requirements for PDSCH and PDCCH. Five companies support to define SDR requirements and one company do not see motivation to do this. Five companies support to define PBCH requirements and one company prefer to deprioritize it. Two companies proposed to define PBCH requirements only with unknown SSB index. **Tentative agreement:** - Define PDSCH, PDCCH, PBCH performance requirements. ○ FFS on PBCH requirements definition only for unknown SSB index - FFS on SDR requirements definition **Candidate options:** PBCH requirements: - Option 1: Only with unknown SSB index - Option 2: Both know and unknown SSB index SDR requirements - Option 1: Define SDR requirements - Option 2: Do not define SDR requirements **Recommendations for 2nd round:** Discuss candidate options.
	Issue 1-2-3: Scenarios to be considered for requirements definition Five companies agreed on proposals 1,2,3. One company preferred to further check. **Tentative agreement:** RAN4 defines demodulation requirements for the following scenarios: - SA FR2-2 - NR DC or CA with FR1 anchor and FR2-2 RAN4 does not consider FR2-2 CA scenario in Rel-17 **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement

	Issue 1-2-4: Shared spectrum access requirements Six companies agreed to define both BS and UE requirements without LBT. One company proposed to define UE requirements with and without LBT. **Tentative agreement:** - Define BS requirements without LBT - Define UE requirements without LBT - Note: It is assumed that these requirements cover both NR SA and shared spectrum access deployments **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement
Sub-topic 1-3: Channel model for requirements definition	**Issue 1-3-1: Propagation conditions** All companies agreed that multi-path fading and static propagation conditions should be considered. **Tentative agreement:** Both static propagation condition and Multi-path fading propagation conditions are considered. **Candidate options: NA** **Recommendations for 2nd round: NA**

	Issue 1-3-2: RMS delay spread Most of the companies suggest continue discussion next meeting on the appropriate RMS delay spread. Two companies proposed to consider TDL-D channel model instead of TDL-A. **Tentative agreement: NA** **Candidate options:** - TDL channel model: ○ Option 1: TDL-A ○ Option 2: TDL-D - RMS Delay spread: ○ Option 1: 5ns ○ Option 2: 10ns ○ Option 3: 20ns - Note: Definition of requirements with different channel models is not precluded **Recommendations for 2nd round:** Discuss candidate options.
	Issue 1-3-3: Max Doppler frequency Most of the companies agreed to consider at least 3km/h. More discussion in needed on higher UE speed. Two companies support just to double FR2-1 max Doppler frequency and frequency shift for FR2-2 requirements. **Tentative agreement:** - Consider 3 km/h UE speed ([200] Hz). - FFS on higher UE speed. **Candidate options:** - Option 1: 10 km/h (650 Hz) - Option 2: 30 km/h (2000 Hz) **Recommendations for 2nd round:** Discuss applicable Doppler frequency for 3 km/h. Discuss necessity of requirements with higher UE speed and corresponding candidate options.

Sub-topic 1-4: Phase noise	**<u>Issue 1-4-1: Study on phase noise impact for requirements derivation</u>** Methodology on requirements definition was discussed and some additional clarifications were suggested to the original proposal 1. Applicable Phase noise model is captured in issue 1-4-2. **Tentative agreement:** Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise. - No Tx phase noise is modelled - Rx Phase noise is modelled only to find feasible FRC configuration (i.e. achieve maximum throughput and loss in comparison to scenarios without Rx phase noise is less than 1 dB) - 70 GHz carrier frequency is assumed **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement
	<u>Issue 1-4-2: Phase noise model</u> Almost all companies agree to get initial alignment results with phase noise model Option 1. One company prefer to have flexible choice. Same time several companies mentioned that single model allows to easily align results. **Tentative agreement:** Consider PN model set 1 in TS 38.808 for initial simulation results alignment. **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement.

	Issue 1-4-3: TDD pattern **Moderator**: this issue should be discussed under scope of sub-topic 1-2 but by mistakenly was added to sub-topic 1-4. All companies agreed to further discuss this issue but for results alignment some baseline assumption can be reached. **Tentative agreement:** Consider the following TDD pattern as a baseline for simulation results alignment: - 120 kHz: 3D1S1U, S=10D:2G:2U - 480 kHz: 12D4S4U, S1=S2=14D:0G:0U, S3=12D:2G:0U, S4=0D:6G:8U96 - 960 kHz: 24D8S8U, S1=S2=S3=S4=S5=14D:0G:0U, S6=10D:4G:0U,S7=0D:12G:2U, S8=0D:0G:14U **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement.
Sub-topic 1-5: Implementation of FR2-2 requirements into specification	**Issue 1-5-1: Implementation of FR2-2 requirements into specification** Four companies agreed to reuse the same clauses for FR2-2 requirements as used for FR2-1. Several companies proposed to follow RF room approach. Same time more discussion is needed what RF room approach means if companies want to reach such agreement. **Tentative agreement:** - Capture FR2-2 demodulation requirement into same section as FR2-1 but with different tables if possible. Adding extra phrase as “for FR2-1” and “for FR2-2” to requirement tables for differentiation if needed. **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement

1.4 Discussion on 2nd round (if applicable)

1.4.1 Sub-topic 1-1: Work plan

Issue 1-1: Work plan

Tentative agreement

Table 2: Tentative agreement

RAN4#102-e:
1. Discussion and agreement on work plan 2. Discussion on performance requirements scope 3. Initial discussion on work split Initial discussion on simulation assumptions
RAN4#103-e:
1. Finish discussions on performance requirements scope per each physical channel 2. Finish discussions on simulation assumptions per each physical channel 3. Finish discussions on work split 4. Initial round of simulation results collection and alignment 5. Initial draft CRs for TS 38.104 Base Station (BS) radio transmission and reception 6. Initial draft CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing 7. Initial draft CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements
RAN4#104
1. Final round of simulation results collection and alignment 2. CRs for TS 38.104 Base Station (BS) radio transmission and reception 3. CRs for TS 38.141-2 Base Station (BS) conformance testing Part 2: Radiated conformance testing 4. CRs for TS 38.101-4 User Equipment (UE) radio transmission and reception; Part 4: Performance requirements

Recommended WF:

Agree the work plan.

Table 3: Companies' comments

Company	Comments

Ericsson	Agree with the plan.

1.4.2 Sub-topic 1-2: General aspects of demodulation requirement definition

Issue 1-2-1: General scope of BS demodulation performance requirements

Tentative agreement

Define PUSCH, PUCCH, and PRACH performance requirements.

Recommended WF:

Tentative agreement seems agreeable

Table 4: Companies' comments

Company	**Comments**
Ericsson	Support tentative agreement

Issue 1-2-2: General scope of UE demodulation and CSI reporting performance requirements

Tentative agreement

Define PDSCH, PDCCH, PBCH performance requirements.

- FFS PBCH requirements definition only for not known SSB index
- FFS SDR requirements definition

Candidate options:

PBCH requirements:

- Option 1: Only with not known SSB index
- Option 2: Both known and not known SSB index

SDR requirements

- Option 1: Define SDR requirements

- Option 2: Do not define SDR requirements

Recommended WF:

Discuss candidate options.

Table 5: Companies' comments

Company	**Comments**
Intel	We are fine to define PBCH requirements only with not known SSB index. Actually, both sequence detection and demodulation are performed udner this configuration that cover all PBCH Rx functionality. As for SDR, we do not understand technical point to not define this requirement for FR2-2. SDR is used for FR1 and FR2-2 and based on Rel-15 discussion it is quite important to verify UE under max data rate conditions to guarantee proper L1 and L2 implementation. Support Option 1 for PBCH to reasonably decrease workload and Option 1 for SDR.
Apple	PBCH requirements-Option 1. Only with unknown SSB index. SDR requirements –Option 1- support to define
Nokia	For PBCH, we prefer option 2, but we can compromise with Option 1.
Huawei	RAN 1 has following agreements in RAN 1 Agreement: For the case where SSB location and SCS are explicitly provided to the UE (non-initial access) and SSB does not configure TYpe-0 PDCCH, support 480 kHz and 960 kHz numerologies for the SSB Note: Strive to minimize specification impact due to the new SCS for SSB. It seems indicate that 480/960kHz SSB only can be used for connected mode which SSB index is known for UE. Hence we propose to only consider known index for 480kHz and 960kHz. For SDR test, we can compromise to introduce it if some companies have strong views
Ericsson	Support For PBCH, Option 2.

Qualcomm	For PBCH, we are fine with choosing only one case, to be chosen between known and unknown, depending on the supported SCS numerologies; For SDR, we are fine with the definition of the requirements;

Issue 1-2-3: Scenarios to be considered for requirements definition

Tentative agreement

RAN4 defines demodulation requirements for the following scenarios:

- SA FR2-2
- NR DC or CA with FR1 anchor and FR2-2

RAN4 does not consider FR2-2 CA scenario in Rel-17

Recommended WF:

Tentative agreement seems agreeable

Issue 1-2-4: Shared spectrum access requirements

Tentative agreement

Define BS requirements without LBT

Define UE requirements without LBT

Note: It is assumed that these requirements cover both NR SA and shared spectrum access deployments

Recommended WF:

Confirm tentative agreement

Table 6: Companies' comments

Company	**Comments**
Intel	Support tentative agreement.
Samsung	We are ok with the tentative agreement for BS requirement, define BS requirements without LBT
Apple	We support the tentative agreement

Nokia	We are fine with the tentative agreement.
Huawei	Support tentative agreement
Ericsson	Support tentative agreement
Qualcomm	We are fine not to consider requirements with LBT at this stage given the timeline, but FR1 unlicensed has introduced demod requirements with LBT, and RRM is going to introduce requirements for FR2-2 with LBT, so before excluding these requirements we would like to further check; We would lie to keep UE requirements with LBT FFS at least for now

Issue 1-2-5: TDD pattern

Tentative agreement

Consider the following TDD pattern as a baseline for simulation results alignment:

- 120 kHz: 3D1S1U, S=10D:2G:2U
- 480 kHz: 12D4S4U, S1=S2=14D:0G:0U, S3=12D:2G:0U, S4=0D:6G:8U96
- 960 kHz: 24D8S8U, S1=S2=S3=S4=S5=14D:0G:0U, S6=10D:4G:0U, S7=0D:12G:2U, S8=0D:0G:14U

Recommended WF:

Confirm tentative agreement

Table 7: Companies' comments

Company	**Comments**
Intel	Support tentative agreement.
Samsung	We can use the TDD pattern recommended as baseline, and other options are not precluded
Apple	We support the tentative agreement. Please capture as baseline add that other options are not precluded.
Nokia	We support the tentative agreement. Should we merge the special slots that are 14D:0G:0U and 0D:0G:14U into DL and UL slots?

Huawei	We prefer to keep TDD pattern of 480/960kHz aligned with 120kHz, tentative agreement is OK for us. We can keep it as baseline and other options are not precluded.
Ericsson	We could support tentative agreement. If we agree to use proposed TDD pattern for 480kHz and 960kHz, it can be simplified as following statement which seems to be clearer. - 480 kHz: 14D2S4U, S1=12D:2G:0U, S4=0D:6G:8U - 960 kHz: 29D3S8U, S1=10D:4G:0U, S2=0D:12G:2U, S3=0D:0G:14U
Qualcomm	We are fine with the tentative agreement

1.4.3 Sub-topic 1-3: Channel model for requirements definition

Issue 1-3-1: Propagation conditions

Tentative agreement

Both static propagation condition and Multi-path fading propagation conditions are considered.

Recommended WF:

Tentative agreement seems agreeable

Table 8:

Company	**Comments**
Samsung	In general, we are ok with the tentative agreement, It is better to differentiate for BS and UE side, at least for BS requirement, only AWGN is considered for PRACH, for PUSCH and PUCCH requirement, we don't think it is necessary to define requirement with static propagation condition.
Huawei	We prefer to only consider static propagation in PRACH test ,CQI test (If introduced) and SDR test. For others, we don't see the need.

Ericsson	Support tentative agreement. It might be better to add a note like following: Both static propagation condition (for PRACH, CQI definition test, etc) and Multi-path fading propagation conditions are considered.

Issue 1-3-2: RMS delay spread

Tentative agreement: NA

Candidate options

TDL channel model:

- Option 1: TDL-A
- Option 2: TDL-D

RMS Delay spread:

- Option 1: 5ns
- Option 2: 10ns
- Option 3: 20ns

Note: Definition of requirements with different channel models is not precluded

Recommended WF:

Discuss candidate options.

Table 9: Companies' comments

Company	**Comments**

Intel	What is more practical assumption for FR2-2 should be discussed based on system level analysis? Is this intention to bring system level study next meeting? In our understanding we do not have enough time to do it. Therefore, we suggest considering RAN1 assumption as TDL-A. At least this model can be considered as a baseline and companies may also bring results with TDL-D if needed. Support Option 1 for TDL channel model For RMS delay spread to reduce workload can we remove one Option 1? For example, 5ns. Another alternative is to separate these values by SCS, for instance, as: 120 kHz 20ns, 480, 960 kHz 10 and 5ns for each. Both alternatives are fine for us.
Samsung	Regarding the TDL channel model, we still think option 2 is feasible, For high frequency, the number of multi-path fading is expected less, similar as LOS condition. In TDL D channel, we can see only 1 strongest path, the relative power for other paths are minor, Regarding the RMS delay spread, we are not sure whether we can coverage, we are ok the alternative solution to differentiate SCS proposed by Intel
Apple	We think LOS channel for FR2-2 would be more practical. We define requirements with TDL-D for 1KQAM in FR1. Hence we support defining requirements with both TDLA and TDLD – we can distribute the requirements. NO need to evaluate with both TDLA and TDLD. Delay spread: TDLD with 5ns; TDLA with 10ns seems practical for FR2-2 as the delay spread greatly reduces with narrow beams.
Nokia	We are ok with TDLA 10 for 120 kHz Keep open TDLA 5 or TDLA 10 for 480 and 960 kHz.
Huawei	For TDL channel model, we prefer to only consider TDLA which is the assumption of evaluation by RAN 1. For RMS Delay spread, all options were used by RAN 1's evaluation. Intel's second suggestion is fine for us.: 120 kHz 20ns, 480 kHz 10ns 960 kHz 5ns

Ericsson	For channel model, we think TDL_A should be considered at least. TDL_D could be useful to check the high MCS performance regarding the possible SNR limit for UL OTA test. For RMS delay spread, we prefer taking only one DS value for each channel model to save time and efforts. Basically, LOS channel would have smaller DS compared to NLOS channel. But currently, it is hard to say which one is suitable. We suggest FFS for this topic and companies provide simulation results and link budget analysis in the next meeting. In this meeting, candidate combinations for simulation could be provided by these options.
Qualcomm	We don't think we should exclude TDL-D (which as Apple mentioned in their comment has been used both in FR1 and in FR2-1) as LOS channels seem practical in FR2-2. We are fine with the proposed adjustment of RMS delay spread based on SCS;

Issue 1-3-3: Max Doppler frequency

Tentative agreement

Consider 3 km/h UE speed ([200] Hz).

FFS on higher UE speed.

Candidate options

Option 1: 10 km/h (650 Hz)

Option 2: 30 km/h (2000 Hz)

Recommended WF:

Discuss applicable Doppler frequency for 3 km/h. Discuss necessity of requirements with higher UE speed and corresponding candidate options.

Table 10: Companies' comments

Company	**Comments**
Intel	We confirm 200Hz for 3km/h. As for higher UE speed. We do not have strong preference. 30km/h can be considered as starting point. In case some issues will be identified, we can revise this value.

Samsung	Regarding the Doppler, we are ok with [200Hz] for 3km, In Rel-15 FR2, the maximum Doppler value as 400Hz is considered for dropper frequency, where 40GHz carrier frequency is considered, Therefore, the related speed is about 10km/h, Therefore, we prefer to option 1 if considering higher UE speed
Apple	We support only to consider 3km/hr – 200Hz. Do not consider higher speed at current stage.
Nokia	We think option 2 might be too large for this frequency range. In FR2-1 we have tested up to 300, so if we multiply that by two we would get maximum 600 Hz. So we don't understand why doing 2000 if we didn't test 1000 Hz for FR2-1.
Huawei	Don't have strong views. Prefer option 2
Ericsson	We support starting with 3km/h at least. Our suggestion is to consider higher UE speed to include outdoor deployment cases where high power BS are deployed to cover relative larger cell. The choice of 10km/h or 30km/h will depend on simulation results analysis.
Qualcomm	Based on doppler used in FR2-1 as mentioned in Nokia's comment, we are fine with either the tentative agreement or option 1.

1.4.4 Sub-topic 1-4: Phase noise

Issue 1-4-1: Study on phase noise impact for requirements derivation

Tentative agreement

Companies deliver two sets of ideal simulation results for requirement discussion. Result set#1 is without phase noise and set#2 is with phase noise.

- No Tx phase noise is modelled
- Rx Phase noise is modelled only to find feasible FRC configuration (i.e. achieve maximum throughput and loss in comparison to scenarios without Rx phase noise is less than 1 dB)
- 70 GHz carrier frequency is assumed

Recommended WF:

Confirm tentative agreement

Table 11:

Company	Comments
Intel	Support tentative agreement.
Samsung	We are ok with the tentative agreement
Apple	We support the tentative agreement
Nokia	We are fine with tentative agreement
Huawei	Support tentative agreement
Ericsson	Support tentative agreement
Qualcomm	We are fine with the tentative agreement

Issue 1-4-2: Phase noise model

Tentative agreement

Consider PN model set 1 in TS 38.808 for initial simulation results alignment.

Recommended WF:

Confirm tentative agreement

Table 12: Companies' comments

Company	Comments
Intel	Support tentative agreement.
Samsung	There are two modem in TS 38.808. The performance are diverse, we are not sure modem set 1 is proper for alignment, and for FRC configuration determination. At current stage, we prefer keep both two PN model sets in TS38.808. Encourage companies to provide the results with two models, based on well aligned model for requirements definition Meanwhile, the practical is PN model is up to implementation, it can be different with existing model in 3GPP
Nokia	We would prefer to keep the option of which set from38.808 to use open for the moment.
Huawei	Support tentative agreement

Ericsson	Support tentative agreement
Qualcomm	For initial alignment, we can use PN models 1 and 2, but this might be further discussed once the simulation results are collected.

1.4.5 Sub-topic 1-5: Implementation of FR2-2 requirements into specification

Issue 1-5-1: Implementation of FR2-2 requirements into specification

Tentative agreement

Capture FR2-2 demodulation requirement into same section as FR2-1 but with different tables if possible. Adding extra phrase as “for FR2-1” and “for FR2-2” to requirement tables for differentiation if needed.

Recommended WF:

Confirm tentative agreement

Table 13: Companies’ comments

Company	**Comments**
Intel	Support tentative agreement.
Samsung	In general, we are ok the recommended WF, since the 1st meeting to discuss the specification structure, we can discuss in next meeting and refer the RF part to check whether new sections or new table s are more proper
Apple	We support to add requirements in the same section as FR2-1. We prefer to refrain from adding phrase ‘FR2-2’ if possible. Separate sub-clauses would help with readability and also specifying applicability of requirements.
Nokia	ok
Ericsson	Support tentative agreement.

2 Topic #2: BS performance requirements

2.1 Companies’ contributions summary

T-doc number	Company	Proposals / Observations
R4-2204032	Ericsson	**Proposal 1**: Start with 1/2Tx and 2Rx antenna configuration for FR2-2 BS demodulation requirements **Proposal 2**: FR2-2 could take [20dB] SNR limit at current stage. New test cases and method should be defined if it is finally approved that FR2-2 SNR limit is much lower than 20dB. **Proposal 3**: Take simulation assumptions in Table 2-1 as the start point for PUSCH demodulation to check the phase noise impact and configuration feasibility. Down selection is needed based on simulation results. **Table 2.2-1: Simulation parameters for FR2-2 PUSCH demodulation** **Parameter** / **Value** Transform precoding: Disabled Default TDD UL-DL pattern (Note 1): 120kHz SCS: 3D1S1U, S=10D:2G:2U HARQ – Maximum number of HARQ transmissions: 4 HARQ – RV sequence: 0, 2, 3, 1 DM-RS – DM-RS configuration type: 1 DM-RS – DM-RS duration: single-symbol DM-RS DM-RS – Additional DM-RS symbols: pos0, pos1 DM-RS – Number of DM-RS CDM group(s) without data: 2 DM-RS – Ratio of PUSCH EPRE to DM-RS EPRE: -3 dB DM-RS – DM-RS port(s): {0}, {0, 1} DM-RS – DM-RS sequence generation: N_{ID}=0, n_{SCID}=0 Time domain resource – PUSCH mapping type: B Time domain resource – Start symbol index: 0 Time domain resource – Allocation length: 10 Frequency domain resource – RB assignment: Full applicable test bandwidth (100MHz and 400MHz) Frequency domain resource – Frequency hopping: Disabled TPMI index for 2Tx two-layer spatial multiplexing transmission: 0 Code block group based PUSCH transmission: Disabled PT-RS configuration – Frequency density (K_{PT-RS}): 2, Disabled PT-RS configuration – Time density (L_{PT-RS}): 1, Disabled Test metric – Normalized throughput: 70% Antenna – Tx and Rx configuration: 1Tx 2Rx, 2Tx 2Rx Channel model: TDLA30-200/2000, TDLA10-200/2000, TDLA5-200/2000 MCS – 64QAM MCS table index: 4/16/20 Phase noise – Model sets in TR38.808: Set 1 (Note) Note: Companies are suggested to deliver ideal simulation results with and without phase noise. **Proposal 4**: RAN4 consider define FR2-2 BS demodulation requirements for PUSCH repetition type A. **Proposal 5**: Define new requirements for FR2-2 PUCCH performance. **Proposal 6**: Take simulation assumptions in Table 2.3-1 and 2.3-2 as the start point for PUCCH demodulation to check the phase noise impact and configuration feasibility. Other PUCCH format could be lower priority.

Figure 4: Topic #2: BS performance requirements - Companies' contribution summary: part 1

Table 2.3-1: Simulation Parameters for FR2-2 PUCCH format 1

Parameter	Test
Number of information bits	2
Number of PRBs	1
Number of symbols	14
First PRB prior to frequency hopping	0
Intra-slot frequency hopping	enabled
First PRB after frequency hopping	The largest PRB index – (nrofPRBs – 1)
Group and sequence hopping	neither
Hopping ID	0
Initial cyclic shift	0
First symbol	0
Index of orthogonal cover code (*timeDomainOCC*)	0
SCS and bandwidth	120kHz SCS 100MHz/400MHz
Antenna configuration	1Tx 2Rx
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Phase noise model	Set 1 in TR38.808
Test metric	SNR@NACK→ACK<0.1% SNR@ACK miss<1%
Simulation results: Ideal simulation results with/without phase noise.	

Table 2.3-2: Simulation Parameters for FR2-2 PUCCH format 3

Parameter	Test 1	Test 2
Modulation order	QPSK	
First PRB prior to frequency hopping	0	
Intra-slot frequency hopping	enabled	
First PRB after frequency hopping	The largest PRB index – (Number of PRBs - 1)	
Group and sequence hopping	neither	
Hopping ID	0	
Number of PRBs	1	3
Number of symbols	14	4
The number of UCI information bits	16	16
First symbol	0	0
SCS and bandwidth	120kHz SCS 100MHz/400MHz	
Antenna configuration	1Tx 2Rx	
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000	
Phase noise model	Set 1 in TR38.808	
Test metric	SNR@BLER<1%	
Simulation results: Ideal simulation results with/without phase noise.		

Proposal 7: Define new requirements for FR2-2 multi-RB PUCCH performance. Take simulation assumptions in Table 2.3-3, 2.3-4 and 2.3-5 as the start point for PUCCH format 0/1/4 to check the phase noise impact and configuration feasibility.

Figure 5: Topic #2: BS performance requirements - Companies' contribution summary: part 2

Table 2.3-3: Test Parameters for multi-RB PUCCH format 0

Parameter	Test
Number of UCI information bits	1
Number of PRBs	16
First PRB prior to frequency hopping Intra-slot frequency hopping	0 N/A for 1 symbol
First PRB after frequency hopping	The largest PRB index – (Number of PRBs - 1)
Group and sequence hopping Hopping ID	neither 0
Initial cyclic shift	0
First symbol SCS and bandwidth	13 for 1 symbol 120kHz SCS 100MHz/400MHz
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Test metric	SNR@DTX →ACK <1%

Table 2.3-4: Test Parameters for multi-RB PUCCH format 1

Parameter	Test
Number of information bits	2
Number of PRBs	16
Number of symbols First PRB prior to frequency hopping	14 0
Intra-slot frequency hopping	enabled
First PRB after frequency hopping	The largest PRB index – (nrofPRBs – 1)
Group and sequence hopping	neither
Hopping ID	0
Initial cyclic shift First symbol	0 0
Index of orthogonal cover code (*timeDomainOCC*)	0
SCS and bandwidth	120kHz SCS 100MHz/400MHz
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Test metric	SNR@NACK →ACK <0.1% SNR@ACK miss <1%

Figure 6: Topic #2: BS performance requirements - Companies' contribution summary: part 3

Table 2.3-5: Test parameters for multi-RB PUCCH format 4

Parameter	Value
Modulation order	QPSK
First PRB prior to frequency hoppingstartingPRB	0
Number of PRBs Intra-slot frequency hopping First PRB after frequency hopping	16 enabled The largest PRB index – (Number of PRBs – 1)
Group and sequence hopping	neither
Hopping ID Number of symbols	0 14
The number of UCI information bits	22
First symbol	0
Length of the orthogonal cover code	n2
Index of the orthogonal cover code	n0
DM-RS position SCS and bandwidth	Pos0, {pos0, pos1} 120kHz SCS 100MHz/400MHz
Channel model Test metric	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000 SNR@BLER <1%

Proposal 8: Define new requirements for FR2-2 PRACH. Take simulation assumptions in Table 2.4-1 as the start point to see the phase noise impact and configuration feasibility

Table 2.4-1: simulation parameters for FR2-2 PRACH

PRACH preamble	PRACH SCS (kHz)	Time error tolerance [us]				Frequency offset	
		AWGN	TDLA 30-200/2000	TDLA 10-200/2000	TDLA 5-200/2000	AWGN	Multi-path channel
A2, B4, C2 FFS on other preambles	120	0.07	FFS	FFS	FFS	0	7000

R4-2204395	Intel Corporation	**Observation #1**: 3 SCSs and up to 4 CBWs for each SCS are specified for FR2-2. **Observation #2**: Potentially, quite limited subset of FR2-1 performance requirements from SCS/CBW combination perspective can be reused for FR2-2. **Observation #3**: FR2-2 performance requirements should cover licensed and unlicensed operations. **Observation #4**: In case of FR2-1 requirements reuse for FR2-2, RAN4 needs to discuss applicability of FR2-1 requirements for unlicensed operation. **Observation #5**: PUSCH performance in case of multi-slot PUSCH scheduling by single DCI can be verified by conventional PUSCH test case. **Proposal #1**: Define PUSCH performance requirements to verify 32 UL HARQ processes feature. **Proposal #2**: Define performance requirements for the enhanced PUCCH formats 0, 1, and 4. **Proposal #3**: Define performance requirements for PRACH with 1151 and 571 sequence length with 120 kHz; for PRACH with 571 sequence length with 480 kHz SCS; for PRACH with 139 sequence length with 960 kHz SCS. **Proposal #4**: Define FR2-2 performance requirements for 120, 480, and 960 kHz SCS. **Proposal #5**: Define FR2-2 performance requirements for at least the following SCS/CBW combinations: 120/100, 120/400, 480/400, 960/400 kHz/MHz. **Proposal #6**: Define FR2-2 performance requirements with normal CP only, with up to 2 demodulation branches, and with 1 and 2 Tx antennas. **Observation #6**: The PUSCH performance difference between FR2-1 and FR2-2 at 70% of max throughput is up 0.8 dB for 16QAM and up to 1.5 dB for 64QAM.

Observation #7: There is a negligible performance difference between FR2-1 and FR2-2 scenarios for PUCCH formats 2 and 3.

Observation #8: There is a negligible performance difference in terms of PRACH miss detection between FR2-1 and FR2-2.

Proposal #7: Do not reuse FR2-1 performance requirements for FR2-2.

Proposal #8: Define FR2-2 performance requirements with TDLA 10ns RMS delay spread value and with 200 and 650 Hz max Doppler frequency.

Proposal #9: Define FR2-2 performance requirements with transform precoding disabled with 70% and 30% throughput; requirements with transform precoding enabled; requirements with UCI multiplexed on PUSCH.

Proposal #10: Do not define in Rel-17 FR2-2 performance requirements for 2-step RA type, PUSCH performance requirements with repetition type A, and PUSCH performance requirements with mapping type B with non-slot transmission.

Proposal #11: Define FR2-2 PUSCH performance requirements assuming PTRS Tx.

Proposal #12: Define FR2-2 PUSCH performance requirements only with 1+1 DMRS configuration.

Proposal #13: Define FR2-2 PUSCH performance requirements with transform precoding enabled and UCI multiplexed on PUSCH only for the smallest CBWs for each SCS.

Proposal #14: Define FR2-2 PUSCH performance requirements with transform precoding disabled at least for the following SCS/CBW combinations: 120/100, 120/400, 480/400, 960/400 kHz/MHz.

Proposal #15: Define FR2-2 PUSCH performance requirements according to Tables 2-5.

Table 1. Transform precoding disabled

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	FRC
1	2	TDLA10-650	QPSK, Rank 1
		TDLA10-650	16QAM, Rank 1
		TDLA10-200	64QAM Rank 1
2		TDLA10-650	QPSK, Rank 2
		TDLA10-650	16QAM, Rank 2

Figure 8: Topic #2: BS performance requirements - Companies' contribution summary: part 5

Table 3. Transform precoding enabled

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	FRC
1	2	TDLA10-650	QPSK, Rank 1

Table 4. UCI multiplexed on PUSCH: CSI part 1 requirements

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	UCI bits (CSI part 1, CSI part 2)
1	2	TDLA10-650	7 (5,2)
1	2	TDLA10-650	40 (20,20)

Table 5. UCI multiplexed on PUSCH: CSI part 2 requirements

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	UCI bits (CSI part 1, CSI part 2)
1	2	TDLA10-650	7 (5,2)
1	2	TDLA10-650	40 (20,20)

Proposal #18: Define FR2-2 PRACH performance requirements with AWGN channel model and with TDLA10-650 with frequency offset channel models.

Proposal #19: Define FR2-2 PRACH performance requirements for PRACH preambles A1, A2, A3, B4, C0, C2.

Proposal #20: Consider the following PRACH parameters as initial simulation assumptions: Ncs = 69, logical sequence index = 0, v =0.

Proposal #21: As a baseline option consider application of FR2-1 applicability rules for FR2-2 as well.

R4-2205803	Huawei, HiSilicon	**Proposal 1**: Define the UE requirements for max bandwidth for each SCS. i.e. 400 MHz for 120 kHz SCS, 1600 MHz for 480 kHz and 2000 MHz for 960 kHz. **Proposal 2**: Keep the number of transmission RBs open until there are corresponding agreements from RF team. **Proposal 3**: Not consider LBT failure for PUSCH, PUCCH and PRACH cases. **Proposal 4**: Define PUSCH requirements for 120 kHz, 480 kHz and 960 kHz. **Proposal 5**: Define PUSCH performance requirements by using PN model example 2 defined in TS 38.803. **Proposal 6**: Define PUSCH performance requirements by using ICI compensation.

Figure 9: Topic #2: BS performance requirements - Companies' contribution summary: part 6

Proposal 7: Define the requirements for PRACH operating in FR2-2 with following cases:

- SCS: 120 kHz; Format: A2, B4 and C2; LRA: 1151; Propagation conditions: AWGN and TDLA30-300
- SCS: 480 kHz; Format: A2, B4 and C2, LRA: 571; Propagation conditions: AWGN and TDLA30-300
- SCS: 960 kHz; Format: A2, B4 and C2, LRA: 139; Propagation conditions: AWGN and TDLA30-300

Proposal 8: Reuse test metric of Rel-15 and use assumptions in Table 2 as time error tolerance.

Table 2: Time error tolerance for AWGN and TDLA30-300

PRACH preamble	PRACH SCS (kHz)	Time error tolerance	
		AWGN	TDLA30-300
A2, B4, C2	120	0.07 us	0.22 us
	480	0.02 us	0.17 us
	960	0.01 us	0.16us

Proposal 9: Use following assumptions as start point to discuss for PUCCH requirements definition:

- PF0:
  - 120 kHz, NRB=10, 1 OFDM symbol without hopping 1T2R, TDLA30-300 Low
  - 120 kHz, NRB=10, 2 OFDM symbol with hopping 1T2R, TDLA30-300 Low
  - 480 kHz, NRB=10, 1 OFDM symbol without hopping 1T2R，TDLA30-300 Low
  - 480 kHz, NRB=10, 2 OFDM symbol with hopping 1T2R，TDLA30-300 Low
  - 960 kHz NRB=10, 1 OFDM symbol without hopping 1T2R，TDLA30-300 Low
  - 960 kHz NRB=10, 2 OFDM symbol with hopping 1T2R，TDLA30-300 Low

Figure 10: Topic #2: BS performance requirements - Companies' contribution summary: part 7

		• PF1:
		  ○ 120 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R，TDLA30-300 Low
		  ○ 480 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R, TDLA30-300 Low
		  ○ 960 kHz NRB=10, 14 OFDM symbol with hopping 1T2R, TDLA30-300 Low
		• PF2:
		  ○ 480 kHz, NRB=9, 2 OFDM symbol, 1T2R，TDLA30-300 Low, UCI bits:22bit
		  ○ 960 kHz NRB=9, 2 OFDM symbol , 1T2R，TDLA30-300 Low, UCI bits:22bit
		• PF3
		  ○ 480 kHz, NRB=3, 4 OFDM symbol, 1T2R，TDLA30-300 Low, UCI bits:16bit
		  ○ 960 kHz NRB=3, 4 OFDM symbol , 1T2R，TDLA30-300 Low, UCI bits:16bit
		• PF4:
		  ○ 120 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R，TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2.
		  ○ 480 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R，TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2
		960 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R，TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2

R4-2204589	Nokia, Nokia Shanghai Bell	**Observation** 1: Operation in FR2-2 includes support of 120, 480, and 960 kHz SCS. **Observation 2**: No BS demodulation performance requirements is defined for PRACH, PUCCH, and PUSCH for SCS 480 kHz and 960 kHz. **Proposal 1**: Specify new BS demodulation performance requirements for PRACH, PUCCH, and PUSCH for SCS 480 kHz and 960 kHz **Observation 3**: New channel bandwidths have been introduced in FR2 for 480 kHz and 960 kHz SCS. **Observation 4**: CBW 800 MHz, 1600 MHz, and 2000 MHz are new in FR2 and introduced specifically for FR2-2. **Proposal 2**: Consider all the new CBWs for the performance with 480 and 940 kHz SCS. i.e., 800 and 1600 MHz for SCS 480 kHz, and 800, 1600 and 2000 MHz for SCS 960 kHz.

Figure 11: Topic #2: BS performance requirements - Companies' contribution summary: part 8

		Observation 5: The covered deployment scenarios of FR2-2 require performance requirements under static propagation condition and Multi-path fading propagation conditions. **Proposal 3**: Both static propagation condition and Multi-path fading propagation conditions could be considered when defining new requirements and test cases. **Observation 6**: Scheduling and link adaptation typically allocates large SCS and MCS in situations with low delay spread. **Observation 7**: Distribution of the delay spread in typical scenarios for operation in FR2-2 are mostly concentrated bellow 30 ns, with a large part of the samples experiencing delay spread between 10 and 20 ns. **Observation 8**: Existing RAN4 requirements include TDLA30 as the minimum delay spread for fading channels. **Proposal 4**: RAN4 to study the use of TDLA10 and TDLA20 for demodulation requirements with large SCS and high MCS. **Observation 9**: Doppler shift is directly proportional to the carrier frequency; Hence, it should be higher in FR2-2 compared to FR2-1. **Observation 10**: Simulation assumption for FR2 was 30 GHz. **Proposal 5:** Double the doppler shifts in FR2-2 than the ones already used for FR2-1. i.e., TDLAxx-150, and TDLAxx-300. **Observation 11**: New combinations of L_RA and Δf_RA is introduced for FR2-2. **Proposal 6**: RAN4 to introduce performance requirements for the new combinations of L_RA and Δf_RA introduced for FR2-2. **Observation 12**: Multi-PUSCH scheduling defined in Rel-16 NR-U is used as a baseline for multi-PUSCH scheduling in Rel-17. and not major modification are spotted with respect to Rel-16. **Proposal 7**: RAN4 not to define new BS demodulation requirements for multi-PUSCH scheduling in Rel-17. **Observation 13**: For FR2-2, multi-RB PUCCH format 0, 1, and 4 enchantment for 120/480/960 kHz SCS is supported. **Proposal 8**: Specify BS demodulation requirements for multi-RB PUCCH format 0, 1, and 4.

Figure 12: Topic #2: BS performance requirements - Companies' contribution summary: part 9

2.2 Open issues summary

Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies' contributions

2.2.1 Sub-topic 2-1: SCS/CBW combinations

Sub-topic description:

New SCS and CBWs were introduced for FR2-2. RAN4 needs to discuss SCS/CBW combinations for requirements definition. Moderator suggest discussing separately SCS and CBW to converge on the required SCS/CBW combinations.

Open issues and candidate options before e-meeting:

Issue 2-1-1: SCS for UL requirements definition

- Proposals
  - Option 1 (Nokia): 480, 960 kHz.
  - Option 2 (Ericsson): Prioritize 120kHz and 480 kHz.
  - Option 3 (Huawei, Intel): 120, 480 and 960 kHz.
- Recommended WF
  - Collect views in 1st round on required SCS for UL test cases

Feedback Form 13: Issue 2-1-1: SCS for UL requirements definition

1 – Nokia France We support option 3. 480, 960 kHz are new SCS introduced by this WI. Hence, any BS that claims their support should be tested to verify that they conform with the minimum performance requirements. Hence, we propose to consider these SCS from the beginning without any de-prioritization. Performance requirements with 120 kHz in FR2-1 are already existing with their corresponding test cases. However, since the carrier frequency is increased in FR2-2 then the phase noise become more severe. Hence, the minimum performance requirements need to be evaluated using this SCS in FR2-2.
2 – Samsung Electronics Benelux BV Samsung: we prefer 120KHz SCS firstly, even performance requirments with 120 kHz in FR-1 is defined in existing spec, while CBW requirement is only up to 200MHz, there is no requirement with 400MHz requirement for 120KHz,

3 – Intel Corporation (UK) Ltd Considering limited number of meetings on performance part we do not support any prioritizations for SCS. We share similar view as Nokia and support Option 3.
4 – Ericsson LM Ericsson prefers Option 2 and considers SCS 120kHz and 480kHz as a high priority. Since SCS 960kHz is optional, we would like to reduce the simulation efforts in this early stage.
5 – HiSilicon Technologies Co. Ltd Option 3

Issue 2-1-2: CBW for UL requirements definition

- Proposals
  - SCS 120 kHz
    - Option 1 (Ericsson, Intel): 100 and 400 MHz
    - Option 2 (Huawei): 400 MHz
  - SCS 480 kHz
    - Option 1 (Nokia): 400, 800 and 1600 MHz
    - Option 2 (Ericsson): 400 and 1600 MHz
    - Option 3 (Huawei): 1600 MHz
    - Option 4 (Intel): 400 MHz
  - SCS 960 kHz
    - Option 1 (Nokia): 400, 800, 1600 and 2000 MHz
    - Option 2 (Ericsson): 400 and 2000 MHz
    - Option 3 (Huawei): 2000 MHz
    - Option 4 (Intel): 400 MHz
- Recommended WF
  - Collect views in 1st round on required CBWs for UL test cases.

Feedback Form 14: Issue 2-1-2: CBW for UL requirements definition

1 – Nokia France We support option 1 or option 2. We think it is important to define the performance requirements and test cases for all the CBW. However, testing with min and max CBW can be seen as a good comprise.
2 – Samsung Electronics Benelux BV Samsung: For 120KHz, SCS, we support 400MHz, since there is no requirement for it in FR2-1. If 480KHz is introduced, we prefer to deifne the min and max CBW requirements, there is no need to test and define requirements for all CBW
3 – Intel Corporation (UK) Ltd Min and Max CBW can be a good starting point. Only confirmation from testability aspects is needed on max CBW in terms of max SNR during the test. It can be discussed next meeting. We support Option 1 for 120 kHz and Option 2 for 480 and 960 kHz also in addition to our original proposed Option 1 for 120 kHz and Option 4 for 480 and 960 kHz.
4 – Ericsson LM Ericsson: We prefer considering the minimum and maximum BW for each SCS. But we also want to remind companies to notice that the testability for maximum BW at such high frequency, i.e., 2GHz BW. Further investigation on link budget on larger BW would be needed, but currently, RF don't have clear conclusion on the test method. Maybe we could start with the minimum BW for 480kHz and 960kHz (if agreed to introduce) at current stage.
5 – HiSilicon Technologies Co. Ltd We prefer to only consider max supported CBWs

2.2.2 Sub-topic 2-1: General issues

Sub-topic description

General aspects regardless of UL Physical channel

Open issues and candidate options before e-meeting:

Issue 2-2-1: FR2-1 requirements reuse

- Proposals
  - Proposal 1 (Intel): Do not reuse FR2-1 performance requirements for FR2-2.
- Recommended WF
  - Collect views in 1st round.

Feedback Form 15: Issue 2-2-1: FR2-1 requirements reuse

1 – Nokia France We agree with this proposal. But we think it is applied for both UE and BS so we think this issue can be removed to the general section.
2 – Samsung Electronics Benelux BV Samsung we are ok with this proposal
3 – Intel Corporation (UK) Ltd We agree to consider this issue as a general aspect.
4 – HiSilicon Technologies Co. Ltd we are ok with this proposal
5 – Ericsson LM Ericsson: Not sure about the meaning of "reuse" in Proposal 1. We think FR2-1 requirements should not be directly applied for FR2-2 product basically, because the channel model might be different while the phase noise impact should be considered.

Issue 2-2-2: General simulation assumptions

- Proposals
  - Proposal 1 (Ericsson): Start with 1/2Tx and 2Rx antenna configuration for FR2-2 BS demodulation requirements
  - Proposal 2 (Intel): Define FR2-2 performance requirements with normal CP only, with up to 2 demodulation branches, and with 1 and 2 Tx antennas.
- Recommended WF
  - Collect views in 1st round.

Feedback Form 16: Issue 2-2-2: General simulation assumptions

1 – Nokia France We agree with both proposals.
2 – Samsung Electronics Benelux BV Samsung: OK with option 1 and option 2, for option 2, only 2Rx demodulation branches are considered

3 – Intel Corporation (UK) Ltd Support both proposals
4 – HiSilicon Technologies Co. Ltd Support both proposals
5 – Ericsson LM Ericsson: We support starting with 1/2Tx and 2Rx for demodulation. We also agree to define requirements using normal CP for 120kHz SCS, but we are open for 480kHz and 960kHz SCS and considering the very short duration on normal CP.

Issue 2-2-3: Test SNR limit

- Proposals
  - Proposal 1 (Ericsson): FR2-2 could take [20dB] SNR limit at current stage. New test cases and method should be defined if it is finally approved that FR2-2 SNR limit is much lower than 20dB
- Recommended WF
  - Collect views in 1st round

Feedback Form 17: Issue 2-2-3: Test SNR limit

1 – Nokia France We agree with this proposal.
2 – Samsung Electronics Benelux BV Samsung: we can go option 1 as start point
3 – Intel Corporation (UK) Ltd We support this proposal.
4 – Ericsson LM Ericsson: We are open for further discussion.
5 – HiSilicon Technologies Co. Ltd Need more time to check

2.2.3 Sub-topic 2-3: PUSCH performance requirements

Sub-topic description

Details of PUSCH performance requirements

Open issues and candidate options before e-meeting:

Issue 2-3-1: Scope of PUSCH performance requirements

- Proposals
  - Proposal 1 (Ericsson): RAN4 consider define FR2-2 BS demodulation requirements for PUSCH repetition type A
  - Proposal 2 (Ericsson): The waveform could only consider CP-OFDM. Regarding the potential high PAR caused by worse PA linearization, DFT-s-OFDM could be considered later after the discussion on CP-OFDM
  - Proposal 3 (Intel): Define FR2-2 performance requirements with transform precoding disabled with 70% and 30% throughput; requirements with transform precoding enabled; requirements with UCI multiplexed on PUSCH.
  - Proposal 4 (Intel): Do not define in Rel-17 FR2-2 performance requirements for 2-step RA type, PUSCH performance requirements with repetition type A, and PUSCH performance requirements with mapping type B with non-slot transmission.
  - Proposal 5 (Intel): Define FR2-2 PUSCH performance requirements according to Tables 2-5.

- Recommended WF
  - Collect views in 1st round

Feedback Form 18: Issue 2-3-1: Scope of PUSCH performance requirements

1 – Nokia France We agree with proposals 1, 2, 3, and 4. Regarding propagation condition proposed in proposal 5 we think we should use what will be agreed in the general section in sub-topic 1-3.
2 – Samsung Electronics Benelux BV Samsung: In general, we agree with option 2, 3 and 4. For option 5, the channnel condition can be further discussed. we prefer to use TDL-D as start point
3 – Intel Corporation (UK) Ltd From requirements scope perspective, we suggest considering only minimum required test cases based on Rel-15 discussion for FR2-1. Repetition type A is beneficial feature, but can be deprioritized in Rel-17 to focus on minimum functionality. UCI multiplexing is not precluded in FR2-2 but considering processing issue raised by Ericsson, we are fine to also deprioritize such requirement definition. Therefore, we recommend to define FR2-2 performance requirements with transform precoding disabled with 70% and 30% throughput and requirements with transform precoding enabled in Rel-17.

4 – Ericsson LM Ericsson: We think PUSCH with repetition type A could be useful for FR2-2 for coverage. It would be worthy to define requirements for it. For UCI multiplexing on PUSCH, we don't see much benefit but open for discussion.
5 – HiSilicon Technologies Co. Ltd We propose to only define FR2-2 performance requirements with transform precoding disabled with 70%

Issue 2-3-2: PUSCH performance requirements for multi-PUSCH scheduling

- Proposals
  - Proposal 1 (Nokia): RAN4 not to define new BS demodulation requirements for multi-PUSCH scheduling in Rel-17
- Recommended WF
  - Collect views in 1st round

Feedback Form 19: Issue 2-3-2: PUSCH performance requirements for multi-PUSCH scheduling

1 – Samsung Electronics Benelux BV Samsung: We are ok with option 1, similar as Rel-15 and Rel-16, there is no multi-PUSCH scheduling requirement
2 – Intel Corporation (UK) Ltd Support Proposal 1.
3 – HiSilicon Technologies Co. Ltd Support Proposal 1.
4 – Ericsson LM Ericsson: We support Proposal 1 that no algorithm difference is seen for multi-PUSCH scheduling.

Issue 2-3-3: PUSCH performance requirements with 32 UL HARQ processes

- Proposals
  - Proposal 1 (Intel): Define PUSCH performance requirements to verify 32 UL HARQ processes feature
- Recommended WF
  - Collect views in 1st round

Feedback Form 20: Issue 2-3-3: PUSCH performance requirements with 32 UL HARQ processes

1 – Nokia France We do not support this proposal. For FR2-1 and FR1 no such test was design for BS. We do not see a reason to define such a test for FR2-2 because 1) the workload is very high due to many test cases; 2) demodulation performance requirement is not used to verify memory problem of the BS.
2 – Samsung Electronics Benelux BV Samsung: Similar as Rel-15/16, we donot think it is ncessary to define test cases with large number of UL HARQ process
3 – HiSilicon Technologies Co. Ltd We don't support this proposal. Similar views with Nokia
4 – Ericsson LM Ericsson: We don't see much benefit to define requirement with 32 UL HARQ from demodulation perspective. As in Rel-15, no explicit HARQ process number is defined for the requirement because it is not relevant for BS demodulation.
5 – Intel Corporation (UK) Ltd We are fine to not define PUSCH requirements with 32 UL HARQ processes considering received feedback from companies.

Issue 2-3-4: General PUSCH test setup

Moderator suggest discussing different aspects of simulation assumptions in one place since this is the first meeting. Companies, potentially, need more time on detailed work on simulation assumptions. Same time it is encouraged to converge on some general aspects.

- Proposals
  - Proposal 1 (Ericsson): Start with MCS4/16/20 to see if it is feasible
  - Proposal 2 (Ericsson): DM-RS/PT-RS configuration could start with Rel-15 assumptions. Further discussion is needed based on simulation results
  - Proposal 3 (Huawei): Keep the number of transmission RBs open until there are corresponding agreements from RF team.
  - Proposal 4 (Intel): Define FR2-2 PUSCH performance requirements assuming PTRS Tx
  - Proposal 5 (Intel): Define FR2-2 PUSCH performance requirements only with 1+1 DMRS configuration
- Recommended WF

- Collect views in 1st round

Feedback Form 21: Issue 2-3-4: General PUSCH test setup

1 – Nokia France We agree with the all the proposals. However, for the number of PRBs we suggest for the sake of advance of the work for the next meeting to agree on a temporary value. For example the maximum value that does not violate any CBW possible assuming a 5% or 10% guard band. We prose to discuss (SCS (kHz) CBW (MHz)) = (120 100) (120 400) (480 400) (480 800) (480 1600) (960 400) (960 800) (960 1600) (960 2000) proposed PRBs = (66) (264) (66) (132) (264) (32) (66) (132) (156)
2 – Samsung Electronics Benelux BV Samsung: we are ok with all proposals.
3 – Intel Corporation (UK) Ltd We support all these proposals and temporary values for PRB number suggested by Nokia.
4 – HiSilicon Technologies Co. Ltd OK with all proposals and temporary values for PRB number suggested by Nokia
5 – Ericsson LM We agree with the Proposals. We could discuss the details (parameters) when general (RF) issues are settled.

Issue 2-3-5: Detailed PUSCH test setup

One company has submitted detailed set of simulation assumptions. Moderator suggests discussing it in the second round.

- Proposals
  - Proposal 1 (Ericsson): Take simulation assumptions in Table 2-1 as the start point for PUSCH demodulation to check the phase noise impact and configuration feasibility. Down selection is needed based on simulation results

- Recommended WF
  - Collect views in 2nd round

Feedback Form 22: Issue 2-3-5: Detailed PUSCH test setup

1 – Ericsson LM Agree with recommended WF.

Issue 2-3-6: Rx processing assumptions

- Proposals
  - Proposal 1 (Huawei): Define PUSCH performance requirements by using ICI compensation.
- Recommended WF
  - Collect views in 2nd round

Feedback Form 23: Issue 2-3-6: Rx processing assumptions

1 – Samsung Electronics Benelux BV Samsung: In general, whether to apply ICI compensation is up to BS implementation. we should evaulate the PN impact firstly
2 – Intel Corporation (UK) Ltd At least for high MCS values ICI compensation is required. To evaluate phase noise impact we suggest considering two options: 1) Practical CPE compensation only; 2) Practical CPE + ICI compensation
3 – Ericsson LM Agree with recommended WF.

Issue 2-3-7: Other

This set of proposals directly depends on the other issues or do not require urgent agreement. Can be deprioritized for the second-round discussion

- Proposals
  - Proposal 1 (Intel): Define FR2-2 PUSCH performance requirements with transform precoding enabled and UCI multiplexed on PUSCH only for the smallest CBWs for each SCS.
  - Proposal 2 (Intel): Define FR2-2 PUSCH performance requirements with transform precoding disabled at least for the following SCS/CBW combinations: 120/100, 120/400, 480/400, 960/400 kHz/MHz
  - Proposal 3 (Intel): As a baseline option consider application of FR2-1 applicability rules for FR2-2 as well.
- Recommended WF
  - Collect views in 2nd round

Feedback Form 24: Issue 2-3-7: Other

1 – Samsung Electronics Benelux BV Samsung: we should focus on the test scope firstly, the detail test setup can be further discussion
2 – Ericsson LM Agree with recommended WF.

Table 2. Transform precoding disabled

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	FRC
1	2	TDLA10-650	QPSK, Rank 1
		TDLA10-650	16QAM, Rank 1
		TDLA10-200	64QAM Rank 1
2		TDLA10-650	QPSK, Rank 2
		TDLA10-650	16QAM, Rank 2

Table 3. Transform precoding enabled

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	FRC
1	2	TDLA10-650	QPSK, Rank 1

Table 4. UCI multiplexed on PUSCH: CSI part 1 requirements

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	UCI bits (CSI part 1, CSI part 2)
1	2	TDLA10-650	7 (5,2)
1	2	TDLA10-650	40 (20,20)

Table 5. UCI multiplexed on PUSCH: CSI part 2 requirements

Number of Tx antennas	Number of demodulation branches	Propagation conditions and correlation matrix	UCI bits (CSI part 1, CSI part 2)
1	2	TDLA10-650	7 (5,2)
1	2	TDLA10-650	40 (20,20)

Figure 13: Proposal 5 (Intel): Scope of PUSCH performance requirements

Table 2.2-1: Simulation parameters for FR2-2 PUSCH demodulation

Parameter		Value
Transform precoding		Disabled
Default TDD UL-DL pattern (Note 1)		120kHz SCS: 3D1S1U, S=10D:2G:2U
HARQ	Maximum number of HARQ transmissions	4
	RV sequence	0, 2, 3, 1
DM-RS	DM-RS configuration type DM-RS duration	1 single-symbol DM-RS
	Additional DM-RS symbols	pos0, pos1
	Number of DM-RS CDM group(s) without data	2
	Ratio of PUSCH EPRE to DM-RS EPRE	-3 dB
	DM-RS port(s)	{0}, {0, 1}
	DM-RS sequence generation	N_{ID}=0, n_{SCID} =0
Time domain resource	PUSCH mapping type	B
	Start symbol index	0
	Allocation length	10
Frequency domain resource	RB assignment	Full applicable test bandwidth (100MHz and 400MHz)
	Frequency hopping	Disabled
TPMI index for 2Tx two-layer spatial multiplexing transmission		0
Code block group based PUSCH transmission		Disabled
PT-RS configuration	Frequency density (K_{PT-RS})	2, Disabled
	Time density (L_{PT-RS})	1, Disabled
Test metric	Normalized throughput	70%
Antenna	Tx and Rx configuration	1Tx 2Rx 2Tx 2Rx
Channel model		TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
MCS	64QAM MCS table index	4/16/20
Phase noise	Model sets in TR38.808	Set 1 (Note)
Note: Companies are suggested to deliver ideal simulation results with and without phase noise.		

Figure 14: Proposal 1 (Ericsson): Detailed PUSCH test setup

2.2.4 Sub-topic 2-4: PUCCH performance requirements

Sub-topic description

Details of PUCCH performance requirements

Open issues and candidate options before e-meeting:

Issue 2-4-1: Scope of PUCCH performance requirements

- Proposals
  - Option 1 (Intel, Huawei, Ericsson): Define performance requirements for the enhanced PUCCH formats 0, 1, and 4. Define new requirements for PUCCH formats 2 and 3
  - Option 2 (Nokia): Define performance requirements for the enhanced PUCCH formats 0, 1, and 4
- Recommended WF
  - Collect views in 1st round

Feedback Form 25: Issue 2-4-1: Scope of PUCCH performance requirements

1 – Nokia France We agree with option 1. Not mentioning new requirements for PUCCH formats 2 and 3 in our proposal does not mean that we are saying no to them.
2 – Samsung Electronics Benelux BV Samsung: we are ok with option 2, we would like to check why we need to new format 2 and 3?
3 – Intel Corporation (UK) Ltd We support Option 1. PF 2 and 3 require new requirements due to another channel model (at least from RMS delay spread and max Doppler frequency perspective) in FR2-2 compared to FR2-1 and higher phase impact.
4 – HiSilicon Technologies Co. Ltd Support option 1
5 – Ericsson LM We support the definition of new requirements at least for normal PUCCH format 1/3, and also define requirements for enhanced PUCCH format 0/1/4.

Issue 2-4-2: Detailed PUCCH test setup

Moderator suggest focusing, at least, on baseline assumptions like test metrics and SCS. Second level details can be discussed in the second round.

- Proposals
    - Proposal 1 (Ericsson): Take simulation assumptions in Table 2.3-1 and 2.3-2 as the start point for PUCCH demodulation to check the phase noise impact and configuration feasibility. Other PUCCH format could be lower priority.
    - Proposal 2 (Ericsson): Define new requirements for FR2-2 multi-RB PUCCH performance. Take simulation assumptions in Table 2.3-3, 2.3-4 and 2.3-5 as the start point for PUCCH format 0/1/4 to check the phase noise impact and configuration feasibility.

- Proposal 3 (Huawei): Use following assumptions as start point to discuss for PUCCH requirements definition
    - PF0:
        - 120 kHz, NRB=10, 1 OFDM symbol without hopping 1T2R, TDLA30-300 Low
        - 120 kHz, NRB=10, 2 OFDM symbol with hopping 1T2R, TDLA30-300 Low
        - 480 kHz, NRB=10, 1 OFDM symbol without hopping 1T2R□TDLA30-300 Low
        - 480 kHz, NRB=10, 2 OFDM symbol with hopping 1T2R□TDLA30-300 Low
        - 960 kHz NRB=10, 1 OFDM symbol without hopping 1T2R□TDLA30-300 Low
        - 960 kHz NRB=10, 2 OFDM symbol with hopping 1T2R□TDLA30-300 Low
    - PF1:
        - 120 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R□TDLA30-300 Low
        - 480 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R, TDLA30-300 Low
        - 960 kHz NRB=10, 14 OFDM symbol with hopping 1T2R, TDLA30-300 Low
    - PF2:
        - 480 kHz, NRB=9, 2 OFDM symbol, 1T2R□TDLA30-300 Low, UCI bits:22bit
        - 960 kHz NRB=9, 2 OFDM symbol , 1T2R□TDLA30-300 Low, UCI bits:22bit
    - PF3
        - 480 kHz, NRB=3, 4 OFDM symbol, 1T2R□TDLA30-300 Low, UCI bits:16bit
        - 960 kHz NRB=3, 4 OFDM symbol , 1T2R□TDLA30-300 Low, UCI bits:16bit
    - PF4:
        - 120 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R□TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2.

        - 480 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R□TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2
        - 960 kHz, NRB=10, 14 OFDM symbol with hopping 1T2R□TDLA30-300 Low, UCI bits: 22 bits with polar coding/ Other UCI bits less than 11 with RM coding, OCC length=2

- Proposal 4 (Intel): Define the following set of requirements
    - DTX to ACK probability requirements
    - Enhanced PUCCH format 0:
        - ACK missed detection requirements
        - 1 and 2 OFDM symbols
    - Enhanced PUCCH format 1
        - NACK to ACK probability requirements
        - ACK missed detection requirements
    - PUCCH format 2:
        - ACK missed detection requirements
        - UCI BLER performance requirements
        - 1 and 2 OFDM symbols
    - PUCCH format 3:
        - UCI BLER performance requirements
        - With and without additional DMRS
        - 4 and 14 OFDM symbols
    - Enhanced PUCCH format 4: With and without additional DMRS
        - UCI BLER performance requirements
- Recommended WF
    - Collect views in 1st round

Feedback Form 26: Issue 2-4-2: Detailed PUCCH test setup

1 – Nokia France We agree on these proposals after they capture the agreements that will be made in the general section.
2 – Samsung Electronics Benelux BV Samsung: we support option 3, the detail number of RB, payload, channel model can be further discussed

3 – HiSilicon Technologies Co. Ltd Support option 3
4 – Ericsson LM Suggest to discuss this once the scope has been agreed.

Table 2.3-1: Simulation Parameters for FR2-2 PUCCH format 2

Parameter	Test
Number of information bits Number of PRBs	2 1
Number of symbols First PRB prior to frequency hopping Intra-slot frequency hopping	14 0 enabled
First PRB after frequency hopping	The largest PRB index – (nrofPRBs – 1)
Group and sequence hopping	neither
Hopping ID	0
Initial cyclic shift First symbol	0 0
Index of orthogonal cover code (*timeDomainOCC*)	0
SCS and bandwidth	120kHz SCS 100MHz/400MHz
Antenna configuration	1Tx 2Rx
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Phase noise model	Set 1 in TR38.808
Test metric	SNR@NACK→ACK<0.1% SNR@ACK miss<1%
Simulation results: Ideal simulation results with/without phase noise.	

Table 2.3-2: Simulation Parameters for FR2-2 PUCCH format 3

Parameter	Test 1	Test 2
Modulation order First PRB prior to frequency hopping	QPSK 0	
Intra-slot frequency hopping First PRB after frequency hopping Group and sequence hopping	enabled The largest PRB index – (Number of PRBs - 1) neither	
Hopping ID Number of PRBs	0 1	3
Number of symbols	14	4
The number of UCI information bits	16	16
First symbol	0	0
SCS and bandwidth Antenna configuration	120kHz SCS 100MHz/400MHz 1Tx 2Rx	
Channel model Phase noise model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000 Set 1 in TR38.808	
Test metric	SNR@BLER<1%	
Simulation results: Ideal simulation results with/without phase noise.		

Figure 15: Proposal 1 (Ericsson): Detailed PUCCH test setup

Table 2.3-3: Test Parameters for multi-RB PUCCH format 0

Parameter	Test
Number of UCI information bits Number of PRBs	1 16
First PRB prior to frequency hopping Intra-slot frequency hopping	0 N/A for 1 symbol
First PRB after frequency hopping	The largest PRB index – (Number of PRBs - 1)
Group and sequence hopping Hopping ID	neither 0
Initial cyclic shift	0
First symbol SCS and bandwidth	13 for 1 symbol 120kHz SCS 100MHz/400MHz
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Test metric	SNR@DTX →ACK <1%

Table 2.3-4: Test Parameters for multi-RB PUCCH format 1

Parameter	Test
Number of information bits	2
Number of PRBs Number of symbols	16 14
First PRB prior to frequency hopping	0
Intra-slot frequency hopping First PRB after frequency hopping Group and sequence hopping	enabled The largest PRB index – (nrofPRBs – 1) neither
Hopping ID Initial cyclic shift	0 0
First symbol	0
Index of orthogonal cover code (*timeDomainOCC*)	0
SCS and bandwidth	120kHz SCS 100MHz/400MHz
Channel model	TDLA30-200/2000 TDLA10-200/2000 TDLA5-200/2000
Test metric	SNR@NACK →ACK <0.1% SNR@ACK miss <1%

Table 2.3-5: Test parameters for multi-RB PUCCH format 4

Parameter	Value
Modulation order	QPSK
First PRB prior to frequency hoppingstartingPRB Number of PRBs	0 16
Intra-slot frequency hopping First PRB after frequency hopping Group and sequence hopping	enabled The largest PRB index – (Number of PRBs – 1) neither
Hopping ID	0
Number of symbols	14
The number of UCI information bits First symbol	22 0
Length of the orthogonal cover code	n2
Index of the orthogonal cover code	n0
DM-RS position SCS and bandwidth	Pos0, {pos0, pos1} 120kHz SCS

2.2.5 Sub-topic 2-5: PRACH performance requirements

Sub-topic description

Details of PRACH performance requirements

Open issues and candidate options before e-meeting:

Issue 2-5-1: Scope of PRACH requirements

- Proposals
  - Proposal 1 (Intel): For FR2-2 define the same set of PRACH performance requirements as in FR2-1:
    - False alarm probability requirements
    - PRACH miss detection requirements
- Recommended WF
  - Collect views in 1st round

Feedback Form 27: Issue 2-5-1: Scope of PRACH requirements

1 – Nokia France We agree with this proposal.
2 – Samsung Electronics Benelux BV Samsung: we are ok with option 1
3 – HiSilicon Technologies Co. Ltd We agree with this proposal.
4 – Ericsson LM We support Proposal 1.

Issue 2-5-2: SCS

- Proposals
  - Option 1 (Ericsson): Prioritize 120kHz SCS. Lower priority for 480kHz and 960kHz SCS
  - Option 2 (Nokia, Huawei, Intel): 120, 480 and 960 kHz
- Recommended WF
  - Collect views in 1st round

Feedback Form 28: Issue 2-5-2: SCS

1 – Samsung Electronics Benelux BV Samsung: we support option 1, focus on 120KHz firstly
2 – Intel Corporation (UK) Ltd We support Option 2. Number of PRACH test cases is limited so requirements for all SCSs can be defined simultaneously.
3 – HiSilicon Technologies Co. Ltd We support option 2. Same views with Intel
4 – Ericsson LM To align with our proposal in General part, we prefer to prioritize 120kHz and 480kHz, but we are open for 960kHz SCS for PRACH.

Issue 2-5-3: Sequence length

- Proposals
  - Proposal 1 (Ericsson): L= 139, 571, 1151 for 120kHz
  - Proposal 2 (Nokia): RAN4 to introduce performance requirements for the new combinations of L_RA and Δf_RA introduced for FR2-2.
  - Proposal 3 (Huawei): Only max supported sequence length for each SCS
  - Proposal 4 (Intel): Define performance requirements for PRACH with 1151 and 571 sequence length with 120 kHz; for PRACH with 571 sequence length with 480 kHz SCS; for PRACH with 139 sequence length with 960 kHz SCS
- Recommended WF
  - Collect views in 1st round

Feedback Form 29: Issue 2-5-3: Sequence length

1 – Samsung Electronics Benelux BV Samsung: we are ok with option 3
2 – Intel Corporation (UK) Ltd We support proposals 2 and 4 that are similar and in addition requirements definition for 139 sequence length for 120 kHz SCS. We expect that the supported sequence length will be up to BS declaration, hence it is required to cover all possible configurations.
3 – HiSilicon Technologies Co. Ltd We support proposal 3, but proposal 4 is also fine for us

4 – Ericsson LM Maybe simulations based on different sequence lengths with phase noise impact are needed. We suggest to start with 120kHz SCS using different sequence lengths. Other SCS could be tested if companies have resources.

Issue 2-5-4: PRACH formats

- Proposals
  - Option 1 (Ericsson, Huawei): A2, B4, C2
  - Option 2 (Intel): A1, A2, A3, B4, C0, C2
- Recommended WF
  - Collect views in 1st round

Feedback Form 30: Issue 2-5-4: PRACH formats

1 – Nokia France We agree with option 1.
2 – Samsung Electronics Benelux BV Samsung: we support option 1
3 – Intel Corporation (UK) Ltd We are fine to compromise to Option 1.
4 – HiSilicon Technologies Co. Ltd We agree with option 1.
5 – Ericsson LM We are open for discussion. Basically, all formats could be used for FR2-2, but A2/B4/C2 are typical formats for most of Rel-16 scenarios. Regarding small cell deployment in FR2-2, short duration format could also be considered.

Issue 2-5-5: Channel model and Frequency offset

- Proposals
  - Proposal 1 (Ericsson): Consider AWGN and multi-path fading channels, such as TDLA30-200/2000, TDLA10-200/2000 and TDLA5-200/2000
  - Proposal 2 (Huawei): consider both AWGN and TDLA30-300

- Proposal 3 (Intel): Define FR2-2 PRACH performance requirements with AWGN channel model and with TDLA10-650 with frequency offset channel models

- Recommended WF
  - Collect views in 1st round

Feedback Form 31: Issue 2-5-5: Channel model and Frequency offset

1 – Nokia France We propose to double the doppler shifts and frequency shift in the test cases designed using previous use cases. regardless on the assumed UE speed and assumed frequency. For example for PRACH test cases for FR2-1 We propose to use 8000 Hz as Frequency offset and TDLAxx-600 as a propagation condition.
2 – Samsung Electronics Benelux BV Samsung: we should discuss the channel model firstly
3 – Intel Corporation (UK) Ltd We support proposal from Nokia to double max Doppler shift for PRACH requirements. Requirements with AWGN and fading propagation conditions should be defined. Fading conditions should be aligned among different physical channels
4 – HiSilicon Technologies Co. Ltd We need more time to check the channel model firstly
5 – Ericsson LM AWGN is necessary while for multi-path fading channel, we could follow the PUSCH and PUCCH channel models, while down selection could be possible as well.

Issue 2-5-6: Frequency offset

- Proposals
  - Option 1 (Huawei): 0.1*71GHz=7100Hz
  - Option 2 (Ericsson): Consider 0.1ppm (7000Hz) for FR2-2.

- Recommended WF
  - Collect views in 1st round

Feedback Form 32: Issue 2-5-6: Frequency offset

1 – Nokia France We propose to double the doppler shifts and frequency shift in the test cases designed using previous use cases. regardless on the assumed UE speed and assumed frequency. For example for PRACH test cases for FR2-1 We propose to use 8000 Hz as Frequency offset and TDLA30-600 as a propagation condition.
2 – Samsung Electronics Benelux BV Samsung: either option 1 or option 2 are fine with us, since the target carrier frequencey is up to 71GHz, option 1 can be considered
3 – Intel Corporation (UK) Ltd Option 1 is more preferable considering that requirements should be applicable up to 71 GHz. Also we are fine with proposal from Nokia on 8000 Hz
4 – HiSilicon Technologies Co. Ltd Prefer Option 1
5 – Ericsson LM We are fine with both options.

Issue 2-5-7: Time error tolerance

- Proposals
  - Proposal 1 (Huawei): Reuse test metric of Rel-15 and use assumptions in Table 2 as time error tolerance.

Table 2: Time error tolerance for AWGN and TDLA30-300

PRACH preamble	PRACH SCS (kHz)	Time error tolerance	
		AWGN	TDLA30-300
A2, B4, C2	120	0.07 us	0.22 us
	480	0.02 us	0.17 us
	960	0.01 us	0.16us

Figure 17: Proposal 1 (Huawei): time error tolerance

  - Proposal 2 (Ericsson): 0.07us for AWGN. For multi-path fading channels, time error could be further discussed based on delay profile and timing error.

- Recommended WF
  - Collect views in 2nd round

Feedback Form 33: Issue 2-5-7: Time error tolerance

1 – Samsung Electronics Benelux BV Samsung: ok with option 2, the time error pending the channel used
2 – HiSilicon Technologies Co. Ltd It depends on channel model
3 – Ericsson LM Agree with recommended WF

Issue 2-5-8: (Ncs, logical sequence index, v)

- Proposals
  - Proposal 1 (Intel): Consider the following PRACH parameters as initial simulation assumptions: Ncs = 69, logical sequence index = 0, v =0.
- Recommended WF
  - Collect views in 2nd round

Feedback Form 34: Issue 2-5-8: (Ncs, logical sequence index, v)

1 – Samsung Electronics Benelux BV Samsung: we can use option 1 as starting point, other options are not precluded
2 – HiSilicon Technologies Co. Ltd we can use option 1 as starting point, other options are not precluded
3 – Ericsson LM Agree with recommended WF

Issue 2-5-9: Detailed simulation assumptions

- Proposals
  - Proposal 1 (Huawei): Define the requirements for PRACH operating in FR2-2 with following cases:
    - SCS: 120 kHz; Format: A2, B4 and C2; LRA: 1151; Propagation conditions: AWGN and TDLA30-30

- SCS: 480 kHz; Format: A2, B4 and C2, LRA: 571; Propagation conditions: AWGN and TDLA30-300
- SCS: 960 kHz; Format: A2, B4 and C2, LRA: 139; Propagation conditions: AWGN and TDLA30-300.

○ Proposal 2 (Ericsson): Define new requirements for FR2-2 PRACH. Take simulation assumptions in Table 2.4-1 as the start point to see the phase noise impact and configuration feasibility.

Table 2.4-1: simulation parameters for FR2-2 PRACH

PRACH preamble	PRACH SCS (kHz)	Time error tolerance [us]				Frequency offset	
		AWGN	TDLA30-200/2000	TDLA10-200/2000	TDLA5-200/2000	AWGN	Multi-path channel
A2, B4, C2 FFS on other preambles	120	0.07	FFS	FFS	FFS	0	7000

Figure 18: Proposal 2 (Ericsson): Detailed simulation assumptions

- Recommended WF

○ Collect views in 2nd round

Feedback Form 35: Issue 2-5-9: Detailed simulation assumptions

1 – Samsung Electronics Benelux BV Samsung: we can apply option 1 as starting piont , FFS on channel model, FFS on SCS
2 – Ericsson LM Agree with recommended WF

2.3 Summary for 1st round

2.3.1 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

Table 14: First round summary for Topic #2

	Summary
Sub-topic 2-1: SCS/CBW combinations	**Issue 2-1-1: SCS for UL requirements definition** Three companies support introduction of requirements for 120, 480 and 960 kHz SCS. One company suggested prioritizing 120 and 480 kHz. One company suggested prioritizing 120 kHz. **Tentative agreement:** Consider the following SCS for UL requirements definition: - 120, 480 kHz - FFS 960 kHz **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion on necessity of requirements with 960 kHz SCS.
	Issue 2-1-2: CBW for UL requirements definition All companies agree to consider min and max CBW for each SCS. Several companies raised the possible testability issue for high CBWs. **Tentative agreement:** - Consider minimum CBW for each SCS for UL requirements definition. - Consider maximum CBW for each SCS for UL requirements definition if no testability aspects are identified ○ Perform link budget analysis to study max achievable SNR during the test **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement.
Sub-topic 2-1: General issues	**Issue 2-2-1: FR2-1 requirements reuse** All companies agreed with proposal one. One company suggest to clarify what ”reuse” means. **Tentative agreement:** Do not apply FR2-1 performance requirements for FR2-2. **Candidate options: NA** **Recommendations for 2nd round: NA**

	Issue 2-2-2: General simulation assumptions All companies agreed to consider 1-2Tx/2Rx configuration. Four companies support considering normal CP length for all SCS. One company suggest discussing extended CP for 480 and 960 kHz SCS due to short slot length. Same time according to TS 38.211 extended CP length is not defined for 480 and 960 kHz SCSs. **Tentative agreement:** Define UL performance requirements with: - Normal CP - With 1 and 2 Tx antennas - With 2 demodulation branches **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement
	Issue 2-2-3: Test SNR limit Four companies support this proposal and one company needs more time to check. **Tentative agreement:** Take [20] dB SNR limit FR2-2 at starting point. New test cases and method should be defined if it is finally approved that FR2-2 SNR limit is much lower than [20] dB. **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement

	Issue 2-3-1: Scope of PUSCH performance requirements Diverse views on scope of PUSCH requirements **Tentative agreement:** Define the following PUSCH performance requirements: - Performance requirements with transform precoding disabled with 70% throughput - FFS performance requirements with transform precoding disabled with 30% throughput - FFS performance requirements with transform precoding enabled - FFS performance requirements for PUSCH repetition type A Do not define the following PUSCH performance requirements: - Performance requirements for 2-step RA type - Performance requirements with mapping type B with non-slot transmission - Performance requirements with UCI multiplexed on PUSCH **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion on FFS aspect and try to converge on PUSCH scope.
	Issue 2-3-2: PUSCH performance requirements for multi-PUSCH scheduling All companies agreed with proposal 1. **Tentative agreement:** Do not define BS demodulation requirements for multi-PUSCH scheduling **Candidate options: NA** **Recommendations for 2nd round: NA**

	Issue 2-3-3: PUSCH performance requirements with 32 UL HARQ processes Companies converged to not define requirements with 32 UL HARQ processes **Tentative agreement:** Do not define PUSCH performance requirements to verify 32 UL HARQ processes feature **Candidate options: NA** **Recommendations for 2nd round: NA**
	Issue 2-3-4: General PUSCH test setup All companies agreed with proposed options and with suggestion on the temporary RB number for each CBW. PRB number will be updated once RF room reaches corresponding agreement. **Tentative agreement:** Consider the following simulation assumptions at starting point for PUSCH performance requirements: - MCS 4, 16, 20 - DM-RS/PT-RS configuration Rel-15 assumptions - 1+1 DMRS configuration - PTRS Tx on - Temporary PRB number: ○ (66)(264)(66)(132)(264)(32)(66)(132)(156) for SCS (kHz CWB (MHz)) = (120 100)(120 400)(480 400) (480 800)(480 1600)(960 400)(960 800)(960 1600)(960 2000)
	Issue 2-3-5: Detailed PUSCH test setup No discussion in 1st round **Recommendations for 2nd round:** Collect views considering progress in other issues.
	Issue 2-3-6: Rx processing assumptions Limited number of comments. **Recommendations for 2nd round:** Continue discussion
	Issue 2-3-7: Other No discussion in 1st round **Recommendations for 2nd round:** Collect views considering progress in other issues.

Sub-topic 2-4: PUCCH performance requirements	**<u>Issue 2-4-1: Scope of PUCCH performance requirements</u>** Four companies support Option 1 and one company supports Option 2. Considering majority view moderator suggest Option 1. **Tentative agreement:** - Define performance requirements for the enhanced PUCCH formats 0, 1, and 4. - Define new requirements for PUCCH formats 2 and 3. **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement
	<u>Issue 2-4-2: Detailed PUCCH test setup</u> More discussion is needed considering progress of general issues. Moderator will update this issue for 2nd round discussion. **Recommendations for 2nd round:** Collect views considering progress in other issues.
Sub-topic 2-5: PRACH performance requirements	**<u>Issue 2-5-1: Scope of PRACH requirements</u>** All companies agreed with proposal 1. **Tentative agreement:** Define the following PRACH performance requirements: - False alarm probability requirements - PRACH miss detection requirements **Candidate options: NA** **Recommendations for 2nd round: NA**
	<u>Issue 2-5-2: SCS</u> Four companies support 120 kHz. Three companies support 480 kHz. Two companies support 960 kHz **Tentative agreement:** PRACH SCS: - 120, 480 kHz - FFS 960 kHz **Candidate options: NA** **Recommendations for 2nd round:** Discuss necessity of PRACH requirements with 960 kHz SCS.

	Issue 2-5-3: Sequence length Three companies agree with proposal 4. One company prefers proposal 3. **Tentative agreement:** PRACH sequence length: - 120 kHz: ○ 1151, 571 ○ FFS 139 - 480 kHz: ○ 571 ○ FFS on 139 - 960 kHz: ○ 139 **Candidate options: NA** **Recommendations for 2nd round:** Discuss FFS options.
	Issue 2-5-4: PRACH formats All companies agreed to consider Option 1. **Tentative agreement:** PRACH formats: A2, B4, C2
	Issue 2-5-5: Channel model and Frequency offset More discussion is needed considering progress of Sub-topic 1-3. **Tentative agreement: NA** **Recommendations for 2nd round:** Focus on sub-topic 1-3 first.

	Issue 2-5-6: Frequency offset All companies agreed to consider Option 1. One company proposed 8000 Hz that is double value of 4000Hz that is used for FR2-1. **Tentative agreement: NA** **Candidate options:** - Option 1: 7100 Hz - Option 2: 8000 Hz **Recommendations for 2nd round:** Discussed above options.
	Issue 2-5-7: Time error tolerance 0.07us can be agreed for AWGN. More discussion is needed for multi-path fading conditions. **Tentative agreement:** Time error tolerance: - 0.07us for AWGN - FFS for multi-path fading **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion considering progress of sub-topic 1-3.
	Issue 2-5-8: (Ncs, logical sequence index, v) All companies support to consider proposal 1 as starting point. **Tentative agreement:** Consider the following PRACH parameters as starting point: Ncs = 69, logical sequence index = 0, v =0. **Candidate options: NA** **Recommendations for 2nd round: NA**
	Issue 2-5-9: Detailed simulation assumptions More discussion is needed considering progress of other issues **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion in 2nd round considering progress of other issues.

2.4 Discussion on 2nd round (if applicable)

2.4.1 Sub-topic 2-1: SCS/CBW combinations

Issue 2-1-1: SCS for UL requirements definition

Tentative agreement

Consider the following SCS for UL requirements definition:

- 120, 480 kHz
- FFS 960 kHz

Recommended WF:

Continue discussion on necessity of requirements with 960 kHz SCS.

Table 15: Companies' comments

Company	Comments
Intel	We prefer to consider 960 as well to have the full coverage. If BS will support only 960 kHz there will be no tests to verify it.
Samsung	at current stage, we prefer to 120 and 480KHz,
Nokia	We think it is important to consider 960 kHz SCS without deprioritizing. also since the schedule of ext_to_71GHz is very tight (only 3 meetings) it will be very hard to conclude the requirements for 960 kHz if we deprioritize it now. Additionally, 960 kHz is the only SCS that allows for the maximum CBW that is allowed for FR2-2, 2000 MHz channel. Considering that, we think that it is important to have the requirements for 960 kHz
Huawei	Share same views with Intel
Ericsson	Theoretically, SCS 960kHz would have much smaller phase noise impact. If 120kHz and 480kHz could pass the requirement, we don't think 960kHz would be a problem. Furthermore, the 960kHz SCS is suitable for larger BW, i.e., 1.6GHz/2GHz, but the testability of larger BW is still not clear. Referring to FR2-1, 240kHz SCS is not introduced in the demodulation requirement. We suggest only to consider 120/480kHz SCS for FR2-2. We still prefer FFS on 960kHz.

Issue 2-1-2: CBW for UL requirements definition

Tentative agreement

Consider minimum CBW for each SCS for UL requirements definition.

Consider maximum CBW for each SCS for UL requirements definition if no testability aspects are identified

- Perform link budget analysis to study max achievable SNR during the test

Recommended WF:

Confirm tentative agreement.

Table 16: Companies' comments

Company	**Comments**
Intel	Support tentative agreement.
Samsung	Ok with tentative agreement
Nokia	We agree with the tentative agreement
Huawei	Support tentative agreement
Ericsson	Support tentative agreement

2.4.2 Sub-topic 2-1: General issues

Issue 2-2-1: FR2-1 requirements reuse

Tentative agreement

Do not apply FR2-1 performance requirements for FR2-2.

Recommended WF:

Tentative agreement seems agreeable

Table 17: Companies' comments

Company	**Comments**
Nokia	We agree with the tentative agreement

Issue 2-2-2: General simulation assumptions

Tentative agreement

Define UL performance requirements with:

- Normal CP
- With 1 and 2 Tx antennas
- With 2 demodulation branches

Recommended WF:

Confirm tentative agreement.

Table 18: Companies' comments

Company	Comments
Intel	Support tentative agreement.
Samsung	Ok with tentative agreement,
Nokia	We agree with the tentative agreement
Huawei	Support tentative agreement
Ericsson	Support tentative agreement

Issue 2-2-3: Test SNR limit

Tentative agreement

Take [20] dB SNR limit FR2-2 at starting point. New test cases and method should be defined if it is finally approved that FR2-2 SNR limit is much lower than [20] dB.

Recommended WF:

Confirm tentative agreement.

Table 19: Companies' comments

Company	Comments
Intel	Support tentative agreement.
Samsung	Ok with tentative agreement

Huawei	Support tentative agreement.
Ericsson	Support tentative agreement.

2.4.3 Sub-topic 2-3: PUSCH performance requirements

Issue 2-3-1: Scope of PUSCH performance requirements

Tentative agreement

Define the following PUSCH performance requirements:

- Performance requirements with transform precoding disabled with 70% throughput
- FFS performance requirements with transform precoding disabled with 30% throughput
- FFS performance requirements with transform precoding enabled
- FFS performance requirements for PUSCH repetition type A

Do not define the following PUSCH performance requirements:

- Performance requirements for 2-step RA type
- Performance requirements with mapping type B with non-slot transmission
- Performance requirements with UCI multiplexed on PUSCH

Recommended WF:

Continue discussion on FFS aspect and try to converge on PUSCH scope

Table 20: Companies' comments

Company	**Comments**
Intel	PUSCH repetition type A is beneficial feature, but it is out of minimum set of the required functionality to operate in FR2-2. It can be addressed in future. Same time requirement for 30% throughput is important and we suggest defining one test case to verify soft buffer. Otherwise, there will be inconsistency with FR2-1 minimum test cases. Similar for DFT-S-OFDM.
Samsung	From lager SCS and large CBW verification, in our view, 70% with CP-OFDM should be enough. Regarding repetition A, we are open to further discuss

Nokia	We are ok having 30% TP as low priority For requirements with transform precoding and repetition type A. The performance requirement of cell-edge UE needs to be guaranteed Otherwise we agree with the tentative agreement.
Huawei	We prefer to only consider performance requirements with transform precoding disabled with 70% throughput considering work burden
Ericsson	For test metric, 30% throughput could be used to check performance for some special cases, such as more HARQ retransmission etc. We don't have strong view on it. For DFT-s-OFDM, we suggest companies deliver some simulation results based on DFT-s-OFDM and compared with CP-OFDM. If large gain can be seen, precoding enabled test cases could be defined with limited cases. For PUSCH repetition type A requirement, it is useful for coverage limited scenario, especially outdoor deployment. If it is agreed to be introduced, only 120kHz SCS could be considered for the requirement to limit the test effort.

Issue 2-3-2: PUSCH performance requirements for multi-PUSCH scheduling

Tentative agreement

Do not define BS demodulation requirements for multi-PUSCH scheduling

Recommended WF:

Tentative agreement seems agreeable.

Issue 2-3-3: PUSCH performance requirements with 32 UL HARQ processes

Tentative agreement

Companies converged to not define requirements with 32 UL HARQ processes

Recommended WF:

Tentative agreement seems agreeable

Issue 2-3-4: General PUSCH test setup

Tentative agreement

Consider the following simulation assumptions at starting point for PUSCH performance requirements:

- MCS 4, 16, 20
- DM-RS/PT-RS configuration Rel-15 assumptions
- 1+1 DMRS configuration
- PTRS Tx on
- Temporary PRB number:
- (66)(264)(66)(132)(264)(32)(66)(132)(156) for SCS (kHz CWB (MHz)) = (120 100)(120 400)(480 400) (480 800)(480 1600)(960 400)(960 800)(960 1600)(960 2000)

Recommended WF:

Confirm tentative agreement.

Table 21: Companies' comments

Company	**Comments**
Intel	Support tentative agreement. Only PRB number should be updated considering agreement in RF session.
Samsung	For PTRS, there is no PTRS for MCS4, since the PN impact is minor, we are not sure whether it is needed, we are fine to enable PTRS for all MCS level As for high MCS level as 20, based on experienced in Rel-15, it may be not feasible for 2 Tx, considering the interference between two layers We can differentiate the MCS with different Tx, i. e MCS 4 ,16 and MCS 20 for 1Tx, MCS 3, 16 for 2Tx, if 2Tx is introduced
Nokia	We support the tentative agreement
Huawei	Support tentative agreement

Ericsson	We support following (for SCS 120 KHz and 480 KHz): - MCS 4, 16, 20 - DM-RS/PT-RS configuration Rel-15 assumptions - 1+1 DMRS configuration - PTRS Tx on We suggest that the tentative PRB numbers should be FFS. We can use the proposed tentative PRB numbers for simulations, and the requirements will be defined upon the results and RF conclusions.

Issue 2-3-5: Detailed PUSCH test setup

Tentative agreement: NA

Candidate options:

Option 1:

Table 22: Option 1

	Parameter	Value
HARQ	Maximum number of HARQ transmissions	4
	RV sequence	0,2,3,1
Time domain resource	PUSCH mapping type	B
	Start symbol index	0
	Allocation length	10
Frequency domain resource	Frequency hopping	Disabled
TPMI index for 2Tx two-layer spatial multiplexing transmission		0
Code block group based PUSCH transmission		Disabled
Test metric	Normalized throughput	70%

Recommended WF:

Collect views whether option 1 is acceptable

Table 23: Companies' comments

Company	Comments
Intel	Test metric should be removed considering on-going discussion on 30% requirement introduction. Other parameters are fine for us.
Samsung	We are ok with the tentative agreement
Nokia	We agree with option1.
Huawei	OK with tentative agreement
Ericsson	We are fine with parameters in the table for now and further discussion in next meeting is needed based on the simulation results.

Issue 2-3-6: Rx processing assumptions

Tentative agreement: NA

Candidate Options:

Option 1:Define PUSCH performance requirements by using ICI compensation

Recommended WF:

Collect views whether Option 1 is agreeable.

Table 24: Companies' comments

Company	Comments
Intel	Support Option 1. Same time if companies think that more study is needed, we are fine to provide results with CPE only and with CPE + ICI compensation.
Samsung	We suggestion study is needed, since ICI compensation is pending on BS implementation, we need to check the PN impact firstly

Nokia	ICI compensation is part of phase noise compensation. Even if it is in some cases the dominant factor, we do not think that we need to define PUSCH performance requirements by using ICI compensation instead of phase noise compensation. So, we do not support this option We propose option 2: Define PUSCH performance requirements by using phase noise compensation
Huawei	We support option 1. Same time we are fine to bring the results with/without ICI compensation
Ericsson	We suggest to FFS until next meeting. Companies could deliver simulation results with/without ICI compensation and see the difference, then make decision if we need to consider ICI compensation into requirement definition.

Issue 2-3-7a: Other

Tentative agreement: NA

Candidate Options:

CBW for performance requirements with transform precoding enabled:

- Option 1: Only the smallest CBWs for each SCS.

Recommended WF:

Collect views whether Option 1 is agreeable if requirements for transform precoding enabled will be introduced.

Table 25: Companies' comments

Company	**Comments**
Intel	Support Option 1 if requirement for scenario with transform precoding disabled will be agreed. Similar approach is used for FR2-1.
Samsung	Ok with option 1
Nokia	Option 1 is ok as a starting point
Ericsson	We are OK with Option 1 if transform precoding enabled is agreed to be introduced.

Issue 2-3-7b: Other

Tentative agreement: NA

Candidate Options:

Applicability rule:

- Option 1: As a baseline option consider application of FR2-1 applicability rules for FR2-2 as well.

Recommended WF:

Collect views whether Option 1 is agreeable.

Table 26: Companies' comments

Company	Comments
Intel	Support Option 1 as a baseline option. Each applicability rule can be further discussed case by case if needed.
Samsung	We can discuss the test applicability later, after the requirement is stable
Nokia	We agree with option 1 as a starting point.
Huawei	Same views with Samsung
Ericsson	Basically OK. Need more check and agree with Samsung.

2.4.4 Sub-topic 2-4: PUCCH performance requirements

Issue 2-4-1: Scope of PUCCH performance requirements

Tentative agreement:

Define performance requirements for the enhanced PUCCH formats 0, 1, and 4.

Define new requirements for PUCCH formats 2 and 3.

Recommended WF:

Confirm tentative agreement.

Table 27: Companies' comments

Company	Comments
Intel	Support tentative agreement.
Samsung	We are ok with the requirement of enhanced PUCCH formats 0, 1 and 4. We would like to clarify what is new requirements for PUCCH format2 and format3, with large SCS or CBW? We are not whether it is needed?
Nokia	We agree with the tentative agreement
Huawei	Support tentative agreements
Ericsson	Support tentative agreement

Issue 2-4-2a: Detailed PUCCH test setup for PUCCH format 0

Tentative agreement: NA

Candidate Options:

Number of PRBs:

- Option 1: 16 (enhanced format)
- Option 2: 10 (enhanced format)

Number of OFDM symbols:

- Option 1: 1
- Option 2: 1 and 2

Intra-slot frequency hopping: enabled if number of OFDM symbols higher than 1

Test metric: ACK missed detection rate < 1%

Recommended WF:

Discuss candidate options.

Table 28: Companies' comments

Company	Comments

Intel	For number of PRBs we support Option 1 for 480 and 960 kHz. 1 PRB should be considered for 120 kHz. For number of OFDM symbols we think one and two OFDM symbols is better from test coverage perspective, but to reduce work load we are fine to consider only 1 symbol.
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	For number of PRBs we support Option 1. (The maximum number of possible PRBs for each format) For Number of OFDM symbols we do not have strong opinion. both options are fine for us
Huawei	**Number of PRBs:** We prefer option 2 for 480/960kHz and 1RB for 120kHz **Number of OFDM symbols** We prefer to consider option 2 to cover both hopping and non hopping
Ericsson	For PRB number, both options are OK for us considering both SCS 480 KHz and 960 KHz. For OFDM symbol number, we prefer 1 symbol to check the potentially worse case and reduce effort

Issue 2-4-2b: Detailed PUCCH test setup for PUCCH format 1

Tentative agreement: NA

Candidate Options:

Number of PRBs:

- Option 1: 1
- Option 2: 16 (enhanced format)
- Option 2: 10 (enhanced format)

Number of OFDM symbols:

- Option 1: 14

Intra-slot frequency hopping: enabled

Test metric: ACK missed detection rate < 1% and NACK to ACK probability < 0.1%

Recommended WF:

Discuss candidate options.

Table 29: Companies' comments

Company	Comments
Intel	For number of PRBs we support Option 1 for 120 kHz. Option 2 can be considered for 480 and 960 kHz. For number of OFDM symbols we think one and two OFDM symbols is better from test coverage perspective, but to reduce work load we are fine to consider only 1 symbol.
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	For number of PRBs we support Option 2. (The maximum number of possible PRBs for each format) For Number of OFDM symbols we do not have strong opinion. Option 1 is ok
Huawei	Number of PRBs: Option 3 for 480/960khz and 1RB for 120kHz
Ericsson	If only multi-PRB requirement will be defined for PF1, both 16 and 10 are fine for us for 480k/960kHz SCS.

Issue 2-4-2c: Detailed PUCCH test setup for PUCCH format 2

Tentative agreement: NA

Candidate Options:

Number of PRBs:

- Option 1: 9

Number of OFDM symbols:

- Option 1: 2
- Option 2: 1 and 2

Intra-slot frequency hopping: enabled

Test metric: ACK missed detection rate < 1%, UCI BLER < 1%

Recommended WF:

Discuss candidate options.

Table 30: Companies' comments

Company	**Comments**
Intel	For number of OFDM symbols we think one and two OFDM symbols is better from test coverage perspective, but to reduce work load we are fine to consider only 1 symbol.
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	We propose to use the parameters from FR2-1. Table 8.3.4.1.1-1: Test
Huawei	Number of OFDM symbols: Prefer option 1
Ericsson	We can accept Option 1 with 2 OFDM symbols.

Issue 2-4-2d: Detailed PUCCH test setup for PUCCH format 3

Tentative agreement: NA

Candidate Options:

Number of PRBs:

- Option 1: 1 and 3

Number of OFDM symbols:

- Option 1: 14 and 4
- Option 2: 4

Additional DMRS

- Option 1: With and without

Intra-slot frequency hopping: enabled

Test metric: UCI BLER < 1%

Recommended WF:

Discuss candidate options.

Table 31: Companies' comments

Company	**Comments**
Intel	In our view, combination with 3 PRB with 4 OFDM symbols is enough to reduce workload and verify PUCCH format 3 implementation.
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	We propose to use the parameters from FR2-1. Table 8.3.5.1-1: Test Parameters
Huawei	Share same views with Intel and not consider additional DMRS
Ericsson	We prefer only to consider 3 PRB with 4 symbols regarding potential relative worse performance.

Issue 2-4-2e: Detailed PUCCH test setup for PUCCH format 4

Tentative agreement: NA

Candidate Options:

Number of PRBs:

- Option 1: 16 (Enhanced)
- Option 2: 10 (Enhanced)

Number of OFDM symbols:

- Option 1: 14

Additional DMRS

- Option 1: With and without

Intra-slot frequency hopping: enabled

Test metric: UCI BLER < 1%

Recommended WF:

Discuss candidate options.

Table 32: Companies' comments

Company	**Comments**
Intel	We support Option 1 but also can accept Option 2.
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	For number of PRBs we support Option 1. (The maximum number of possible PRBs for each format) For Number of OFDM symbols we do not have strong opinion. Option 1 is ok
Huawei	Number of PRBs: We prefer option 2 Additional DMRS: We prefer to only define one case and need to cover both DMRS configurations
Ericsson	For PRB number, both 16 and 10 are fine for us.

2.4.5 Sub-topic 2-5: PRACH performance requirements

Issue 2-5-1: Scope of PRACH requirements

Tentative agreement:

Define the following PRACH performance requirements:

- False alarm probability requirements
- PRACH miss detection requirements

Recommended WF:

Confirm tentative agreement

Issue 2-5-2: SCS

Tentative agreement:

PRACH SCS:

- 120, 480 kHz
- FFS 960 kHz

Recommended WF:

Discuss necessity of PRACH requirements with 960 kHz SCS.

Table 33: Companies' comments

Company	**Comments**
Intel	We prefer to consider 960 as well to have the full coverage. If BS will support only 960 kHz there will be no tests to verify it.
Samsung	We support 120KHz and 480KHz
Nokia	We think we should also define requirements for 960 kHz PRACH
Huawei	Same views with Intel
Ericsson	Same comments as Issue 2-1-1.

Issue 2-5-3: Sequence length

Tentative agreement:

PRACH sequence length:

- 120 kHz:
  - 1151, 571
  - FFS 139
- 480 kHz:
  - 571
  - FFS on 139
- 960 kHz:
  - 139

Recommended WF:

Discuss FFS options.

Table 34: Companies' comments

Company	Comments
Samsung	At current stage, we prefer to keep it open, more check is needed
Nokia	We would like to keep 139 as well for 120 and 480 kHz SCS. The reason is that the long sequences might not be used in all scenarios. It is clear the necessity of long PRACH sequences for unlicensed, and in some other scenarios where more robust PRACH detection is desirable. But would also be used in many scenarios for resource optimization since it uses less PRBs.
Huawei	We are OK to cover all supported sequence length for each SCS considering BS may declare supporting different SCS
Ericsson	We think LA=139 could be the baseline for PRACH performance which might be worse comparing to larger sequence. It could be useful to compare with FR2-1. We suggest introducing requirement for LA=139 for both 120kHz and 480kHz SCS.

Issue 2-5-4: PRACH formats

Tentative agreement:

PRACH formats: A2, B4, C2

Recommended WF:

Confirm tentative agreement

Issue 2-5-6: Frequency offset

Tentative agreement: NA

Candidate options:

- Option 1: 7100 Hz

- Option 2: 8000 Hz

Recommended WF:

Discuss candidate options.

Table 35: Companies' comments

Company	Comments
Samsung	If the assumption is 0.1ppm*carrier frequency , option 1 is prefered
Nokia	Both options are acceptable for us
Huawei	Option 1
Ericsson	Prefer Option 1 to align with 0.1ppm FO assumption at 71GHz.

Issue 2-5-7: Time error tolerance

Tentative agreement:

Time error tolerance:

- 0.07us for AWGN
- FFS for multi-path fading

Recommended WF:

Continue discussion considering progress of sub-topic 1-3

Table 36: Companies' comments

Company	Comments
Samsung	Pending on the channel condition for PRACH requirement
Nokia	We prefer to keep it open. As it was discussed in NR-U, the time error tolerance was defined based on the LRA and the channel model used.
Huawei	Support recommended WF

Ericsson	Depend on the conclusion of channel model.

Issue 2-5-8: (Ncs, logical sequence index, v)

Tentative agreement:

Consider the following PRACH parameters as starting point: Ncs = 69, logical sequence index = 0, v =0

Recommended WF:

Confirm tentative agreement

Table 37: Companies' comments

Company	**Comments**
Intel	Support tentative agreement.
Samsung	Ok with tentative agreement as starting point, other options are not precluded
Nokia	Prefer to keep it open and define based on the LRA.
Huawei	Support recommended WF
Ericsson	OK with tentative agreement as start point. Further check is needed.

3 Topic #3: UE performance requirements

3.1 Companies' contributions summary

<table>
<tr><th>T-doc number</th><th>Company</th><th>Proposals / Observations</th></tr>
<tr><td>R4-2204584</td><td>Ericsson</td><td>
Proposal 1: RAN4 defines the UE demodulation and CSI reporting requirements with:

Number of receive antennas: 2Rx
Modulation order: Up to 64QAM
Both single carrier (FR2-2) and NR-DC FR1 + FR2-2 scenarios

Proposal 2: RAN4 defines the UE demodulation requirements with:

FR2-2 TDD: SCS = 120 kHz with min CBW = 100 MHz and Max CBW = 400 MHz
FR2-2 TDD: SCS = 480 kHz with min CBW = 400 MHz and Max CBW = 1600 MHz

Observation 1: In Rel-17, NR operation in FR2-2 will only support Rel-15 patterns for CP-OFDM

Proposal 3: Consider the parametrized phase noise model in [4] and use Rel-15 PTRS pattern for tests.

Proposal 4: Define PDSCH demodulation requirements for UE with the following test setup.
<table>
<tr><th>Assumptions</th><th>Value</th></tr>
<tr><td>Carrier Frequency [GHz]</td><td>70 GHz</td></tr>
<tr><td>Subcarrier Spacing [KHz]</td><td>120 KHz, 480 KHz</td></tr>
<tr><td>Waveform</td><td>CP-OFDM</td></tr>
<tr><td>CP Type</td><td>Normal CP</td></tr>
<tr><td>Channel Model</td><td>TDL model as defined in of TR38.901 Clause 7.7.2:
- TDL-A (5ns, 10ns, 30 ns DS)</td></tr>
<tr><td>Antenna configuration</td><td>For TDL model: 2x2 ULA Low</td></tr>
<tr><td>Velocity</td><td>3 km/h, 30 km/h</td></tr>
<tr><td>PA Model</td><td>None</td></tr>
<tr><td>gNB TRP PN Model</td><td>TR38.803 example 2 BS PN profile and [3] Set 1</td></tr>
<tr><td>UE PN Model</td><td>TR38.803 example 2 UE PN profile and [3] Set 1</td></tr>
<tr><td>Pre-loaded Tx EVM</td><td>0%</td></tr>
<tr><td>Additive Rx EVM</td><td>0%</td></tr>
<tr><td>I-Q Imbalance</td><td>None</td></tr>
<tr><td>Frequency Offset</td><td>0 ppm</td></tr>
<tr><td>Channel Estimation</td><td>Realistic channel estimation</td></tr>
<tr><td>Transmission Rank</td><td>Rank 1 (Rank 2 is FFS)</td></tr>
<tr><td>DMRS Configuration</td><td>2 DMRS symbols at (2,11) symbol index</td></tr>
<tr><td>PTRS Configuration</td><td>For CP-OFDM: (K = 2, L = 1)</td></tr>
<tr><td>CSI-RS / TRS</td><td>CSI-RS/TRS is assumed to be off (for RS overhead)</td></tr>
<tr><td>MCS/TBS</td><td>From MCS Table 1 (TS38.214):
- MCS 7 (QPSK),
- MCS 16 (16QAM),
- [MCS 22] (64QAM).

Note: It is assumed that N_{oh}^{PRB} = 0 for MCS calculations.</td></tr>
</table>
</td></tr>
</table>

Figure 19: Topic #3 UE performance requirements - Companies' contribution summary: part 1

FR2-2 TDD, SCS 120 KHz

Test number	CBW / SCS	MCS and rank	TDD UL/DL pattern	Propagation condition	Antenna configuration	Metric	Reference from TS38.101-4 7.2.2.2.1
1-1 (Note 1)	100MHz / 120kHz	QPSK 0.3 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
1-2 (Note 1)	100MHz / 120kHz	16QAM 0.48 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
1-3 Note 1)	100MHz / 120kHz	64QAM 0.43 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-6
2-1 (Note 1)	400MHz / 120kHz	QPSK 0.3 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
2-2 (Note 1)	400MHz / 120kHz	16QAM 0.48 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
2-3 (Note 1)	400MHz / 120kHz	64QAM 0.43 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-6
3-1	TBD / 120kHz	QPSK 0.3 Rank 2	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
3-2	TBD / 120kHz	16QAM 0.48 Rank 2	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
Note 1	Tests (1,2)-1, (1,2)-2, and (1,2)-3 will consider Rank 1 instead of Rank 2 as stated in TS 38.101-4 Section 7.2.2.2.1.						

Figure 20: Topic #3 UE performance requirements - Companies' contribution summary: part 2

FR2-2 TDD, SCS 480 KHz

Test number	CBW / SCS	MCS and rank	TDD UL/DL pattern	Propagation condition	Antenna configuration	Metric	Reference from TS38.101-4
1-1	400MHz / 480kHz	QPSK 0.3 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
1-2	400MHz / 480kHz	16QAM 0.48 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
1-3	400MHz / 480kHz	64QAM 0.43 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-1	1600MHz / 480kHz	QPSK 0.3 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-2	1600MHz / 480kHz	16QAM 0.48 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-3	1600MHz / 480kHz	64QAM 0.43 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New

Proposal 5: Define PDCCH demodulation requirements for UE in FR2-2 with the following test setup.

FR2-2 TDD, SCS 120 KHz

Test number	CBW (MHz)	CORESET RB	CORESET duration	Aggregation level	Propagation condition	Antenna config	Metric (Pm-dsg)	Reference from TS38.101-4 7.3.2.2
1-1	100	60	1	2	TDL-A (5, 10, 30) ns	1x2 low	1%	1Tx Test 1
1-2	100	60	1	4	TDL-A (5, 10, 30) ns	1x2 low	1%	1Tx Test 2
1-3	100	60	1	8	TDL-A (5, 10, 30) ns	2x2 low	1%	2Tx Test 1
1-4	100	60	2	16	TDL-A (5, 10, 30) ns	2x2 low	1%	2Tx Test 2
2-1	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	1x2 low	1%	New
2-2	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	2x2 low	1%	New

Figure 21: Topic #3 UE performance requirements - Companies' contribution summary: part 3

Proposal 6: Define PBCH demodulation requirements with the following test setup.

Test number	BW / SSB SCS	Propagation condition	Antenna configuration	Metric (Pm-bch)	Reference from TS38.101-4 SS/PBCH block index A : not known B : known
1-1	100 MHz / 120 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	A
1-2	400 MHz / 120 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	B
2-1 (Note 1)	400 MHz / 480 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	A
2-2 (Note 1)	1600 MHz / 480 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	B
Note 1: SSB SCS 480 KHz is new.					

Proposal 7: Define SDR test for UE in FR2-2 considering 2Rx UE.

Proposal 8: Define the CQI reporting definition test for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics.

Proposal 9: Define the wideband CQI reporting under fading condition for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics.

R4-2204834	Nokia, Nokia Shanghai Bell	**Observation 1:** Operation in FR2-2 includes support of 120, 480, and 960 kHz SCS. **Observation 2**: Channel bandwidths of up to 2000 MHz are supported in FR2-2. **Observation 3**: In order to support FR2-2 operation, a UE has to support at least 120 kHz SCS. **Observation 4:** Reduced slot duration and CP length will have an impact on UE demodulation performance.

Figure 22: Topic #3 UE performance requirements - Companies' contribution summary: part 4

Observation 5: For FR2-2 the 120kHz SCS is mandatory.

Observation 6: For FR2-2 the 480/960kHz SCS are optional.

Proposal 1: Specify new UE demodulation and CSI reporting performance requirements for SCS 480kHz and 960kHz, including PDSCH, PDCCH and PBCH.

Observation 7: In FR2-2 there is support for operation of 120 kHz SCS with 100 MHz and 400 MHz channel bandwidth.

Observation 8: In order to take advantage of the benefits of the operation above 52.6 GHz, the support of 400 MHz channel bandwidth for 120 kHz SCS might become more important when comparing to operation in FR2-1.

Proposal 2: Specify new UE demodulation and CSI reporting performance requirements for SCS 120 kHz with 400 MHz channel bandwidth for PDSCH, PDCCH and PBCH.

Proposal 3: Study if new UE demodulation and CSI reporting performance requirements for SCS 120 kHz with 100 MHz channel bandwidth are needed for the operation in FR2-2.

Observation 9: Support of 480 kHz SCS includes channel bandwidths from 400 MHz to 1600 MHz.

Observation 10: Support of 960 kHz SCS includes channel bandwidths from 400 MHz to 2000 MHz.

Proposal 4: RAN4 to specify new UE demodulation and CSI reporting requirements for PDSCH, PDCCH and PBCH with the following SCS and channel bandwidth combinations:

- 480 kHz SCS with 400 MHz, 800 MHz, and 1600 MHz channel bandwidth
- 960 kHz SCS with 400 MHz, 800 MHz, 1600 MHz, and 2000 MHz channel bandwidth

Observation 11: Currently FDL_high may not exceeding 48200 MHz as defined in 38.101-4. This value must be increased to cover the FR2-2 frequency range.

Proposal 5: Increase the FLD_high max frequency to cover FR2-2 frequency bands, i.e. "FDL_high may not exceed 71000 MHz" and reconsider existing requirements if needed.

Observation 12: Higher frequencies used in FR2-2 will result in increased phase error which needs to be considered when defining the performance requirements for FR2-2 for all SCS defined in FR2-2.

Observation 13: Current configuration for PTRS provides the maximum PTRS REs possible in the standard.

Proposal 6: Rederive performance requirements with the maximally dense PTRS configurations for FR2-2 below:

PTRS configuration	Frequency density ($K_{PT\text{-}RS}$)		2
	Time density ($L_{PT\text{-}RS}$)		1
	Resource Element Offset		2

Figure 23: Topic #3 UE performance requirements - Companies' contribution summary: part 5

		Observation 14: Scheduling and link adaptation typically allocates large SCS and MCS in situations with low delay spread. **Observation 15**: Distribution of the delay spread in typical scenarios for operation in FR2-2 are mostly concentrated below 30 ns, with a large part of the samples experiencing delay spread between 10 and 20 ns. **Observation 16:** Existing RAN4 requirements include TDLA30 as the minimum delay spread for fading channels. **Proposal 7**: RAN4 to study the use of TDLA10 and TDLA20 for demodulation requirements with large SCS and high MCS. **Observation 17:** Doppler shift is directly proportional to the carrier frequency; Hence, it should be higher in FR2-2 compared to FR2-1. **Observation 18**: Simulation assumption for FR2 was 30 GHz. **Proposal 8**: We propose to double the doppler shifts in FR2-2 than the ones already used for FR2-1. i.e., TDLAxx-150, and TDLAxx-300.
		Observation 19: SCS of 120kHz is extended to also be part of FR2-2, hence the current requirements for SCS 120kHz might not be sufficient to cover the full FR2 frequency range. **Observation 20:** Based on analysis of impact related to phase noise, channel model doppler and channel bandwidth it can be decided if new requirements for 120kHz SCS in FR2-2 is required or if the existing UE demodulation requirements can be adjusted to cover the full FR2 range (i.e., FR2-1 + FR2-2). **Proposal 9:** Analyse the impact of the FR2-2 frequency range on the existing UE demodulation and CSI reporting performance requirements for SCS of 120kHz. If needed, add new performance requirements for PDSCH, PDCCH and PBCH with FR2-2 using 120kHz SCS. **Proposal 10:** In case new UE demodulation and CSI reporting requirements are needed for 120kHz SCS in FR2-2, update the existing requirements to be valid for FR2-1 only and create separate requirements for FR2-2. **Observation 21:** Multi-PDSCH scheduling by a single DCI has been introduced in Rel.17. However, the scheduled PDSCH resources are independent and as such the same demodulation requirements should apply to each PDSCH instance.

Figure 24: Topic #3 UE performance requirements - Companies' contribution summary: part 6

		Observation 22: The number of HARQ processes has been increase to 32 [4]. There are enough HARQ processes to run the UE demodulation tests without running out of processes and thus starving the transmission pipeline. **Proposal 12:** RAN4 to not have explicit new demod requirements for increased number of HARQ processes. However, RAN4 to take care to specify sufficient HARQ processes for other PDSCH requirements. **Observation 23:** If the channel model is changed for FR2-2 it should be discussed in RAN4 if changes to the CSI reporting requirements will be needed. **Proposal 13**: RAN4 to discuss how changes to the channel models would impact the CSI reporting requirements. **Observation 24**: Deployment scenarios agreed in RF and RRM already include FR2-2 only standalone and CA/NR-DC with FR1 anchor. **Proposal 14**: RAN4 to consider UE demodulation and CSI reporting requirements including the following scenarios: • Standalone FR2-2 only • CA and NR-DC with FR1 anchor and FR2-2.
R4-2205802	Huawei, HiSilicon	**Proposal 1**: Define following performance requirements for UE operating in 71GHz band: • For 120 kHz SCS: PDSCH • For 480 kHz SCS and 960 kHz SCS (Optional with capability signaling): PBCH, PDCCH and PDSCH **Proposal 2:** Use transmission burst model defined in LAA as start point to be discussed and set the gap between two transmission bursts at least to 4/8/16 OFDM symbols for 120/480/960 kHz SCS. Further discuss following test setup: • COT duration
		• LBT failure probability • HARQ feedback • Start symbol and end symbol within the slot **Proposal 3:** Define the UE requirements for max bandwidth for each SCS. i.e. 400 MHz for 120 kHz SCS, 1600 MHz for 480 kHz and 2000 MHz for 960 kHz. **Proposal 4**: Keep the number of transmission RBs open until there are corresponding agreements from RF team. **Proposal 5**: Use 2 receiving antennas. **Proposal 5:** Define two set of PDSCH requirements for license band without LBT mechanism and unlicensed band with LBT mechanism.

Figure 25: Topic #3 UE performance requirements - Companies' contribution summary: part 7

		Proposal 6: Define the PDSCH performance requirements for both rank 1 and rank 2: • Rank 1: DMRS port 1000 is used and configure the RRC signalling indicating UE to assume FDD-OCC is not applied to all the antenna ports for DMRS which is applicable should be configured • Rank 2: DMRS port 1000 and 1002 are used **Proposal 7:** Define the PDSCH performance requirements with following assumptions: • 120 kHz SCS: Single TB scheduling • 480 kHz SCS: 4-TB scheduling • 960 kHz SCS: 8-TB scheduling **Proposal 8:** Define the PDSCH performance requirements by using PN model example 2 defined in TS 38.803. **Proposal 9:** Define the PDSCH performance requirements by using ICI compensation. **Proposal 10:** Use following assumptions for PDCCH performance test. • SCS: 480 kHz and 960 kHz • Antenna configuration: 1T2R and 1T4R • Aggregation level: 2 and 4 for 1T2R; 8 and 16 for 2T2R • PDCCH transmissions: PDCCH is transmitted in the first slot of every four slots for 480 kHz and in the first slot of every eight slots for 960 kHz **Proposal 11**: Use following assumptions for PBCH performance test: • SCS: 480 kHz and 960 kHz • Antenna configuration: 1T2R • SSB index: Known and set it to index 0 • Propagation conditions: TDLA30-75 • TDD
R4-2205918	Intel Corporation	**Observation #1**: Existing FR2-1 UE demodulation performance requirements cover all DL physical channels and have quite broad test coverage from functionality/feature perspective.
		Observation #2: Using of high SCS is beneficial at high carrier frequency to eliminate negative phase noise impact. **Observation #3:** Performance comparison study should be performed to understand whether FR2-1 120 kHz SCS requirements can be reused for FR2-2. New set of requirements should be defined to cover new SCS and CBWs combinations. **Observation #4**: FR2-2 performance requirements should cover licensed and unlicensed operations.

Figure 26: Topic #3 UE performance requirements - Companies' contribution summary: part 8

		Observation #5: In case of FR2-1 requirements reuse for FR2-2, RAN4 needs to discuss applicability of FR2-1 requirements for unlicensed operation. **Proposal #1**: Define FR2-2 UE demodulation requirements that cover licensed and unlicensed operations. **Proposal #2:** Define PDSCH performance requirements with 480 and 960 kHz SCS with multi-slot scheduling by single DCI. **Proposal #3:** Define PDSCH performance requirements for 32 DL HARQ processes with the test metric 30% of maximum throughput. **Proposal #4:** Define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS. **Proposal #5:** Consider 120 kHz SCS with 100 MHz CBW as a baseline scenario for introduction of UE demodulation performance requirements. Define a limited number of test cases for 480 and 960 kHz SCS with 400MHz CBW. Further discuss necessity of requirements introduction for other CBWs considering test setup limitation aspects. **Proposal #6**: Define FR2-2 performance requirements with normal CP only, with 2 Rx antennas, and with 1 and 2 Tx antennas that is selected case by case. **Observation #6:** Higher than 3 dB performance loss is observed for certain FR2-1 performance requirements when carrier frequency is increased to 71 GHz. **Observation #7:** There is a negligible performance difference between PDCCH test cases with 52 and 71 GHz carrier frequencies. **Observation #8:** Typical propagation conditions in FR2-2 are different from FR2-1. **Proposal #7:** Do not reuse FR2-1 performance requirements for FR2-2. **Proposal #8:** Define FR2-2 performance requirements with TDLA 10ns RMS delay spread value and with 200 and 650 Hz max Doppler frequency. **Proposal #9:** Define FR2-2 PDSCH performance requirements according to Tables 2-6.

Figure 27: Topic #3 UE performance requirements - Companies' contribution summary: part 9

Table 1. Requirements for Rank 1 with mapping type A

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70
100/120	16QAM, 0.48	TDLA10-650	2x2 ULA Low	30
100/120	64QAM, 0.46	TDLA10-650	2x2 XPL Medium	70
400/480	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70
400/960	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70

Table 3. Requirements for Rank 2 with mapping type A

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	70
100/120	16QAM, 0.48	TDLA10-650	2x2 ULA Low	70

Table 4. Requirements for Rank 2 for enhanced receiver type 1

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	16QAM, 0.48	TDLA10-200	2x2 ULA Medium	70

Figure 28: Topic #3 UE performance requirements - Companies' contribution summary: part 10

Table 4. Requirements for Rank 2 for enhanced receiver type 1

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	16QAM, 0.48	TDLA10-200	2x2 ULA Medium	70

Table 5. Requirements for Rank 1 with mapping type B

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	70

Table 6. Requirements for 32 DL HARQ processes

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	30

Proposal #10: For FR2-2 120 kHz SCS define the same set of PDCCH performance requirements as in FR2-1 but with the updated channel model.

Proposal #11: Do not define PBCH performance requirements for FR2-2 in Rel-17.

Proposal #12: Define SDR performance requirements for FR2-2.

Proposal #13: Study SNR values applicability in Table 7.5A.1-4: "SNR required to achieve 85% of peak throughput under AWGN conditions" for FR2-2.

Proposal #14: Define CQI reporting requirements only for wideband CQI reporting granularity.

Proposal #15: Study reuse of FR2-1 CQI reporting requirements in Static propagation conditions for FR2-2.

Proposal #16: Define FR2-2 CQI reporting requirements in Fading propagation conditions for FR2-2 with the typical channel model for FR2-2.

Proposal #17: Define FR2-2 PMI reporting requirements with type 1 single panel codebook, rank 1, and wideband PMI reporting granularity.

Proposal #18: Define FR2-2 RI reporting requirements with rank 1 and rank 2, and with low and high antenna correlations.

Proposal #19: Do not define DL performance requirements for CA in FR2-2 in Rel-17.

Figure 29: Topic #3 UE performance requirements - Companies' contribution summary: part 11

3.2 Open issues summary

3.2.1 Sub-topic 3-1: SCS/CBW combinations

Sub-topic description:

New SCS and CBWs were introduced for FR2-2. RAN4 needs to discuss SCS/CBW combinations for requirements definition. Moderator suggest discussing separately SCS and CBW to converge on the required SCS/CBW combinations.

Open issues and candidate options before e-meeting:

Issue 3-1-1: SCS for DL requirements definition

- Proposals
  - Option 1 (Nokia, Huawei, Intel): 120, 480 and 960 kHz
    - Huawei: 120, 480, 960 kHz for PDSCH and 480, 960 kHz for PDCCH/PBCH
  - Option 2 (Ericsson): 120 and 480 kHz
- Recommended WF
  - Collect views in 1st round on required SCS for DL test cases.
  - Check whether it is agreeable to cover at least 120 and 480 kHz SCS
  - Further discuss whether to cover 960 kHz SCS

Feedback Form 36: Issue 3-1-1: SCS for DL requirements

1 – Intel Corporation (UK) Ltd We support Option 1. Propagation conditions and phase noise have different impact on each SCS, hence Rx algorithms can be adjusted for each SCS like channel estimation, phase noise ICI compensation etc.
2 – Nokia We prefer Option 1. Regarding Option 2, we have concerns down prioritizing 960 kHz with the tight schedule that we have. Since we have only two meetings, if we postpone the discussion on 960 kHz, we won't be able to finish these requirements in time.
3 – Apple GmbH We support to only cover 120KHz SCS since that's mandatory. Since both 480KHz and 960KHz are optional, we prefer to de-prioritize them given limited time. But okay to consider at least 480KHz in addition to 120KHz. But definitely not all 3.
4 – HiSilicon Technologies Co. Ltd Option 1

5 – Ericsson LM

Ericsson supports Option 2. SCS 960 KHz is optional and we believe that could be deprioritized at this stage.

6 – Qualcomm Technologies Int

We are also fine with considering 120 and 480kHz with higher priority. For 960kHz there is also a potential issue with the necessity of having a different SCS for SSB in the test

Issue 3-1-2: CBW for DL requirements definition

Moderator recommends paying intention to the on-going discussion on FR2 enhanced OTA test methods [FR2_enhTestMethods] in which initial DL SNR assessment during the demod test is discussed for FR2-2.

- Proposals
  - SCS 120 kHz
    - Option 1 (Nokia, Huawei): 400 MHz
    - Option 2 (Ericsson, Intel): 100 MHz and 400 MHz
  - SCS 480 kHz
    - Option 1 (Nokia): 400 MHz, 800 MHz, and 1600 MHz
    - Option 2 (Ericsson): 400 MHz and 1600 MHz
    - Option 3 (Huawei): 1600 MHz
    - Option 4 (Intel): 400 MHz
  - SCS 960 kHz
    - Option 1 (Nokia): 400 MHz, 800 MHz, 1600 MHz, and 2000 MHz
    - Option 2 (Huawei): 2000 MHz
    - Option 3 (Intel): 400 MHz
- Recommended WF
  - Collect views in 1st round on required CBWs for DL test cases.

Feedback Form 37: Issue 3-1-2: CBW for DL requirements definition

1 – Intel Corporation (UK) Ltd

Main set of FR2-1 UE demodulation requirements is defined for one CBW and one SCS, and limited number of test cover other possible CBWs/SCS combinations. We suggest considering the same approach for FR2-2: Define requirements with 120 kHz and 100 MHz as a main set and limited number of test cases for 120 kHz 400 MHz and 480, 960 kHz + 400 MHz.

2 – Nokia

We understand the concerns of adding requirements for all CBW configurations and can compromise to requirements covering at least the lower and upper bands for each SCS:

SCS 120kHz: Option 2 (100MHz and 400MHz)

SCS 480kHz: Prefer option 1, but can compromise to Option 2 (400MHz and 1600MHz)

SCS 960kHz: Prefer option 1, but can compromise to Option 2+option3 (400MHz and 2000MHz)

3 – Apple GmbH

There is discussion in RF session on optionality of CBWs for FR2-2. We should wait for conclusion on that before we define requirements for all CBW. Also, just like in Rel-15 FR2, we dont need to define requirements for all CBW for SCS.

Based on the RF session the mandatory CBW are:

- 120KHz: 100MHz
- 480KHz: 400MHz
- 960 KHz: 400MHz

We propose that demod requirements are only defined for the above CBW first.

4 – HiSilicon Technologies Co. Ltd

Need more time to check the discussions on supported CBWs from RF session

5 – Ericsson LM

Ericsson supports

Option 2 [NP1] [KT2] for SCS 120 KHz,

Option 2 for SCS 480 KHz, and disagree with Option 3 since the min CBW is mandatory, so it should be considered for performance requirements.

For SCS 960 KHz, Ericsson deprioritizes this SCS, however, if we will go for it, Ericsson will support Option 1 but without including all intermediate CBW.

3.2.2 Sub-topic 3-2: General issues

Sub-topic description

General aspects regardless of DL Physical channel

Open issues and candidate options before e-meeting:

Issue 3-2-1: FR2-1 requirements reuse for 120 kHz SCS

- Proposals
  - Proposal 1 (Intel): Do not reuse FR2-1 performance requirements for FR2-2.

- Proposal 2 (Nokia): Study if new UE demodulation and CSI reporting performance requirements for SCS 120 kHz with 100 MHz channel bandwidth are needed for the operation in FR2-2
- Proposal 3: (Nokia): Analyse the impact of the FR2-2 frequency range on the existing UE demodulation and CSI reporting performance requirements for SCS of 120kHz. If needed, add new performance requirements for PDSCH, PDCCH and PBCH with FR2-2 using 120kHz SCS.
- Proposal 4: (Nokia): In case new UE demodulation and CSI reporting requirements are needed for 120kHz SCS in FR2-2, update the existing requirements to be valid for FR2-1 only and create separate requirements for FR2-2

- Recommended WF
  - Collect views in 1st round.

Feedback Form 38: Issue 3-2-1: FR2-1 requirements reuse for 120 kHz SCS

1 – Intel Corporation (UK) Ltd Our evaluations show that current PDSCH requirements are not applied for FR2-2 due to higher phase noise impact. In addition, we think that another channel model should be considered for FR2-2 with smaller RMS delay spread and higher max Doppler frequency. Therefore, we proposed to not reuse FR2-1 requirements.
2 – Nokia Based on the simulation results provided by Intel, we agree with Proposal 1.
3 – Apple GmbH The requirements from FR2-1 for 120KHz cannot be reused for FR2-2 as the phase noise has different impact depending on carrier frequency.
4 – HiSilicon Technologies Co. Ltd We agree with Proposal 1 since channel model and phase noise model is different
5 – Ericsson LM Ericsson supports Proposal 1 due to PN effects
6 – Qualcomm Technologies Int We think it's best to evaluate applicability of the requirements once we have results and check effective PN impact. For PDSCH this might be of less importance if the channel models or BW combinations change

Issue 3-2-2: General simulation assumptions

- Proposals
  - Proposal 1 (Ericsson): RAN4 defines the UE demodulation and CSI reporting requirements with:
    - Number of receive antennas: 2RxModulation order:

        - Up to 64QAM

    - Proposal 2 (Intel): Define FR2-2 performance requirements with normal CP only, with 2 Rx antennas, and with 1 and 2 Tx antennas that is selected case by case.
    - Proposal 3 (Huawei): Use 2 receiving antennas
    - Proposal 4 (Huawei): Keep the number of transmission RBs open until there are corresponding agreements from RF team

- Recommended WF
    - Collect views in 1st round

Feedback Form 39: Issue 3-2-2: General simulation assumptions

1 – Intel Corporation (UK) Ltd We are fine with all proposals, and suggestion from Nokia on number of RBs for BS (issue 2-3-4) can be considered for UE as well.
2 – Nokia All proposals seems agreeable to us. For proposal 4 results are not expected from RAN1 any time soon, so we need to start simulation on a temporary alignment. Similar to our comment for BS (issue 2-3-4): For the number of PRBs we suggest for the sake of advance of the work for the next meeting to agree on a temporary value. For example, the maximum value that does not violate any CBW possible assuming a 5% or 10% guard band. We propose to discuss (SCS (kHz) CBW (MHz)) = (120 100) (120 400) (480 400) (480 800) (480 1600) (960 400) (960 800) (960 1600) (960 2000) proposed PRBs = (66) (264) (66) (132) (264) (32) (66) (132) (156)
3 – Apple GmbH Proposals 1-3 are fine. For proposal 4, we need to use some assumption to bring simulation results. We propose to wait until end of this meeting and use the numbers agreed in RF session. Another alternative is to use numbers based on current proposals as proposed by Nokia above. Again we propose to define requirements with combinations below: 120KHz: 100MHz - 66PRB 480KHz: 400MHz - 66PRB 960 KHz: 400MHz - 32 PRB
4 – HiSilicon Technologies Co. Ltd We are fine with all proposals and suggestion from Nokia on number of RBs are fine for us

5 – Ericsson LM Ericsson supports Proposal 1, and agrees on Proposals 2, 3 and 4 as well.

Issue 3-2-3: Other

- Proposals
  - Proposal 1 (Nokia): Increase the FLD_high max frequency to cover FR2-2 frequency bands, i.e. "FDL_high may not exceed 71000 MHz" and reconsider existing requirements if needed:
- Recommended WF
  - Collect views in 1st round

Feedback Form 40: Issue 3-2-3: Other

1 – Intel Corporation (UK) Ltd Support proposal 1.
2 – Nokia Support Proposal 1
3 – HiSilicon Technologies Co. Ltd Need more time to check
4 – Ericsson LM Ericsson supports Proposal 1.

3.2.3 Sub-topic 3-3: PDSCH performance requirements

Sub-topic description

Details of PDSCH performance requirements

Open issues and candidate options before e-meeting:

Issue 3-3-1: Detailed scope of PDSCH requirements

Current issue is based on the exact proposed summary tables for PDSCH requirements. Companies may either comment directly to this issue or use issues [3-3-2 – 3-3-8] created in a classical way.

- Proposals
  - Proposal 1 (Ericsson):

- Proposal 2 (Intel): Define FR2-2 PDSCH performance requirements according to Tables 2-6

- Recommended WF
  - Collect views in 1st round

Feedback Form 41: Issue 3-3-1: Detailed scope of PDSCH requirements

1 – Nokia We prefer to discuss these topics, e.g. propagation conditions etc. separately and not as finished tables.
2 – Apple GmbH We should define requirements for mandatory features first.Later discus requirements with other optional features.
3 – HiSilicon Technologies Co. Ltd Same views with Apple and Nokia. Especially, we propose to only focus on basic requirements and de-prioritized optional features such as PDSCH requirements with type B mapping, enhanced receiver type A and 32 DL HARQ processes
4 – Ericsson LM Ericsson supports Proposal 1. We believe that for SCS 120 KHz, max CW = 400 MHz should be examined, and performance requirements should be defined accordingly. For SCS 480 KHz, we can accept to start with min CBW = 400 MHz, which is mandatory, and keep the max CBW = 1600 MHz for later.
5 – Qualcomm Technologies Int We share also other companies' views that we should focus on a limited set of basic requirements at this stage to make it within the work plan constraints. Additional requirements can be included after we have this baseline set

Issue 3-3-2: PDSCH performance requirements for multi-PDSCH scheduling

- Proposals
  - Proposal 1 (Nokia): RAN4 to not include new UE demodulation performance requirements for the feature of Multi-PDSCH scheduled by a single DCI
  - Proposal 2 (Huawei): Define the PDSCH performance requirements with following assumptions:
    - 120 kHz SCS: Single TB scheduling
    - 480 kHz SCS: 4-TB scheduling

        - 960 kHz SCS: 8-TB scheduling

    - Proposal 3 (Intel): Define PDSCH performance requirements with 480 and 960 kHz SCS with multi-slot scheduling by single DCI.

- Recommended WF

    - Collect views in 1st round

Feedback Form 42: Issue 3-3-2: PDSCH performance requirements for multi-PDSCH scheduling

1 – Nokia We do not have a strong preference for proposal 1. We are fine to also have separate requirements for multi-PDSCH scheduled by single DCI, if time remains. However, we see it as lower importance compared to the other topics. We see different reasons from contributions for proposal 2 (use Multi-PDSCH to speed up test) and proposal 3 (add Multi-PDSCH requirements to test the newly added feature), hence we feel proposal 2 should be discussed separately. We also see that the decision on multi-PDSCH is not yet finalized for 480kHz/960kHz SCS in RAN1.
2 – Apple GmbH Focus on mandatory features first for FR2-2 requirements, given the limited time to define performance requirements in Rel-17.
3 – HiSilicon Technologies Co. Ltd We support proposal 2. As discussed in our paper, PDCCH can't be scheduled in every slot for 480kHz/960kHz SCS. Therefore, multi-TB scheduling may help speed up the test.
4 – Ericsson LM Ericsson is open for discussion
5 – Intel Corporation (UK) Ltd According to our understanding of RAn1 UE feature list, support of 480 and 960 kHz SCS assumes support of multi-slot scheduling feature. Therefore, we support proposal 2 and 3.
6 – Qualcomm Technologies Int The impact of this choice on demodulation performance needs to be checked, we can further discuss it

Issue 3-3-3: PDSCH performance requirements with 32 DL HARQ processes

- Proposals

    - Proposal 1 (Intel): Define PDSCH performance requirements for 32 DL HARQ processes with the test metric 30% of maximum throughput

- Proposal 2 (Nokia): RAN4 to not have explicit new demod requirements for increased number of HARQ processes. However, RAN4 to take care to specify sufficient HARQ processes for other PDSCH requirements.

- Recommended WF
  - Collect views in 1st round

Feedback Form 43: Issue 3-3-3: PDSCH performance requirements with 32 DL HARQ processes

1 – Nokia We do not have a strong opinion here. Can also accept Proposal 1. However use of 32 HARQ process should be limited to certain test scenarios, since it is defined as optional UE feature in R1-2200780.
2 – Apple GmbH Focus on mandatory features first for FR2-2 requirements, given the limited time to define performance requirements in Rel-17.
3 – HiSilicon Technologies Co. Ltd Agree with Apple
4 – Ericsson LM Agree with Apple and Huawei, but open for discussion if needed.
5 – Intel Corporation (UK) Ltd Support of 32 HARQ processes impacts soft buffer implementation. It cannot be an issue for BS, but for UE it really important to verify that UE stores all soft bits and makes soft combining. Just one test case is enough for this feature. Support proposal 1.

Issue 3-3-4: Mapping type

- Proposals
  - Proposal 1 (Intel): A and B

- Recommended WF
  - Collect views in 1st round

Feedback Form 44: Issue 3-3-4: Mapping type

1 – Nokia Agree to proposal 1 (to follow legacy)
2 – Apple GmbH Define requirements with Mapping Type A alone.
3 – HiSilicon Technologies Co. Ltd Agree with Apple
4 – Ericsson LM Open for discussions
5 – Intel Corporation (UK) Ltd We suggest using approach from FR2-1 and define most of the requirements with mapping type A and one test with mapping type B.

Issue 3-3-5: Requirements with 30% throughput

- Proposals
  - Proposal 1 (Intel): Define
- Recommended WF
  - Collect views in 1st round

Feedback Form 45: Issue 3-3-5: Requirements with 30% throughput

1 – Nokia Agree to proposal 1 (to follow legacy)
2 – Apple GmbH Only define requirements for 70% max TP.
3 – HiSilicon Technologies Co. Ltd Agree with Apple
4 – Ericsson LM For DL, we do believe that 70% peak throughput is more relevant. 30% case could be considered in UL

5 – Intel Corporation (UK) Ltd Soft buffer implementation is an important aspect for UE architecture hence we proposed to define one test case with 30% throughput test metric. This test should be considered as a part of minimum performance requirements for FR2-2 similar to FR2-1. This issue was discussed in RAN1 and finally RAN1 asked RAN4 to define suitable test cases (R1-1801139).

Issue 3-3-6: Requirements for enhanced receiver type 1

- Proposals
  - Proposal 1 (Intel): Define
- Recommended WF
  - Collect views in 1st round.

Feedback Form 46: Issue 3-3-6: Requirements for enhanced receiver type 1

1 – Nokia Agree to proposal 1 (to follow legacy)
2 – Apple GmbH Dont define requirements for enhancements receiver Type 1. We need not repeat all requirements for FR2-2. Just choose a small set of requirements to cover mandatory features.
3 – HiSilicon Technologies Co. Ltd Agree with Apple
4 – Ericsson LM Agree with Apple and Huawei, but open for discussion if needed.
5 – Intel Corporation (UK) Ltd We are fine to deprioritize requirements for enhanced receiver type 1 considering limited time on performance part.

Issue 3-3-7: MCS, modulation order for PDSCH requirements

- Proposals
  - Proposal 1 (Ericsson): QPSK 0.3, 16QAM, 0.48, 64QAM, 0.43
  - Proposal 2 (Intel): QPSK 0.3, 16QAM, 0.48, 64QAM, 0.46

- Recommended WF
    - Collect views in 2nd round

Feedback Form 47: Issue 3-3-7: MCS, modulation order for PDSCH requirements

1 – Intel Corporation (UK) Ltd We propose to consider the same MCS values for FR2-2 as used in FR2-1 as starting point: MCS 4, MCS 13, MCS 22.
2 – Apple GmbH Proposal 2 to use existing MCS as baseline is fine for us.
3 – HiSilicon Technologies Co. Ltd Proposal 2 is fine for us
4 – Ericsson LM We support both proposals and we would like to maintain MCS moderate, [MCS 22].

Issue 3-3-8: Rank

- Proposals
    - Proposal 1 (Ericsson): Rank 1 (Rank 2 FFS)
    - Proposal 2 (Huawei): Define the PDSCH performance requirements for both rank 1 and rank 2:
        - Rank 1: DMRS port 1000 is used and configure the RRC signalling indicating UE to assume FDD-OCC is not applied to all the antenna ports for DMRS which is applicable should be configured
        - Rank 2: DMRS port 1000 and 1002 are used
    - Proposal 3 (Intel): Rank 1 and 2
- Recommended WF
    - Collect views in 2nd round

Feedback Form 48: Issue 3-3-8: Rank

1 – Intel Corporation (UK) Ltd We support to consider both Rank 1 and Rank 2. As for FD-OCC for Rank 1, we suggest to evaluate both options to understand performance impact because for 120 kHz and 960 kHz observations might be quite different.

2 – Ericsson LM

Ericsson supports Proposal 1. We do believe that Rank 2 should be FFS, since we prioritize SCS 120 KHz and 480 KHz, and would not go for high MCS.

Issue 3-3-9: PTRS configuration

- Proposals
  - Proposal 1 (Ericsson): Use Rel-15 PTRS pattern for tests
  - Proposal 2 (Nokia): Rederive performance requirements with the maximally dense PTRS configurations for FR2-2 below:

- Recommended WF
  - Collect views in 2nd round

Feedback Form 49: Issue 3-3-9: PTRS configuration

1 – Ericsson LM

We support Proposal 1 which encloses Proposal 2, since Rel-15 provides K = 2, L = 1

Issue 3-3-10: Detailed PDSCH configuration

- Proposals
  - Proposal 1 (Ericsson): Define PDSCH demodulation requirements for UE with the following test setup:

- Recommended WF
  - Collect views in 2nd round pending on progress of issues above

Feedback Form 50: Issue 3-3-10: Detailed PDSCH configuration

Issue 3-3-11: Transmission burst model

- Proposals

- Proposal 1 (Huawei): Use transmission burst model defined in LAA as start point to be discussed and set the gap between two transmission bursts at least to 4/8/16 OFDM symbols for 120/480/960 kHz SCS. Further discuss following test setup:
    - COT duration
    - LBT failure probability
    - HARQ feedback
    - Start symbol and end symbol within the slot

- Recommended WF
    - Collect views in 2nd round

Feedback Form 51: Issue 3-3-11: Transmission burst mode

1 – Apple GmbH Dont consider transmission burst model as we propose not to define requirements with LBT failure.
2 – HiSilicon Technologies Co. Ltd We can compromise to not consider LBT failure
3 – Ericsson LM We do not support LBT for FR2-2, but we are open for discussion.
4 – Qualcomm Technologies Int If we introduce LBT, our view is that we can reuse NR-U transmission model used in Rel.16, with updated configuration parameters and we don't need to introduce a complete new model in NR, also in the interest of time

Issue 3-3-12: Rx processing assumptions

- Proposals
    - Proposal 1 (Huawei): Define PDSCH performance requirements by using ICI compensation.

- Recommended WF
    - Collect views in 2nd round

Feedback Form 52: Issue 3-3-12: Rx processing assumptions

1 – Intel Corporation (UK) Ltd At least for high MCS values ICI compensation is required. To evaluate phase noise impact we suggest considering two options: 1) Practical CPE compensation only; 2) Practical CPE + ICI compensation

2 – Ericsson LM We agree that CPE only is not enough for FR2-2, and ICI compensation is needed.
3 – Qualcomm Technologies Int This assumption should be further discussed

FR2-2 TDD, SCS 120 KHz

Test number	CBW / SCS	MCS and rank	TDD UL/DL pattern	Propagation condition	Antenna configuration	Metric	Reference from TS38.101-4 7.2.2.2.1
1-1 (Note 1)	100MHz / 120kHz	QPSK 0.3 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
1-2 (Note 1)	100MHz / 120kHz	16QAM 0.48 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
1-3 Note 1)	100MHz / 120kHz	64QAM 0.43 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-6
2-1 (Note 1)	400MHz / 120kHz	QPSK 0.3 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
2-2 (Note 1)	400MHz / 120kHz	16QAM 0.48 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
2-3 (Note 1)	400MHz / 120kHz	64QAM 0.43 Rank 1	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-6
3-1	TBD / 120kHz	QPSK 0.3 Rank 2	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-1
3-2	TBD / 120kHz	16QAM 0.48 Rank 2	FR2.120-2	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	Test 2-3
Note 1	Tests (1,2)-1, (1,2)-2, and (1,2)-3 will consider Rank 1 instead of Rank 2 as stated in TS 38.101-4 Section 7.2.2.2.1.						

FR2-2 TDD, SCS 480 KHz

Test number	CBW / SCS	MCS and rank	TDD UL/DL pattern	Propagation condition	Antenna configuration	Metric	Reference from TS38.101-4
1-1	400MHz / 480kHz	QPSK 0.3 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
1-2	400MHz / 480kHz	16QAM 0.48 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
1-3	400MHz / 480kHz	64QAM 0.43 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-1	1600MHz / 480kHz	QPSK 0.3 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-2	1600MHz / 480kHz	16QAM 0.48 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New
2-3	1600MHz / 480kHz	64QAM 0.43 Rank 1	TBD	TDL-A (5, 10, 30) ns	2x2 ULA Low	70% of peak rate	New

Figure 30: Proposal 1 (Ericsson): detailed scope of PDSCH requirements

Table 2. Requirements for Rank 1 with mapping type A

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70
100/120	16QAM, 0.48	TDLA10-650	2x2 ULA Low	30
100/120	64QAM, 0.46	TDLA10-650	2x2 XPL Medium	70
400/480	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70
400/960	QPSK, 0.30	TDLA10-650	2x2 ULA Low	70

Table 3. Requirements for Rank 2 with mapping type A

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	70
100/120	16QAM, 0.48	TDLA10-650	2x2 ULA Low	70

Table 4. Requirements for Rank 2 for enhanced receiver type 1

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	16QAM, 0.48	TDLA10-200	2x2 ULA Medium	70

Table 5. Requirements for Rank 1 with mapping type B

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	70

Table 6. Requirements for 32 DL HARQ processes

CBW (MHz)/SCS (kHz)	Modulation and code rate	Propagation conditions	Correlation matrix and antenna configuration	Fraction of maximum throughput
100/120	QPSK, 0.30	TDLA10-200	2x2 ULA Low	30

Figure 31: Proposal 2 (Intel): detailed scope of PDSCH requirements

PTRS configuration	Frequency density ($K_{PT\text{-}RS}$)		2
	Time density ($L_{PT\text{-}RS}$)		1
	Resource Element Offset		2

Figure 32: Proposal 2 (Nokia): PTRS configuration

Assumptions	Value
Carrier Frequency [GHz]	70 GHz
Subcarrier Spacing [KHz]	120 KHz, 480 KHz
Waveform CP Type	CP-OFDM Normal CP
Channel Model	TDL model as defined in of TR38.901 Clause 7.7.2: - TDL-A (5ns, 10ns, 30 ns DS)
Antenna configuration Velocity	For TDL model: 2x2 ULA Low 3 km/h, 30 km/h
PA Model	None
gNB TRP PN Model	TR38.803 example 2 BS PN profile and [3] Set 1
UE PN Model	TR38.803 example 2 UE PN profile and [3] Set 1
Pre-loaded Tx EVM Additive Rx EVM	0% 0%
I-Q Imbalance Frequency Offset	None 0 ppm
Channel Estimation	Realistic channel estimation
Transmission Rank	Rank 1 (Rank 2 is FFS)
DMRS Configuration	2 DMRS symbols at (2,11) symbol index
PTRS Configuration CSI-RS / TRS	For CP-OFDM: (K = 2, L = 1) CSI-RS/TRS is assumed to be off (for RS overhead)
MCS/TBS	From MCS Table 1 (TS38.214): - MCS 7 (QPSK), - MCS 16 (16QAM), - [MCS 22] (64QAM). Note: It is assumed that N_{oh}^{PRB} = 0 for MCS calculations.

Figure 33: Proposal 1 (Ericsson): detailed PDSCH configuration

3.2.4 Sub-topic 3-4: PDCCH performance requirements

Sub-topic description

Details of PDCCH performance requirements

Open issues and candidate options before e-meeting:

Issue 3-4-1: Performance requirements for multi-slot PDCCH monitoring

- Proposals
  - Proposal 1 (Intel): Define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS:
- Recommended WF
  - Collect views in 1st round

Feedback Form 53: Issue 3-4-1: Performance requirements for multi-slot PDCCH monitoring

1 – Apple GmbH Focus on mandatory features first for FR2-2 requirements, given the limited time to define performance requirements in Rel-17.
2 – HiSilicon Technologies Co. Ltd Need more time to check
3 – Ericsson LM Open for discussion

Issue 3-4-2: PDCCH simulation assumptions

- Proposals
  - Proposal 1 (Intel): For FR2-2 120 kHz SCS define the same set of PDCCH performance requirements as in FR2-1 but with the updated channel model.
  - Proposal 2 (Huawei): Use following assumptions for PDCCH performance test.
    - SCS: 480 kHz and 960 kHz
    - Antenna configuration: 1T2R and 1T4R
    - Aggregation level: 2 and 4 for 1T2R; 8 and 16 for 2T2R

- PDCCH transmissions: PDCCH is transmitted in the first slot of every four slots for 480 kHz and in the first slot of every eight slots for 960 kHz

- Proposal 3 (Ericsson): Define PDCCH demodulation requirements for UE in FR2-2 with the following test setup

FR2-2 TDD, SCS 120 KHz

Test number	CBW (MHz)	CORESET RB	CORESET duration	Aggregation level	Propagation condition	Antenna config	Metric (Pm-dsg)	Reference from TS38.101-4 7.3.2.2
1-1	100	60	1	2	TDL-A (5, 10, 30) ns	1x2 low	1%	1Tx Test 1
1-2	100	60	1	4	TDL-A (5, 10, 30) ns	1x2 low	1%	1Tx Test 2
1-3	100	60	1	8	TDL-A (5, 10, 30) ns	2x2 low	1%	2Tx Test 1
1-4	100	60	2	16	TDL-A (5, 10, 30) ns	2x2 low	1%	2Tx Test 2
2-1	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	1x2 low	1%	New
2-2	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	2x2 low	1%	New

FR2-2 TDD, SCS 480 KHz

Test number	CBW (MHz)	CORESET RB	CORESET duration	Aggregation level	Propagation condition	Antenna config	Metric (Pm-dsg)	Reference from TS38.101-4 7.3.2.2
1-1	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	1x2 Low	1%	New
1-2	400	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	2x2 Low	1%	New
2-1	1600	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	1x2 Low	1%	New
2-2	1600	TBD	TBD	TBD	TDL-A (5, 10, 30) ns	2x2 Low	1%	New

Figure 34: Proposal 3 (Ericsson): PDCCH simulation assumptions

- Recommended WF

  - Collect views in 2nd round

Feedback Form 54: Issue 3-4-2: PDCCH simulation assumptions

1 – Ericsson LM

Ericsson supports Proposal 3. About Proposal 2, Ericsson asks Huawei more details on the needed 1T4R for FR2-2.

3.2.5 Sub-topic 3-5: PBCH performance requirements

Sub-topic description

Details of PBCH performance requirements.

Open issues and candidate options before e-meeting:

Issue 3-5-1: PBCH simulation assumptions (if introduced pending on outcome of issues Issue 1-2-2)

- Proposals
  - Proposal 1 (Huawei): Use following assumptions for PBCH performance test:
    - SCS: 480 kHz and 960 kHz
    - Antenna configuration: 1T2R
    - SSB index: Known and set it to index 0
    - Propagation conditions: TDLA30-75
    - TDD:
  - Proposal 2 (Ericsson): Define PBCH demodulation requirements with the following test setup

Test number	BW / SSB SCS	Propagation condition	Antenna configuration	Metric (Pm-bch)	Reference from TS38.101-4 SS/PBCH block index A : not known B : known
1-1	100 MHz / 120 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	A
1-2	400 MHz / 120 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	B
2-1 (Note 1)	400 MHz / 480 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	A
2-2 (Note 1)	1600 MHz / 480 KHz	TDL-A (5, 10, 30) ns	1x2 Low	1%	B
Note 1: SSB SCS 480 KHz is new.					

Figure 35: Proposal 2 (Ericsson): PBCH simulation assumptions

- Recommended WF
  - Collect views in 2nd round

Feedback Form 55: Issue 3-5-1: PBCH simulation assumptions

1 – Ericsson LM

Ericsson supports Proposal 2 where we consider both known and unknown SSB block index. Furthermore, the channel model should be different of FR2-1

3.2.6 Sub-topic 3-6: SDR performance requirements

Sub-topic description

Details of SDR performance requirements

Open issues and candidate options before e-meeting:

Issue 3-6-1: SDR performance requirements (if introduced pending on outcome of issues Issue 1-2-2)

Introduction of SDR requirements is discussed in Sub-topic 1-2

- Proposals
  - Proposal 1 (Intel): Study SNR values applicability in Table 7.5A.1-4: "SNR required to achieve 85% of peak throughput under AWGN conditions" for FR2-2
  - Proposal 2(Ericsson): Define SDR test for UE in FR2-2 ;considering 2 Rx UE

MCS indexes for indicated UE capabilities applicable for FR2-2.

Received antenna	Maximum number of PDSCH MIMO layers	Maximum modulation format	Scaling factor	MCS
2Rx UE	1	6	0.75	[22]
	1	6	0.4	14
	1	4	1	16
	1	4	0.8	16
	1	4	0.75	16
	1	4	0.4	10
	1	2	1	9
	1	2	0.8	9
	1	2	0.75	9
	1	2	0.4	4

Figure 36: Proposal 2 (Ericsson): MCS indexes for indicated UE capabilities applicable for FR2-2

- Recommended WF
  - Collect views in 1st round

Feedback Form 56: Issue 3-6-1: SDR performance requirements

1 – Intel Corporation (UK) Ltd Table 7.5A.1-4 in TS 38.101-4 specified baseband SNR required to achieve 85% in AWGN conditions. Since phase noise has higher impact in FR2-2, analysis on these SNR values applicability for FR2-2 is needed.
2 – Apple GmbH We need to further study and revise the MCS config For SDR requirements.
3 – HiSilicon Technologies Co. Ltd We support to not define SDR test
4 – Ericsson LM We can agree with Apple, that further studies are needed.

3.2.7 Sub-topic 3-7: CSI reporting requirements

Sub-topic description

Details of CSI reporting requirements

Open issues and candidate options before e-meeting:

Issue 3-7-1: Scope of CSI reporting requirements

- Proposals
  - Proposal 1 (Ericsson): Only CQI, PMI is FFS
  - Proposal 2 (Intel): CQI, PMI and RI
- Recommended WF
  - Collect views in 1st round

Feedback Form 57: Issue 3-7-1: Scope of CSI reporting requirements

1 – Intel Corporation (UK) Ltd We suggest having the same test coverage for FR2-2 as in FR2-1 because there can be a dedicated UEs defined for FR2-2 operation. We understand that RAN4 has limited time to define all requirements, but still the minimum functionality should be verified.

2 – Apple GmbH We slightly prefer to de-priortize CSI reporting for FR2-2 given the time. We need to revisit the feedback delay and doppler for FR2-2 to ensure that the parameters give reasonable results. If we must define requirements, only define CQI reporting in AWGN first. Requirements in fading channel need additional work.
3 – HiSilicon Technologies Co. Ltd We propose to postpone the CSI test in next release considering the workload and timeline
4 – Ericsson LM Ericsson supports Proposal 1 but can agree with Apple and Huawei to postpone this task.

Issue 3-7-2: CQI reporting requirements under static propagation conditions

- Proposals
  - Proposal 1 (Ericsson): Define the CQI reporting definition test for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics
  - Proposal 21 (Intel): Study reuse of FR2-1 CQI reporting requirements in Static propagation conditions for FR2-2
- Recommended WF
  - Collect views in 1st round

Feedback Form 58: Issue 3-7-2: CQI reporting requirements under static propagation conditions

1 – Intel Corporation (UK) Ltd In our understanding current FR2-1 CQI reporting requirements under static propagation conditions can be also applied for FR2-2. We suggest analyzing this for the next meeting.
2 – Apple GmbH Reusing CQI reporting requirements from FR2 for 120KHz for FR2-2 might work. Suggest that as a starting point.
3 – HiSilicon Technologies Co. Ltd We propose to postpone it in next release
4 – Ericsson LM Ericsson supports Proposal 1 (both proposals can converge). However, we are fine to postpone this as suggested by Huawei.

Issue 3-7-3: CQI reporting requirements under fading propagation conditions

- Proposals
    - Proposal 1 (Intel): Define FR2-2 CQI reporting requirements in Fading propagation conditions for FR2-2 with the typical channel model for FR2-2
    - Proposal 2 (Nokia): RAN4 to discuss how changes to the channel models would impact the CSI reporting requirements
    - Proposal 3 (Ericsson): Define the wideband CQI reporting under fading condition for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics
- Recommended WF
    - Collect views in 1st round

Feedback Form 59: Issue 3-7-3: CQI reporting requirements under fading propagation conditions

1 – Intel Corporation (UK) Ltd Support proposal 3. Also, channel model should be changed to more typical configuration as mentioned in Proposals 1 and 2.
2 – Apple GmbH Dont define requirements in fading channels.
3 – HiSilicon Technologies Co. Ltd We propose to postponing it in next release
4 – Ericsson LM [Option 1] Ericsson supports Proposal 3 while all proposals can converge. [Option 2] We can postpone this task as suggested by Huawei

Issue 3-7-4: Simulation assumptions for CQI reporting requirements

- Proposals
    - Proposal 1 (Ericsson): 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics
    - Proposal 2 (Intel): Define CQI reporting requirements only for wideband CQI reporting granularity
- Recommended WF
    - Collect views in 2nd round

Feedback Form 60: Issue 3-7-4: Simulation assumptions for CQI reporting requirements

1 – Ericsson LM Ericsson supports Proposal 1.

Issue 3-7-5: Simulation assumptions for PMI reporting requirements

- Proposals
  - Proposal 1 (Intel): Define FR2-2 PMI reporting requirements with type 1 single panel codebook, rank 1, and wideband PMI reporting granularity
- Recommended WF
  - Collect views in 2nd round

Feedback Form 61: Issue 3-7-5: Simulation assumptions for PMI reporting requirements

Issue 3-7-6: Simulation assumptions for RI reporting requirements

- Proposals
  - Proposal 1 (Intel): Define FR2-2 RI reporting requirements with rank 1 and rank 2, and with low and high antenna correlations
- Recommended WF
  - Collect views in 2nd round

Feedback Form 62: Issue 3-7-6: Simulation assumptions for RI reporting requirements

3.3 Summary for 1st round

3.3.1 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.

Table 38: First round summary for Topic #3

	Summary

Sub-topic 3-1: SCS/CBW combinations	**Issue 3-1-1: SCS for DL requirements definition** All companies support 120 kHz and 480 kHz. More discussion is needed on 960 kHz **Tentative agreement**: Consider the following SCS for DL requirements definition: - 120, 480 kHz - FFS 960 kHz **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion on necessity of requirements with 960 kHz SCS.

	Issue 3-1-2: CBW for DL requirements definition
	Diverse views on the required CBW. For 120 kHz SCS four companies support 100 MHz and 3 companies 400 MHz also. For 480 kHz four companies support 400 MHz and 2 companies 1600 MHz also. For 960 kHz SCS four companies support 400 MHz and 2 companies 2000 MHz also. Further discussion is needed.
	Tentative agreement:
	- 120 kHz:
	  ○ 100, 400 MHz
	- 480 MHz:
	  ○ 400 MHz
	  ○ FFS on 1600 MHz
	- 960 kHz:
	  ○ 400 MHz
	  ○ FFS on 2000 MHz
	Candidate options: NA
	Recommendations for 2nd round:
	Discuss FFS options.

Sub-topic 3-2: General issues	**<u>Issue 3-2-1: FR2-1 requirements reuse for 120 kHz SCS</u>** Five companies support proposal 1. **Tentative agreement**: Do not apply FR2-1 performance requirements for FR2-2. **Candidate options: NA** **Recommendations for 2nd round: NA**
	<u>Issue 3-2-2: General simulation assumptions</u> All companies agreed with proposed options and with suggestion on the temporary PRB number for each CBW. PRB number will be updated once RF room reaches corresponding agreement. **Tentative agreement**: Consider the following simulation assumptions at starting point for PDSCH performance requirements: - Normal CP - 1 and 2 Tx antennas and 2 Rx antennas - Up to 64QAM modulation order - Temporary PRB number: ○ (66)(264)(66)(132)(264)(32)(66)(132)(156) for SCS (kHz CWB (MHz)) = (120 100)(120 400)(480 400) (480 800)(480 1600)(960 400)(960 800)(960 1600)(960 2000) **Candidate options: NA** **Recommendations for 2nd round: NA**
	<u>Issue 3-2-3: Other</u> Three companies support proposal 1. One company prefer more time to check. **Tentative agreement**: Increase the FLD_high max frequency to cover FR2-2 frequency bands, i.e. "FDL_high may not exceed 71000 MHz" and reconsider existing. **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement.

Sub-topic 3-3: PDSCH performance requirements	**<u>Issue 3-3-1: Detailed scope of PDSCH requirements</u>** No need to reach agreement on this issue. **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round: NA**

	<u>Issue 3-3-2: PDSCH performance requirements for multi-PDSCH scheduling</u>
	Different views were received on this issue. More discussion is needed.
	Tentative agreement: **NA**
	Candidate options:
	- Option 1: Define PDSCH performance requirements with the following assumptions:
	  ○ 120 kHz SCS: Single TB scheduling
	  ○ 480 kHz SCS: 4-TB scheduling
	  ○ 960 kHz SCS: 8-TB scheduling
	- Option 2: Do not define PDSCH performance requirements with multi-TB scheduling
	Recommendations for 2nd round:
	Continue discussion based on the candidate options

	<u>Issue 3-3-3: PDSCH performance requirements with 32 DL HARQ processes</u> Different views were received on this issue. More discussion is needed. **Tentative agreement**: **NA** **Candidate options:** - Option 1: Define one test case to verify PDSCH performance with 32 DL HARQ processes with the test metric 30% of maximum throughput. - Option 2: Do not define requirements for PDSCH with 32 DL HARQ processes. **Recommendations for 2nd round:** Continue discussion based on the candidate options

	Issue 3-3-4: Mapping type All companies agreed to consider at least mapping type A. More discussion is needed on mapping type B. **Tentative agreement**: - Define PDSCH requirements with mapping type A - FFS define PDSCH test case to verify mapping type B processing. **Candidate options: NA** **Recommendations for 2nd round:** Discuss necessity of requirement for mapping type B.
	Issue 3-3-5: Requirements with 30% throughput Different views were received on this issue. More discussion is needed. **Tentative agreement**: **NA** **Candidate options:** - Option 1: Define PDSCH requirement with 30% throughput. - Option 2: Do not define PDSCH requirement with 30% throughput. **Recommendations for 2nd round:** Continue discussion considering above options.
	Issue 3-3-6: Requirements for enhanced receiver type 1 Companies are converged to not defined requirements for enhanced receiver type 1. **Tentative agreement**: Do not define PDSCH requirements with enhanced receiver type 1. **Candidate options: NA** **Recommendations for 2nd round: NA**

	Issue 3-3-7: MCS, modulation order for PDSCH requirements MCS 4 and 13 can be agreed. More discussion is needed on MCS with 64QAM **Tentative agreement**: Define PDSCH requirements with MCS 4, MCS 13, and MCS [22] **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement and discuss MCS value to cover 64QAM
	Issue 3-3-8: Rank More discussion is needed on Rank 2 and FD-OCC dispreading **Tentative agreement**: Define PDSCH requirements with: - Rank 1 ○ FFS FD-OCC is not applied to all the antenna ports for DMRS - FFS Rank 2 **Candidate options: NA** **Recommendations for 2nd round:** Discussed FFS aspects. More details on FD-OCC issue is encouraged to be provided.
	Issue 3-3-9: PTRS configuration More discussion is needed. Same time proposal 1 and 2 are same and can be collapse to one option. **Tentative agreement**: Consider PTRS configuration as K=2, L=1 **Candidate options: NA** **Recommendations for 2nd round:** Confirm tentative agreement.
	Issue 3-3-10: Detailed PDSCH configuration Proposal 1 should be rederived considering progress of other issues **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round:** Continue discussion in 2nd round considering progress of other issues.

	Issue 3-3-11: Transmission burst model Two options are on table after first round discussion. **Tentative agreement**: **NA** **Candidate options:** - Option 1: Use transmission burst model defined in LAA as start point to be discussed and set the gap between two transmission bursts at least to 4/8/16 OFDM symbols for 120/480/960 kHz SCS. - Option 2: Use Rel-16 NR-U Transmission burst model **Recommendations for 2nd round** Continue discussion in 2nd round considering progress of issue 1-2-4.
	Issue 3-3-12: Rx processing assumptions Limited number of comments. **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion
Sub-topic 3-4: PDCCH performance requirements	**Issue 3-4-1: Performance requirements for multi-slot PDCCH monitoring** More discussion is needed. **Tentative agreement**: **NA** **Candidate options:** - Option 1: Define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS - Option 2: Do not define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS **Recommendations for 2nd round** Continue discussion based on the candidate options
	Issue 3-4-2: PDCCH simulation assumptions Limited number of comments. One question was raised regarding the purpose of introduction requirements with 4Rx. **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion. Provide feedback on the raised question.

Sub-topic 3-5: PBCH performance requirements	**PBCH simulation assumptions (if introduced pending on outcome of issues Issue 1-2-2)** Limited number of comments. **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion considering proposal in issue 1-2-2 to define PBCH requirements only with unknown index.
Sub-topic 3-6: SDR performance requirements	**Issue 3-6-1: SDR performance requirements (if introduced pending on outcome of issues Issue 1-2-2** Companies suggest to have more study if requirements will be introduced. **Tentative agreement**: If requirements will be introduced, study MCS configuration applicability for FR2-2 from FR2-1 and SNR values to achieve 85% throughput. **Candidate options: NA** **Recommendations for 2nd round: NA**
Sub-topic 3-7: CSI reporting requirements	**Issue 3-7-1: Scope of CSI reporting requirements** Three companies prefer to deprioritize CQI reporting requirements at least with fading conditions, PMI and RI reporting requirements introduction. **Tentative agreement**: - Define CQI reporting requirements under static propagation conditions. ○ FFS CQI reporting requirement under multi-path fading conditions - FFS PMI reporting requirements introduction - FFS RI reporting requirements introduction **Candidate options: NA** **Recommendations for 2nd round:** Discuss FFS aspects

	Issue 3-7-2: CQI reporting requirements under static propagation conditions All companies agreed on proposal 1 and 2 as baseline assumption if such requirement will be introduced **Tentative agreement**: Define the CQI reporting definition test for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics **Candidate options: NA** **Recommendations for 2nd round: NA**
	Issue 3-7-3: CQI reporting requirements under fading propagation conditions All companies agreed on proposal 1, 2, and 3 if such requirement will be introduced **Tentative agreement**: Define the wideband CQI reporting under fading condition for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics **Candidate options: NA** **Recommendations for 2nd round:** Confirm or remove tentative agreement considering progress of issue 3-7-1.
	Issue 3-7-4: Simulation assumptions for CQI reporting requirements Limited number of comments. **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion considering progress of other issues
	Issue 3-7-5: Simulation assumptions for PMI reporting requirements No comments **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion considering progress of issue 3-7-1
	Issue 3-7-6: Simulation assumptions for RI reporting requirement No comments **Tentative agreement**: **NA** **Candidate options: NA** **Recommendations for 2nd round** Continue discussion considering progress of issue 3-7-1

3.4 Discussion on 2nd round (if applicable

3.4.1 Sub-topic 3-1: SCS/CBW combinations

Issue 3-1-1: SCS for DL requirements definition

Tentative agreement:

Consider the following SCS for DL requirements definition:

- 120, 480 kHz
- FFS 960 kHz

Recommended WF:

Continue discussion on necessity of requirements with 960 kHz SCS.

Table 39: Companies' comments

Company	Comments
Intel	Definition of single test with 960 kHz will not be a bottleneck from discussion and workload perspective, Therefore, to have full SCS coverage we prefer to define test with 960 kHz.
Apple	We doubt that it will be single test case J We already see 2 options below for different CBW. Prefer to only have requirements for 120 and 480 SCS initially
Nokia	We prefer to keep 960 kHz We think it is important to have requirements for 960 kHz considering that this is the only SCS that allows for the maximum bandwidth used in FR2-2. If we want to have deployments with 2000 MHz they will have to use 960 kHz, and therefore we would like to have demodulation requirements for testing it.
Huawei	We prefer to consider 960kHz SCS to have full SCS coverage
Ericsson	Support tentative agreement

Issue 3-1-2: CBW for DL requirements definition

Tentative agreement:

120 kHz:

- 100, 400 MHz

480 MHz:

- 400 MHz
- FFS on 1600 MHz

960 kHz:

- 400 MHz
- FFS on 2000 MHz

Recommended WF:

Discuss FFS options.

Table 40: Companies' comments

Company	**Comments**
Intel	We are fine to keep max CBW FFS at this stage. There is on-going discussion on FR2-2 demod test methods, and it is already understandable that max SNR during the test is quite limited in FR2-2. Therefore, such high CBWs as 1.6 and 2 GHz might not be testable. Need more time to check this.
Apple	We prefer to limit the requirements to minimum CBW for both 120 and 480 KHz. We very well know that performance doesn't change at higher SCS.
Nokia	We are ok to compromise on our initial position, and test maximum and minimum BW. So we would prefer to already agree on 1600 and 2000 MHz with applicability rule (like in R15/16) to test smallest and widest CBW declared to be supported
Huawei	We propose to keep max CBW FFS and discuss it next meeting,

Ericsson	For SCS 120 KHz: We support the tentative agreement. For SCS 480 KHz: DL requirements should be defined for CBW = 400 MHz (since the min CBW is madatory). However, we can make DL requirements for max CBW = 1600 MHz FFS, and wait for more progress on RF (to assess the large BW case). For SCS 960 KHz: We deprioritize it.

3.4.2 Sub-topic 3-2: General issues

Issue 3-2-1: FR2-1 requirements reuse for 120 kHz SCS

Tentative agreement:

Do not apply FR2-1 performance requirements for FR2-2.

Recommended WF:

Tentative agreement seems agreeable.

Table 41: Companies' comments

Company	Comments
Nokia	We support the tentative agreement.
Ericsson	Support tentative agreement

Issue 3-2-2: General simulation assumptions

Tentative agreement:

Consider the following simulation assumptions at starting point for PDSCH performance requirements:

- Normal CP
- 1 and 2 Tx antennas and 2 Rx antennas
- Up to 64QAM modulation order
- Temporary PRB number:
  - (66)(264)(66)(132)(264)(32)(66)(132)(156) for SCS (kHz CWB (MHz)) = (120 100)(120 400)(480 400) (480 800)(480 1600)(960 400)(960 800)(960 1600)(960 2000)

Recommended WF:

Tentative agreement seems agreeable.

Table 42: Companies' comments

Company	Comments
Intel	Support tentative agreement. Only PRB number should be updated considering agreement in RF session.
Apple	We have many combinations already. We propose to limit to: 120KHz-100MHz 480KHz -400MHz We agree that we should wait for decision in RF session to finalize values, but this should eb okay for initial simulations.
Nokia	We support the tentative agreement.
Huawei	Support tentative agreement.
Ericsson	Support: - Normal CP, - 1 and 2 Tx antennas and 2 Rx antennas, - Up to 64QAM modulation order For PRB number, we can use the tentative PRB numbers for simulations, as follow PRB number for (SCS 120 KHz, CBW in MHz) (120, 100) = 66, (120, 400) = 264 PRB number for (SCS 480 KHz, CBW in MHz) (480, 400) = 66, (480, 1600) based on Issue 3-1-2 discussion outcomes,while we will draw conclusion to set the performance requirements later, upon the obtained results and the RF conclusions

Issue 3-2-3: Other

Tentative agreement:

Increase the FLD_high max frequency to cover FR2-2 frequency bands, i.e. "FDL_high may not exceed 71000 MHz" and reconsider existing.

Recommended WF:

Tentative agreement seems agreeable.

Table 43: Companies' comments

Company	**Comments**
Apple	Where is this to be captured?
Nokia	We support the tentative agreement. Clarification to Apple from 38.101-4: 7.1.1 Applicability of requirements 7.1.1.1 General The minimum performance requirements are applicable for the FR2 operating bands defined in TS 38.101-2 [7] with FDL_high not **exceeding 40000 MHz**
Ericsson	Support tentative agreement

3.4.3 Sub-topic 3-3: PDSCH performance requirements

Issue 3-3-2: PDSCH performance requirements for multi-PDSCH scheduling

Tentative agreement: NA

Candidate options:

Option 1: Define PDSCH performance requirements with the following assumptions:

- 120 kHz SCS: Single TB scheduling
- 480 kHz SCS: 4-TB scheduling
- 960 kHz SCS: 8-TB scheduling

Option 2: Do not define PDSCH performance requirements with multi-TB scheduling

Recommended WF:

Continue discussion based on the candidate options.

Table 44: Companies' comments

Company	**Comments**
Intel	We support Option 1. Multi TB scheduling is mandatory to be supported if UE supports 960 or 480 kHz SCS.
Apple	We support option 2. We would like to wait for RAN1 discussion of UE feature as its not captured in last meeting's version that its mandatory.

Nokia	Prefer to wait RAN1 definition on whether multi-PDSCH scheduling is mandatory for 480/960 kHz SCS. In addition, using 4/8 TB scheduling would require 32 DL HARQ processes to not have HARQ starvation and support of 32 DL HARQ processes are optional for UE. We prefer Option 2, as long as support of 32 HARQ processes are optional. In case requirements is introduced option1 should be changed to: Option 1: Define multi-PDSCH performance requirements with the following assumptions: - 120 kHz SCS: Single TB scheduling - 480 kHz SCS: 4-TB scheduling - 960 kHz SCS: 8-TB scheduling To secure special requirements are created to this purpose on top of the standard PDSCH performance requirements.
Huawei	Option 1. Same views with Intel. Same time, HARQ bundling should also be verfied
Ericsson	Support Option 2

Issue 3-3-3: PDSCH performance requirements with 32 DL HARQ processes

Tentative agreement: NA

Candidate options:

Option 1: Define one test case to verify PDSCH performance with 32 DL HARQ processes with the test metric 30% of maximum throughput.

Option 2: Do not define requirements for PDSCH with 32 DL HARQ processes

Recommended WF:

Continue discussion based on the candidate options.

Table 45: Companies' comments

Company	Comments

Apple	Option 2. We should focus on mandatory features first before introducing requirements with optional features.
Nokia	Support Option 1.
Huawei	Option 2
Ericsson	Support Option 2

Issue 3-3-4: Mapping type

Tentative agreement:

Define PDSCH requirements with mapping type A

FFS define PDSCH test case to verify mapping type B processing.

Recommended WF:

Discuss necessity of requirement for mapping type B.

Table 46: Companies' comments

Company	**Comments**
Intel	Similar to FR2-1 we suggest define one test case to verify mapping type B.
Apple	Only define requirements with mapping Type A. We should focus on mandatory features first before introducing requirements with optional features.
Nokia	We would prefer to also define test case for verification of type B.
Huawei	We prefer to only define requirements for mapping A to reduce test number.
Ericsson	We believe that it could be useful to define requirements for mapping type B

Issue 3-3-5: Requirements with 30% throughput

Tentative agreement: NA

Candidate options:

Option 1: Define PDSCH requirement with 30% throughput.

Option 2: Do not define PDSCH requirement with 30% throughput.

Recommended WF:

Continue discussion based on the candidate options.

Table 47: Companies' comments

Company	Comments
Intel	In our understanding PDSCH requirement with 30% throughput is a part of minimum UE requirements that were introduced for FR1 and FR2-1 in Rel-15. Therefore, we recommend defining similar test for FR2-2.
Apple	We have limited time to define requirements for FR2-2 and in addition we need to evaluate PN impact and we have a large set of requirements . We think we can de-prioritize requirements with 30% Max TP.
Nokia	30% throughput requirements are related to soft HARQ processing. Since 32 HARQ processes are optional, this would only apply for 16 HARQ processes. We prefer to include requirements for 30% throughput, but the number of HARQ processes defined should be discussed. Potentially, since 32 HARQ processes is optional we need one test with 16 HARQ processes and another with 32, depending on the outcome of Issue 3-3-4.
Huawei	Option 2. We prefer to only consider minimum set of test cases.
Ericsson	Support Option 1 where we could define one PDSCH requirement for that, in order to test HARQ combining more thoroughly

Issue 3-3-6: Requirements for enhanced receiver type 1

Tentative agreement:

Do not define PDSCH requirements with enhanced receiver type 1.

Recommended WF:

Confirm tentative agreement

Table 48: Companies' comments

Company	Comments
Ericsson	Support tentative agreement

Issue 3-3-7: MCS, modulation order for PDSCH requirements

Tentative agreement:

Define PDSCH requirements with MCS 4, MCS 13, and MCS [22]

Recommended WF:

Confirm tentative agreement and discuss MCS value to cover 64QAM

Table 49: Companies' comments

Company	Comments
Intel	MCS 22 can be too high from testability perspective. Can we consider MCS 18 as starting point similar to FR2-1 requirements?
Apple	We are okay with Intel's suggestion.
Nokia	Agree with tentative agreement., If it is identified that MCS 22 has testability issues, come back and analyse the feasible MCS options.
Huawei	We have same concern with Intel. We prefer to use MCS 19 as starting point similar to FR2-1 requirements.
Ericsson	Support tentative agreement

Issue 3-3-8: Rank

Tentative agreement:

Define PDSCH requirements with:

- Rank 1
    - FFS FD-OCC is not applied to all the antenna ports for DMRS

- FFS Rank 2

Recommended WF:

Discussed FFS aspects. More details on FD-OCC issue are encouraged to be provided.

Table 50: Companies' comments

Company	Comments
Intel	Can proponent company of FD-OCC provide more details on this issue. At this stage, prefer to keep this issue open until next meeting.
Apple	Rank 1 only. Same question as Intel
Huawei	Based on the evaluation from RAN 1, OCC dispread will have performance degradation for PDSCH with 480/960 kHz, so RAN 1 introduced the new RRC signalling to inform UE not perform FD-OCC dispreading. We think it is an import feature to be verified. But we are OK to keep it FFS and discuss it in next meeting
Ericsson	Support tentative agreement

Issue 3-3-9: PTRS configuration

Tentative agreement:

Consider PTRS configuration as K=2, L=1

Recommended WF:

Tentative agreement seems agreeable.

Table 51: Companies' comments

Company	Comments
Ericsson	Support Rel-15 PTRS (enclosing PTRS density K = 2, L = 1)

Issue 3-3-11: Transmission burst model (This issue can be removed pending on Issue 1-2-4)

Tentative agreement: NA

Candidate options:

Option 1: Use transmission burst model defined in LAA as start point to be discussed and set the gap between two transmission bursts at least to 4/8/16 OFDM symbols for 120/480/960 kHz SCS.

Option 2: Use Rel-16 NR-U Transmission burst model

Recommended WF:

Continue discussion in 2nd round considering progress of issue 1-2-4.

Table 52: Companies' comments

Company	Comments
Apple	We are confused as to why we discuss this based on agreement that we don't define requirements with LBT. We don't need to discuss the transmission burst model in our opinion.
Ericsson	We do not need to include LBT.

Issue 3-3-12: Rx processing assumptions

Tentative agreement: NA

Candidate options:

Option 1: Define PDSCH performance requirements by using ICI compensation

Recommended WF:

Continue discussion.

Table 53: Companies' comments

Company	Comments
Intel	Support Option 1. Same time if companies think that more study is needed, we are fine to provide results with CPE only and with CPE + ICI compensation.
Huawei	Support option 1. We are fine to provide results with CPE only and with CPE+ICI compensation.

Ericsson	We believe that PN effects will be accentuated in FR2-2, and that CPE compensation only would not be enough. We suggest further investigations considering both CPE compensation only and with ICI compensation. Conclusions should be drawn to define the PDSCH requirements.
Qualcomm	We would like to further discuss this in the next meeting;

3.4.4 Sub-topic 3-4: PDCCH performance requirements

Issue 3-4-1: Performance requirements for multi-slot PDCCH monitoring

Tentative agreement: NA

Candidate options:

Option 1: Define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS

Option 2: Do not define performance requirements for multi-slot PDCCH monitoring for 480 and 960 kHz SCS

Recommended WF:

Continue discussion based on the candidate options.

Table 54: Companies' comments

Company	Comments
Apple	Option 2. Same comment as multi-slot PDSCH scheduling.
Huawei	Based on our understanding, PDCCH can only be transmitted in one slot every four slots for 480kHz SCS and in one slot every eight slots for 960kHz SCS. We can use this as baseline assumption and deprioritize the PDCCH monitoring configuration since it has no impact on performance
Ericsson	Need more time to opt.

Issue 3-4-2: PDCCH simulation assumptions

Tentative agreement: NA

Candidate options:

Use following assumptions for PDCCH performance test.

- Antenna configuration:
  - Option 1: 1T2R and 1T4R
  - Option 2: 1T2R and 2T4R
- Aggregation level: 2 and 4 for 1T2R; 8 and 16 for 2T2R

Recommended WF:

Continue discussion. Provide feedback on the raised question regarding the purpose of introduction requirements with 4Rx.

Table 55: Companies' comments

Company	**Comments**
Apple	1T2R is sufficient. Why do we need requirements for 4Rx?
Huawei	We prefer to only consider 2Rx now
Ericsson	Support Antenna config: 1T2R and 2T2R Aggregation level: 2 and 4 for 1T2R, and 8 and 16 for 2T2R

3.4.5 Sub-topic 3-5: PBCH performance requirements

PBCH simulation assumptions (if introduced pending on outcome of issues Issue 1-2-2)

Tentative agreement: NA

Candidate options:

SSB Index:

- Option 1: Known and set it to index 0
- Option 2: Known and not known

Recommended WF:

Continue discussion considering proposal in issue 1-2-2 to define PBCH requirements only with unknown index.

Table 56: Companies' comments

Company	Comments
Apple	The options don't reflect the options in 1-2-2. We prefer to only define it for unknown case.
Nokia	Option 1 and 2 are not matching Option 1 from Issue 1-2-2. So we think it should be either Option 2, or Option 3: Option 3: Not known
Huawei	We prefer to only consider known index as discussed in issue 1-2-2
Ericsson	We support Option 2, while we accept to postpone this discussion for next meetings.
Qualcomm	Choose either known or not known based on SCS configuration;

3.4.6 Sub-topic 3-6: SDR performance requirements

Issue 3-6-1: SDR performance requirements (if introduced pending on outcome of issues Issue 1-2-2

Tentative agreement:

If requirements will be introduced, study MCS configuration applicability for FR2-2 from FR2-1 and SNR values to achieve 85% throughput.

Recommended WF:

Confirm tentative agreement.

Table 57: Companies' comments

Company	Comments
Intel	Support tentative agreement.
Apple	We support the tentative agreement.
Huawei	Support tentative agreement
Ericsson	Support tentative agreement
Qualcomm	We are fine with the tentative agreement

3.4.7 Sub-topic 3-7: CSI reporting requirements

Issue 3-7-1: Scope of CSI reporting requirements

Tentative agreement:

Define CQI reporting requirements under static propagation conditions.

- FFS CQI reporting requirement under multi-path fading conditions

FFS PMI reporting requirements introduction

FFS RI reporting requirements introduction

Recommended WF:

Discuss FFS aspects.

Table 58: Companies' comments

Company	Comments
Intel	At least CQI reporting requirements should be defined. If such prioritization is made, we prefer to have both static and fading propagation conditions.
Apple	We have concerns on the UE speed we need to use to achieve reasonable performance with CQI feedback. In FR2-1 we define requirements with 5Hz Doppler. We don't think its reasonable to go lower that that!
Huawei	We propose to deprioritize CSI test considering work burden
Ericsson	Support tentative agreement, and wait for channel model agreement.
Qualcomm	We are okay with prioritizing static CQI reporting requirements

Issue 3-7-2: CQI reporting requirements under static propagation conditions

Tentative agreement:

Define the CQI reporting definition test for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics.

Recommended WF:

Confirm tentative agreement.

Table 59: Companies' comments

Company	Comments
Intel	Support tentative agreement
Apple	We support the tentative agreement.
Ericsson	Support tentative agreement.

Issue 3-7-3: CQI reporting requirements under fading propagation conditions

Tentative agreement:

Define the wideband CQI reporting under fading condition for 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics.

Recommended WF:

Confirm or remove tentative agreement considering progress of issue 3-7-1.

Table 60: Companies' comments

Company	Comments
Intel	Support tentative agreement
Apple	Do not introduce requirements. Same comments as 3-7-1.
Ericsson	Support tentative agreement

Issue 3-7-4: Simulation assumptions for CQI reporting requirements

Tentative agreement: NA

Candidate Options:

Option 1: 2Rx UE with CQI table 1 (64QAM) by reusing the existing test setup and metrics

Option 2: Define CQI reporting requirements only for wideband CQI reporting granularity

Recommended WF:

Continue discussion considering progress of other issues

Table 61: Companies' comments

Company	Comments
Apple	Do not introduce requirements. Same comments as 3-7-1.

Issue 3-7-5: Simulation assumptions for PMI reporting requirements

Tentative agreement: NA

Candidate Options:

Option 1: Define FR2-2 PMI reporting requirements with type 1 single panel codebook, rank 1, and wideband PMI reporting granularity

Recommended WF:

Continue discussion considering progress of other issues.

Table 62: Companies' comments

Company	Comments
Apple	Do not introduce requirements. Same comments as 3-7-1.

Issue 3-7-6: Simulation assumptions for RI reporting requirement

Tentative agreement: NA

Candidate Options:

Option 1: Define FR2-2 RI reporting requirements with rank 1 and rank 2, and with low and high antenna correlations

Recommended WF:

Continue discussion considering progress of other issues.

Table 63: Companies' comments

Company	Comments

Apple	Do not introduce requirements. Same comments as 3-7-1.

4 Recommendations for Tdocs

4.1 1st round

Existing Tdocs

Table 64:

Tdoc number	Title	Source	Decision	Comment
R4-2205916	Work management for FR2-2 demodulation performance requirement definition	Intel	Revised	

New Tdocs

Table 65:

Tittle	Source	Comment
WF on demodulation performance requirements definition for 52.6 - 71 GHz.	Intel Corporation	WF to cover general aspects, scope of performance requirements and initial simulation assumptions

4.2 2nd round

Table 66:

Tdoc number	Title	Source	Decision	Comment
R4-2207223	WF on demodulation performance requirements definition for 52.6 - 71 GHz	Intel Corporation	Agreeable	

R4-2207205	Work plan for FR2-2 demodulation performance requirement definition	Intel Corporation	Agreeable	