**3GPP TSG-RAN WG4 Meeting #116bis R4-2514510**

**Prague, Czech Republic, 13 October – 17 October 2025**

**Agenda item:** 8.1

**Source:** Feature Lead (Ericsson)

**Title:** Topic summary for [116bis][103] BS RF and coexistence

**Document for:** Information

# Introduction

This summary collects the different proposals and main observations related to the AI 8.5 BS RF and coexistence. According to the Chairman’s notes, the scope includes non-spectrum and non-AI BS RF, MSR, BS RF related coverage and efficiency, and the coexistence study.

The following topics have been identified:

* Topic#1: BS RF requirements and related aspects (e.g. conformance, EMC, …)
* Topic#2: Coexistence studies
* Topic#3: MSR aspects
* Topic#4: BS RF timing
* Topic#5: NTN
* Topic#6: SBFD
* Topic#7: Other aspects

The goal in this first meeting is to identify the common views and early agreements, refine the scope of the SI and list the different areas for further investigations, setting priorities when needed.

Note that in the following, proposals are not necessarily exclusive, they could be complementary. Some major observations have been captured to help the proposal’s understanding.

# Topic #1: BS RF requirements

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513045**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513045.zip) | Samsung | Observation 19: The 6G BS would support 7-24 GHz carrier with potentially more ports and MIMO schemes, and likely in hybrid beamforming scheme.Observation 20: The feasibility and co-ex studies on FR3 carriers, e.g. 7GHz, are the basis of 6G BS RF requirements for 6G Radio. And the study outcomes would also impact the RF requirements in the 6G BS RF requirements in FR1 carriers.Proposal 12: The new 6G BS RF requirements should be discussed based on feasibility and new co-ex studies at least on 7GHz carrier.Observation 21: The agreed 6G BS requirements from 7GHz could then be evaluated to check if they can be expanded to other carriers < 6GHz.Observation 22: It’s worth to discuss whether and how to apply RF requirements on “energy saving mode” when only part of the element arrays and their associated PA is activated. Observation 23: In general, our observation is that the applicability rule, band category, and the relationship between MSR and single-RAT requirements from TS 37.104 could be re-used in introducing MSR requirements for 6G BS. |
| [**R4-2513069**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513069.zip) | Nokia | Proposal 1: It is proposed to take into account above considerations for further work related to 6GR BS specifications structure and simplification.Proposal 2: It is proposed to take into account above considerations for further work related to 6GR BS Tx requirements.Proposal 3: It is proposed to take into account above considerations for further work related to 6GR BS Rx requirements. |
| [**R4-2513076**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513076.zip) | MediaTek inc. | Observation 1: With current BS Tx EVM requirements in TS 38.104, the required EVM changes with the modulation order without considering the target MIMO layers.Observation 2: With the EVM values based on current TS 38.104, the max throughput cannot be achieved with more MIMO layers, and the degradation compared to EVM 0% can be huge in some scenarios.Proposal 1: RAN4 to study a more pragmatic BS TX EVM requirement framework that can avoid the throughput degradation with higher layer MIMO. |
| [**R4-2513129**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513129.zip) | CMCC | Proposal 2: The RF requirements for 5G NR BS could be set as starting point for the 6GR refarming bands.Proposal 3: Conduct research on the 6GR BS RF requirements using the frequency around 7GHz, and consider enhancing the existing RF indicators, e.g. EVM.Proposal 4: Conduction requirements relaxation could be considered in 6G day-1.Observation 4: Some NR bands, such as n41, n78, and n79 have a bandwidth of about 200 MHz, are more likely to be refarmed to 6GR bands in the future.Proposal 7: Legacy coexistence requirements should be revisited in 6G day1. |
| [**R4-2513179**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513179.zip) | CATT | Proposal 3: For new frequency range between FR1 and FR2, some aspects need further study as below:* Which type of BS requirements should be defined and tested,
* Co-existence study with new parameters, such as bandwidth,
* Co-location requirements with FR1 band,
* And other issues.

Proposal 4: Energy efficiency can be considered for BS from below aspects:* Introduce an energy efficiency metric for BS, such as total power consumption per throughput under certain traffic model.
* Investigate whether it is possible to revisit some RF requirements, such as ACLR, EVM, which can help BS for energy saving.
* And other aspects.

Proposal 6: Higher order modulation such as 4096QAM can be studied for DL.BS advanced receiver can be further studied to enable UE higher power through TX EVM relaxation, RAN4 need to make a decision whether it should be introduced in 6GR based on the study results of receiver complexity, system delay and the value of UE power boost. |
| [**R4-2513267**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513267.zip) | NTT DOCOMO, INC. | Observation 1: For the candidate frequency ranges for 6G, establishing appropriate requirement reference points for each frequency range is crucial for a meaningful evaluation of RF performance.Proposal 1: As a first step, we propose establishing a clear principle for the 6G FR framework, deciding whether to align FR partitions with technical characteristics or to use them simply as labels for new spectrum.Observation 2: The growing adoption of beamforming suggests a potential misalignment between the current co-location framework and the deployment realities expected in future 6G systems.Proposal 2: To avoid inefficiencies in deployment, co-location requirements need to be defined with careful consideration of the actual characteristics of beamforming-capable BS.Observation 3: The 5G experience shows that the exclusive use of single-layer Test Models can lead to inaccurate power measurements for beamforming BS due to in-phase signal combining.Observation 4: The 5G experience shows that fixed-PRB Test Models can create a mismatch between testing conditions and the practical needs of deployment and certification.Proposal 3: For 6G, the specification of Test Models needs to reflect the scenarios where they will be utilized. |
| [**R4-2513306**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513306.zip) | Huawei, HiSilicon | Potential optimization for existing FR1 bandsProposal 1: the enhancement of BS type 1-H is focusing on large antenna array case for band above 5GHz.Proposal 2: It is proposed to study the possibility to remove the protection of the BS receiver of own for FDD bands.Proposal 3: It is proposed to study the corresponding BS RF requirements for support wide channel bandwidth.Proposal 4: It is proposed to study the feasibility to extend BS RE power down dynamic range for FR1 bands.RF requirements optimization for centimeter wave bands* Tx

Proposal 5: for co-existence study for centimetre wave bands, it is proposed to study potential differences on the required ACIR due to large array and higher frequency effect and potentially to revisit ACLR and operating band unwanted emission.* Rx

Proposal 6: Since there are no existing non-AAS systems to maintain any equivalence with, it is proposed to study the possibility to remove the link to the existing conducted requirements. A similar approach as FR2 can be adopted, i.e. single declared sensitivity.* Blocking

Proposal 7: It is proposed to use the same methodology used for FR2 to derive a requirement, i.e. blocker vs wanted signal analysis.* Co-location and co-existence

Proposal 8: it is proposed to study whether new requirement/metrics are adopted by considering higher frequency effect and in addition large array effect, pending on the output of Rel-20 BS RF WI. |
| [**R4-2513327**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513327.zip) | ZTE Corporation, Sanechips | Proposal 1: for 5G NR refarming bands, propose to use the RF requirement of 5G NR BS as starting point and make further improvement if confirmed to be necessary.Proposal 2: for 6GR BS, propose to consider the following 5G BS types at least as starting point.

|  |  |
| --- | --- |
| 6GR TN | 6GR NTN |
| NR BS | FR1 SAN |
| Repeater, NCR for coverage extension with low cost | Ka-band SAN |
| SBFD | Ku-band SAN |

Proposal 3: propose to consider the hybrid beamforming BS class in 6GR especially for around 7GHz 6GR BS.Proposal 4: propose to consider the BS type 1-H at FR1 low bands as the evolution of the legacy BS type 1-C in 6G day1.Proposal 5: propose to support the in-band NB-IoT operation for BS type 1-H and BS type 1-O in 6G day1.Proposal 6: if LP-WUS signal is supported in 6G day1, propose to further discuss the impacts on potential EVM degradation of NR signal due to the simultaneous LP-WUS signal transmission.Proposal 7: in order to achieve the more accurate beam steering direction in 6G day1. propose to have some study the architecture and RF feasibility on the calibrated beamforming steering for multi-band operation BS or wide spectrum operation BS instead of defining the fractional bandwidth for different rated EIRP.Proposal 8: for the multi-band operation, propose to consider the dynamic power sharing across different bands to improve the network capacity/coverage.Proposal 11: for minimum EVM requirement of existing 5G modulation order of 6GR, propose to apply the 5G BS EVM requirement as starting point for 6GR BS.Proposal 12: for the optimal EVM requirement, propose to have some discussion on the necessity and evaluation method to figure out the optimal/enhanced EVM requirement to enable the achievable peak data rate if possible. Proposal 13: for the relaxed EVM requirement for 6GR BS, propose to consider the AI or non-AI based DPoD compensation at UE side to improve the DL coverage.Proposal 22: for the ACLR requirement, propose to have some further study on the appropriate ACLR modelling to quantify more realistic interference modelling in the coexistence sharing study and define more proper ACLR requirement;Proposal 23: for the ACLR requirement, propose to consider the performance balance between ACLR and EVM requirement instead of treating these two requirement separately. Proposal 24: for the conformance testing of U6GHz EEIRP mask in 6G, propose to consider the unequally distributed test beams across the whole coverage regions from the time domain (e.g.6GR BS need to provide the sensing or UAV service with periodic beams steering upwards) in addition to the equally distributed test beams in Rel-19.Proposal 25: for in-band blocking requirement of FR1 BS, propose to conduct the further study with more relevant coexistence assumptions to identify the appropriate requirement for 6GR BS.Proposal 26: for out-of-band blocking requirement of FR1 BS, propose to conduct the further study with more relevant coexistence assumptions to identify the appropriate requirement for 6GR BS.Proposal 27: in order to avoid the parallel discussion on improvement on FR1 co-location requirements and coexistence spurious emission requirements between 5G-A and 6GR, propose to wait for the conclusion in 5G-A and make the necessary updates for RF requirements of 6GR BS.Proposal 28: for the enhanced 6GR BS type 1-H, propose to discuss the additional OTA requirement in addition to EIRP and EIS requirement for BS type 1-H to reflect the radiated performance more precisely.  |
| [**R4-2513339**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513339.zip) | Ericsson Limited | Proposal 1: The fundamental concepts of Operating bands, Frequency Ranges, Base Station classes, separate conducted and OTA requirements, MSR BS and AAS BS specifications to be applied also for 6G, with appropriate improvements and simplifications.Proposal 8: Current assumption is 200MHz channel bandwidth for bands in or above 6GHz and further study the need for other wider channel bandwidths, depending on the conclusions on system parameters.Proposal 9: Further study BS hybrid beamforming type of architecture, possibly introducing a new BS type.Proposal 10: If not finalized in Rel-19, further study BS coexistence requirement (additional spurious). Proposal 11: Re-evaluate some requirements (e.g. in-band blocking, out-of-band blocking) assuming today’s actual deployments instead of assumptions from 1999 and UTRA deployments.Proposal 12: Re-assess 7-24GHz study outcomes and its considered models (i.e. PA, phase noise).Proposal 14: Re-visit how BS output power is handled in relevant TS 38.104 requirements and consider introducing PSD based requirements instead.Proposal 15: Study OTA test methods with the intention to improve description and measurement uncertainties for bands in the upper region of FR1 and above.Observation 5: The following three options could be considered for 6G EMC specification structure regarding network nodes: * Option 1: A single unified specification
* Option 2: A consolidated BS specification with separate specifications for Repeaters and IAB
* Option 3: Maintain the current structure

Proposal 20: Adopt Option 2 for the 6G EMC specification structure: a consolidated BS EMC specification with separate EMC specifications for Repeaters and IAB. |

## Open issues summary

### Sub-topic 1-1 6G FR1 requirements

**Issue 1-1-1: Starting point**

* Proposals: Re-use 5G BS RF requirements as starting point
	+ Proposal 1: Agree (Nokia, CMCC, ZTE, Ericsson)
	+ Proposal 2: Need for new coexistence studies (Samsung)
	+ Proposal 3:: The fundamental concepts of Operating bands, Frequency Ranges, Base Station classes, separate conducted and OTA requirements, MSR BS and AAS BS specifications to be applied also for 6G, with appropriate improvements and simplifications (Ericsson)
* Recommended WF
	+ 5G BS RF requirements might be considered as the starting point when defining the 6G BS RF requirements.

The need for additional coexistence studies is discussed in topic#2.

The list of requirements to be re-assessed is discussed in issue 1-1-2.

**Issue 1-1-2: Requirements to be re-assessed**

* Proposals: The following requirements should be re-studied in the 6G scope:
	+ Proposal 1: The following Tx requirements should be considered
		- Proposal 1a: All Tx requirements, conducted and radiated (based on the contribution) (Nokia)
		- Proposal 1b: Tx EVM (Mediatek, ZTE)
			* Study a more pragmatic framework to avoid throughput degradation with higher layer MIMO (Mediatek)
			* For the (*Note: this would be a new requirement*) optimal EVM requirement, propose to have some discussion on the necessity and evaluation method to figure out the optimal/enhanced EVM requirement to enable the achievable peak data rate if possible (ZTE)
			* For the (*Note: this would be a new requirement*) relaxed EVM requirement for 6G R BS, propose to consider the AI or non-AI based DPoD compensation at UE side to improve the DL coverage. (ZTE)
		- Proposal 1c: Higher modulation such as 4096 QAM (CATT)
		- Proposal 1d: Study the possibility to remove the protection of the BS receiver of own BS for FDD bands requirement (Huawei).
		- Proposal 1e: Study the feasibility to extend BS RE power down (control?) dynamic range for FR1 bands (Huawei).
	+ Proposal 2: The following Rx requirements should be considered:
		- Proposal 2a: Study out of band blocking (Nokia, ZTE, Ericsson)
		- Proposal 2b: Study In-band blocking (ZTE, Ericsson)
	+ Proposal 3: Consider relaxation for the conducted requirements for 1-H (CMCC)
	+ Proposal 4: Study pico requirements assuming reusing WiFi components devices (CMCC)
* Recommended WF
	+ To be further discussed and prioritized.

**Issue 1-1-3: New assumptions when re-assessing requirements**

* Proposals:
	+ Proposal 1: Re-evaluate the taken assumptions (e.g. 30dB coupling loss between co-located BS) (Nokia, ZTE)
	+ Proposal 2: To avoid inefficiencies in deployment, co-location requirements need to be defined with careful consideration of the actual characteristics of beamforming-capable BS (NTT Docomo)
	+ Proposal 3: Re-evaluate some requirements (e.g. in-band blocking, out-of-band blocking) assuming today’s actual deployments instead of assumptions from 1999 and UTRA deployments (Ericsson)
* Recommended WF

When re-assessing the pertinence of BS RF requirements, the taken assumptions should be reconsidered, considering actual deployments and AAS BS characteristics (some RF requirements’ assumptions are still based on UTRA and non-AAS BS).

**Issue 1-1-4: ACLR and EVM requirements interdependency**

* Proposals: Link ACLR and EVM requirements:
	+ Proposal 1: consider the performance balance between ACLR and EVM requirement instead of treating these two requirements separately (ZTE).
* Recommended WF

This issue is pending on the 1-12 discussion, if EVM should be further studied or not. If so, to be further discussed if EVM/ACLR interdependency aspects should also be studied in the scope of the 6G SI.

**Issue 1-1-5: Co-location and coexistence Requirements**

* Proposals
	+ Proposal 1: Wait for the conclusion in 5G-A and make the necessary updates for RF requirements of 6GR BS. (ZTE)
	+ Proposal 2: If not finalized in Rel-19, further study BS coexistence requirement (additional spurious) (Ericsson)
* Recommended WF
* The 2 proposals seem aligned, waiting for the outcomes of the Rel-19 and Rel-20 outcomes before deciding if any further investigation in the scope of 6G SI.

**Issue 1-1-6: BS output clarification**

* Proposals
	+ Proposal 1: Re-visit how BS output power is handled in relevant TS 38.104 requirements and consider introducing PSD based requirements instead. (Ericsson)
* Recommended WF

To be further discussed if any clarification on power consideration should be studied in the scope of the 6G SI.

**Issue 1-1-7: FR partitioning**

* Proposals: How to consider the FR partitioning for BS RF requirements:
	+ Proposal 1: Establishing a clear principle for the 6G FR framework, deciding whether to align FR partitions with technical characteristics or to use them simply as labels for new spectrum (NTT Docomo)
* Recommended WF

To be further discussed, especially in the context of any potential new FR for cmWave bands. Note that frequency range definition is discussed in the Spectrum AI.

**Issue 1-1-8: Wider channel bandwidth impact**

* Proposals:
	+ Proposal 1: Study the corresponding BS RF requirements for support wide channel bandwidth (Huawei).
	+ Proposal 2: Current assumption is 200MHz channel bandwidth for bands in or above 6GHz and further study the need for other wider channel bandwidths, depending on the conclusions on system parameters (Ericsson)
* Recommended WF

To be synchronized with the channel BW discussion in the “system parameters” thread. If new channel BW(s) is agreed, then impacts on BS RF requirements will need to be studied.

**Issue 1-1-9: BS type in FR1 low bands (below 1 GHz)**

* Proposals:
	+ Proposal 1: BS type 1-H at FR1 low bands as the evolution of the legacy BS type 1-C in 6G day1 (ZTE).
* Recommended WF

Some initial discussions have been triggered in RAN4 by the LS received from CEPT on this topic, it seems reasonable to further discuss this in the 6G scope.

**Issue 1-1-10: NB-IoT in 6G**

* Proposals: Additional NB-IoT support
	+ Proposal 1: Support the in-band NB-IoT operation for BS type 1-H and BS type 1-O in 6G day1 (ZTE).
* Recommended WF

NB-IoT support by AAS BS has been proposed in the past but no agreement was reached, no AAS BS being considered in the low bands at that time. As this assumption changed (AAS BS below 1 GHz), this might need further discussion.

**Issue 1-1-11: LP-WUS**

* Proposals: LP-WUS impacts
	+ Proposal 1: if LP-WUS signal is supported in 6G day1, propose to further discuss the impacts on potential EVM degradation of NR signal due to the simultaneous LP-WUS signal transmission (ZTE).
* Recommended WF

RAN4 should first conclude if LP-WUS should be supported from the beginning in 6G.

**Issue 1-1-12: Multi-band / wide spectrum**

* Proposals: Study on multi-band/wide spectrum configuration.
	+ Proposal 1: in order to achieve the more accurate beam steering direction in 6G day1. propose to have some study the architecture and RF feasibility on the calibrated beamforming steering for multi-band operation BS or wide spectrum operation BS instead of defining the fractional bandwidth for different rated EIRP (ZTE).
	+ Proposal 2: for the multi-band operation, propose to consider the dynamic power sharing across different bands to improve the network capacity/coverage (ZTE)
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

**Issue 1-1-13: Misc**

* Proposals: The following other aspects should be further considered.
	+ Proposal 1: Study impact of a UE centric network on BS requirements (CATT).
	+ Proposal 2: Further study BS advanced received targeting higher power UE (Tx EVM relaxation) (CATT)
* Recommended WF

To be further discussed.

### Sub-topic 1-2 Hybrid beamforming and BS type 1-H

**Issue 1-2-1: BS type 1-H enhancement**

* Proposals
	+ Proposal 1: Enhance BS type 1-H focusing on large antenna array case for bands above 5GHz (Huawei)
	+ Proposal 2: Consider the hybrid beamforming BS class in 6GR especially for around 7GHz 6GR BS (ZTE)
		- For the enhanced 6GR BS type 1-H, propose to discuss the additional OTA requirement in addition to EIRP and EIS requirement for BS type 1-H to reflect the radiated performance more precisely.
	+ Proposal 3: Further study BS hybrid beamforming type of architecture, possibly introducing a new BS type (Ericsson)
* Recommended WF

Enhancement of BS type-1H should most likely be included in the scope of the 6G SI, potentially introducing a new BS type.

### Sub-topic 1-3 Requirements for cmWave bands and n104

Note that the need for new coexistence studies or not is discussed in topic #2.

**Issue 1-3-1: Requirements above 6 GHz**

* Proposals
	+ Proposal 1: Study feasibility above 7 GHz (Samsung)
	+ Proposal 2: Conduct research including the upper 6 GHz/n104 (CMCC, Samsung has similar observation 21)
	+ Proposal 3: Study which BS type should be considered (CATT)
	+ Proposal 4: Tx: study potential differences on the required ACIR due to large array and higher frequency effect and potentially to revisit ACLR and operating band unwanted emission (Huawei)
	+ Proposal 5: Re-assess 7-24GHz study outcomes and its considered models (i.e. PA, phase noise) (Ericsson)
* Recommended WF

This is also pending on the topic#2 (need for new coex studies or not).

The more precise scope of the study above 7 GHz should be further discussed, as well as the opportunity to include the upper 6GHz (n104) in this study, revisiting some n104 requirements.

**Issue 1-3-2: Co-location and coexistence Requirements**

* Proposals
	+ Proposal 1: Study co-location requirements with FR1 bands. (CATT)
	+ Proposal 2: study whether new requirement/metrics are adopted by considering higher frequency effect and in addition large array effect, pending on the output of Rel-20 BS RF WI. (Huawei)
* Recommended WF

Those aspects should most likely be included in the 6G SI scope.

**Issue 1-3-3: Rx Requirements**

* Proposals: Conducted requirements equivalence
	+ Proposal 1: Since there are no existing non-AAS systems to maintain any equivalence with, it is proposed to study the possibility to remove the link to the existing conducted requirements. A similar approach as FR2 can be adopted, i.e. single declared sensitivity. (Huawei)
	+ Proposal 2: Blocking: use the same methodology used for FR2 to derive a requirement, i.e. blocker vs wanted signal analysis (Huawei)
* Recommended WF

Those aspects should most likely be included in the 6G SI scope.

### Sub-topic 1-4 Conformance aspects

**Issue 1-4-1: 6G Test Models**

* Proposals: Test model improvements:
	+ Proposal 1: the specification of Test Models needs to reflect the scenarios where they will be utilized (NTT Docomo):
		- The 5G experience shows that fixed-PRB Test Models can create a mismatch between testing conditions and the practical needs of deployment and certification.
		- The 5G experience shows that the exclusive use of single-layer Test Models can lead to inaccurate power measurements for beamforming BS due to in-phase signal combining.
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

**Issue 1-4-2: OTA**

* Proposals: OTA test methods:
	+ Proposal 1: Study OTA test methods with the intention to improve description and measurement uncertainties for bands in the upper region of FR1 and above (Ericsson)
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

**Issue 1-4-3: EEIRP for 6 GHz requirement**

* Proposals: EEIRP requirement - conformance updates
	+ Proposal 1: for the conformance testing of U6GHz EEIRP mask in 6G, propose to consider the unequally distributed test beams across the whole coverage regions from the time domain (e.g. 6GR BS need to provide the sensing or UAV service with periodic beams steering upwards) in addition to the equally distributed test beams in Rel-19 (ZTE).
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

### Sub-topic 1-5 Energy efficiency

**Issue 1-5-1: Energy efficiency**

* Proposals
	+ Proposal 1: whether and how to apply RF requirements on “energy saving mode” when only part of the element arrays and their associated PA is activated (Samsung)
	+ Proposal 2: Introduce an energy efficiency metric for BS, such as total power consumption per throughput under certain traffic model (CATT)
	+ Proposal 3: Revisit some RF requirements, such as ACLR, EVM, which can help BS for energy saving (CATT)
* Recommended WF

To be further discussed which energy efficiency topics be studied in the scope of the 6G SI and if RF requirements should be revisited accordingly.

### Sub-topic 1-6 Techincal Specifications

**Issue 1-6-1: Simplification of the 6G technical specifications**

* Proposals: Simplifications
	+ Proposal 1: Define requirements in a generic way (Nokia)
	+ Proposal 2: The complexity of BS specifications must be minimized in terms of number of options, variations and combinations of features. Requirements can be re-used from NR but need to be re-evaluated and if possibly simplified and improved in terms of definitions (Ericsson)
* Recommended WF

The proposals should most likely be considered for 6G, other proposals should be encouraged.

**Issue 1-6-2: 6G specifications structure**

* Proposals: Structure
	+ Proposal 1: One core specification and 2 conformance specifications, like for NR (Nokia)
* Recommended WF

### Sub-topic 1-7 EMC

**Issue 1-7-1: EMC specifications**

* Proposals:
	+ Proposal 1: Adopt Option 2 for the 6G EMC specification structure: a consolidated BS EMC specification with separate EMC specifications for Repeaters and IAB (Ericsson)
* Recommended WF

The proposal might be acceptable.

# Topic #2: Coexistence studies

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513045**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513045.zip) | Samsung | Observation 1: The gaps between co-ex studies performed in RAN4 and 6GR target deployment scenarios in different carrier frequencies are quite large, and they are shown as below.Observation 2: The previously available co-existence studies on 700MHz and 2GHz carrier frequencies are majorly from LTE study, which differs significantly with later 5G NR and the current 6G Radio in both system parameters and deployment scenarios. Observation 3: The previously available co-existence studies on 4GHz and 7GHz carrier frequencies assumed much less antenna array elements and only partial of the deployment scenarios as given in latest 6G deployment discussion. Observation 4: The previously available co-existence studies on 15GHz and 30GHz carrier frequencies also assumed much less antenna array elements, and different scenario (UMa) other than scenarios targeted in latest 6G deployment discussion.Proposal 1: It is proposed to perform new co-existence studies to the carrier frequencies suggested for 6G Radio.Proposal 2: The new 6G Radio co-existence study can start with 7GHz to re-evaluate ACLR and ACS given its significant difference to previous studies in both deployment scenario and BS antenna assumption aspects.Observatoin 5: For 7GHz, TR 38.921 studied co-ex with 8x16x2 array size for Urban Macro, TR 38.922 concluded (8x16)x(3x1)x2 array size for Urban Macro, while latest 6G deployment discussion suggested ”up to 2304” elements.Observation 6: With more elements considered, for example 3x1 sub-array in a same 8x16 antenna, the difference in antenna pattern is already significantly large. The 2304 elements proposed in latest 6G deployment discussion would introduce greater impacts in antenna pattern in new co-existence studies alone.Proposal 3: RAN4 to review and discuss antenna assumptions in TR 38.921, 38.922 and RP-252888 for 7GHz, and to perform new co-existence study with the agreed typical antenna assumption for 7GHz.Proposal 4: In 6G Radio co-existence study, use sub-array based AAS model as a baseline assumption for 6G base stations.Observation 7: The previous co-existence study in TR 38.921 does not study Urban micro, Rural scenarios for 7GHz carrier, which is listed in latest 6G deployment scenario discussion.Observation 8: The previous assumptions for Urban macro in TR 38.921 assumed one layer of hexagonal grid macro stations, while 6G deployment scenario discussion suggested both one layer and two layer layouts. But two layers in latest 6G deployment discussion assumed different carriers in different layers.Observation 9: The previous assumption for sub-urban macro ISD is 900m, which is much smaller than the assumed 1299 or 1732 meters ISD as discussed in latest 6G deployment scenario discussion.Proposal 5: RAN4 to consider the deployment related agreements (e.g. ISD, layout) from 6G deployment scenario discussion as the new 6G Radio co-existence study assumptions.Observation 10: In updated TR 38.901 from Rel-19 7-24GHz channel model study, the sub-urban macro (SMa) was introduced, and aligned with the 6G deployment discussion.Proposal 6: To adopt the updated channel model in TR 38.901, especially for SMa scenario, to the new 6G Radio co-existence study. |
| [**R4-2513069**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513069.zip) | Nokia | Proposal 6: RAN4 should examine whether the simulation parameters and assumptions used for LTE and NR coexistence studies would continue to reflect real-life deployment for 6GR or they should be revised.The outcomes of the coexistence studies as recorded in TR 38.921 and TR 38.922 can be used as a starting point, but RAN4 should examine whether the simulation parameters and assumptions used in these coexistence studies would continue to reflect real-life deployment for 6GR or they should be revised. |
| [**R4-2513129**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513129.zip) | CMCC | Proposal 7: Legacy coexistence requirements should be revisited in 6G day1. |
| [**R4-2513146**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513146.zip) | Qualcomm Germany | Observation 1: In TR 38.922, RAN4 has documented the RF and AAS parameters for the frequency ranges 4.4-4.8 GHz, 7.125-8.4 GHz, and 14.8-15.35 GHz, where adjacent channel coexistence work was done only for 14.8-15.35 GHz. Proposal 1: RAN4 to discuss if additional coexistence studies consistent with the work conducted in TR 38.922 are needed for the 6G SI.Observation 2: If additional coexistence studies are agreed in RAN4, RAN4 could study how to harmonize in the coexistence framework the incorporation of the parameterized BS AAS steering limits in 6G coexistence studies. Observation 3: If additional coexistence studies are agreed in RAN4, RAN4 could study the characterization of the underlying parameters of the out-of-band AAS radiation pattern model in TR 38.922.Observation 4: If additional coexistence studies are agreed in RAN4, proper modeling of UE beamforming gain could be discussed. Both the impact of increasing the number of TXs in FR1 (e.g., 4 or 2 TXs) and the extensions to UE beamforming model (as described in Section 5.2.3.3 in TR 38.803) in FR3 could be addressed. |
| [**R4-2513179**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513179.zip) | CATT | Proposal 3: For new frequency range between FR1 and FR2, some aspects need further study as below:* Which type of BS requirements should be defined and tested,
* Co-existence study with new parameters, such as bandwidth,
* Co-location requirements with FR1 band,
* And other issues.
 |
| [**R4-2513280**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513280.zip) | Xiaomi | Proposal 1: RAN4 should analyses the effect of coexistence if there are new configurations or scenarios for 6GR.Observation 1: Traditional co-existence study under FR1 and FR2 including SBFD operation is already covered by the 5GA.Observation 2: RAN4 also covered new frequency range between 7-24 GHz in previous IMT system parameter study.Proposal 2: RAN4 should analyses the effect of coexistence if there are new configurations or scenarios for 14-15GHzProposal 6: Coexsitence study between 6G and 5G, 6G and 4G is not necessary unless there are signifigate parameters and assumptions changes.  |
| [**R4-2513307**](https://eur02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_116bis%2FDocs%2FR4-2513307.zip&data=05%7C02%7Cdominique.everaere%40ericsson.com%7C9c15ac218e6c40ecb9c008de0345baf4%7C92e84cebfbfd47abbe52080c6b87953f%7C0%7C0%7C638951795458769468%7CUnknown%7CTWFpbGZsb3d8eyJFbXB0eU1hcGkiOnRydWUsIlYiOiIwLjAuMDAwMCIsIlAiOiJXaW4zMiIsIkFOIjoiTWFpbCIsIldUIjoyfQ%3D%3D%7C0%7C%7C%7C&sdata=kxHP15wAMKlSBQx6gELQbCmZ8iTjL7msSuuuucq3vLQ%3D&reserved=0) | Huawei, HiSilicon | Proposal 4-1: RAN4 prioritize co-existence evaluations for new spectrum bands, while the consideration of new scenarios should await guidance from the RAN plenary. Proposal 4-2: RAN4 is to conduct or re-evaluate co-existence studies for newly identified IMT spectrum based on updated assumptions, including HPUE. The U6G band should be prioritized as a starting point. Proposal 4-3: For 6G coexistence study, it is recommended to maintain the established methodology and core metric of <5% throughput loss versus ACIR. |
| [**R4-2513327**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513327.zip) | ZTE Corporation, Sanechips | Proposal 29: for the 6GR coexistence study, propose to consider the coexistence cases as listed in Table 2.4.1-1.Proposal 30: for the 6GR coexistence study, propose to consider the simulation assumptions as listed in Table 2.4.2-1 and Table 2.4.2-2. |
| [**R4-2513339**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513339.zip) | Ericsson Limited | Proposal 13: Re-use coexistence study outcomes for 7.125-8.4 GHz and 14.8-15.35 GHz.Observation 1: Coexistence studies might be needed with the introduction of new 6G features (e.g. ISAC). |

## Open issues summary

### Sub-topic 2-1 – Coexistence studies

**Issue 2-1-1: Coexistence studies**

* Proposals: Need for additional coexistence studies or to redo past studies.
	+ Proposal 1: perform new co-existence studies to the carrier frequencies suggested for 6G Radio (Samsung, Nokia, CMCC)
		- Note: According to the observations, this would include 700MHz, 2GHz, 4 GHz, 7GHz, 15GHz and 30 GHz (Samsung)
		- outcomes of the coexistence studies as recorded in TR 38.921 and TR 38.922 can be used as a starting point (Nokia)
		- The coexistence research in 6G should be conducted based on the actual deployment scenarios in the future (CMCC)
		- studies on coexistence with other technologies should also be conducted (CMCC)
		- Study 5G – 6G coexistence for 700MHz, 4 GHz, 28 GHz, 40 GHz. (ZTE)
	+ Proposal 2: The new 6G Radio co-existence study can start with 7GHz to re-evaluate ACLR and ACS given its significant difference to previous studies in both deployment scenario and BS antenna assumption aspects (Samsung)
	+ Proposal 3: RAN4 to discuss if additional coexistence studies consistent with the work conducted in TR 38.922 are needed for the 6G SI (Qualcomm)
	+ Proposal 4: For the new frequency range between FR1 and FR2, study coexistence with new parameters (e.g. Bandwidth) (CATT).
	+ Proposal 5: Analyses the effect of coexistence if there are new configurations or scenarios for 6GR (Xiaomi)
	+ Proposal 6: Analyses the effect of coexistence if there are new configurations or scenarios for 14-15GHz (Xiaomi)
	+ Proposal 7: Coexistence study between 6G and 5G, 6G and 4G is not necessary unless there are significant parameters and assumptions changes (Xiaomi)
	+ Proposal 8: RAN4 prioritize co-existence evaluations for new spectrum bands, while the consideration of new scenarios should await guidance from the RAN plenary (Huawei)
	+ Proposal 9: RAN4 to conduct or re-evaluate co-existence studies for newly identified IMT spectrum based on updated assumptions, including HPUE. The U6G band should be prioritized as a starting point. (Huawei)
	+ Proposal 10: Re-use coexistence study outcomes for 7.125-8.4 GHz and 14.8-15.35 GHz. (Ericsson)
		- Coexistence studies might be needed with the introduction of new 6G features (e.g. ISAC).
* Recommended WF

There are different views on the need for the coexistence studies, if RAN4 should reuse existing studies results, make some additional coexistence studies or even redo past coexistence studies with new assumptions and models.

This should be further discussed and, if coexistence studies should be done, a prioritization should also be made on (which frequency? Deployment? Other technologies?

### Sub-topic 2-2 - Assumptions

**Issue 2-2-1: Assumptions**

* Proposals: If new or additional coexistence studies should be done, the following assumptions should be considered:
	+ Proposal 1: RAN4 to review and discuss antenna assumptions in TR 38.921, 38.922 and RP-252888 for 7GHz, and to perform new co-existence study with the agreed typical antenna assumption for 7GHz (Samsung, Nokia)
		- RAN4 should examine whether the simulation parameters and assumptions used in these coexistence studies would continue to reflect real-life deployment for 6GR or they should be revised (Nokia)
	+ Proposal 2: In 6G Radio co-existence study, use sub-array based AAS model as a baseline assumption for 6G base stations. (Samsung)
	+ Proposal 3: Consider the deployment related agreements (e.g. ISD, layout) from 6G deployment scenario discussion as the new 6G Radio co-existence study assumptions. (Samsung)
	+ Proposal 4: Adopt the updated channel model in TR 38.901, especially for SMa scenario, to the new 6G Radio co-existence study. (Samsung)
	+ Proposal 5: Consider the simulation assumptions as listed below. (ZTE)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| FR | 700MHz | 4GHz | Around 7GHz | 30GHz |
| Network layout | UMA,Dense Urban,Indoor | UMA,Dense Urban,Indoor | UMA,Dense Urban,Indoor | UMA,Dense Urban,Indoor |
| Propagation model | Refer to 38.901 | Refer to 38.901 | Refer to 38.901 | Refer to 38.901 |
| BS Antenna configuration | Around 700 MHz: Up to 64 Tx and Rx antenna elements | Around 4 GHz: Up to 576 Tx and Rx antenna elements | Around 7 GHz: Up to 2304 Tx and Rx antenna elements | Around 30 GHz: Up to 4096 Tx and Rx antenna elements |
| UE Antenna configuration | Omini antenna | Omini antenna | Omini antenna |  |
| Transmission power control | Refer to 38.922 | Refer to 38.922 | Refer to 38.922 | Refer to 38.803 |
| ACLR/ACS modelling | Depends ACLR modelling | Depends ACLR modelling | Depends ACLR modelling | Depends ACLR modelling |
| Link level performance for 6GR coexistence study | Refer to 38.922 | Refer to 38.922 | Refer to 38.922 | Refer to 38.922 |
| Coexistence simulation methodology | Refer to 38.922 | Refer to 38.922 | Refer to 38.922 | Refer to 38.922 |

* Recommended WF

Further discussion pending agreements on issue 2-1-1.

**Issue 2-2: Coexistence modelling aspects**

* Proposals
	+ Proposal 1: ACLR modelling: further study on the appropriate ACLR modelling to quantify more realistic interference modelling in the coexistence sharing study and define more proper ACLR requirement (ZTE)
	+ Proposal 2: Study how to harmonize in the coexistence framework the incorporation of the parameterized BS AAS steering limits in 6G coexistence studies (Qualcomm)
	+ Proposal 3: Study the characterization of the underlying parameters of the out-of-band AAS radiation pattern model in TR 38.922 (Qualcomm)
	+ Proposal 4: Proper modeling of UE beamforming gain could be discussed. Both the impact of increasing the number of TXs in FR1 (e.g., 4 or 2 TXs) and the extensions to UE beamforming model (as described in Section 5.2.3.3 in TR 38.803) in FR3 could be addressed (Qualcomm)
	+ Proposal 5: For 6G coexistence study, it is recommended to maintain the established methodology and core metric of <5% throughput loss versus ACIR (Huawei)
* Recommended WF

Further discussion pending agreements on issue 2-1-1.

# Topic #3: MSR aspects

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513069**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513069.zip) | Nokia | Proposal 4: Define new capability sets including relevant configurations using 6GR together with LTE and NR.Proposal 5:Similarly as for NR, do not define single-RAT 6GR capability set in MSR specifications. |
| [**R4-2513076**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513076.zip) | MediaTek inc. |  |
| [**R4-2513129**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513129.zip) | CMCC | Observation 3: MSR can provide hardware support for MRSS.Proposal 5: 6GR BS should support MSR, and MSR between 6GR and NR has high priority.Proposal 6: BS RF requirements related to MSR should be studied. |
| [**R4-2513339**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513339.zip) | Ericsson Limited | Proposal 2: The complexity of BS specifications must be minimized in terms of number of options, variations and combinations of features. Requirements can be re-used from NR but need to be re-evaluated and if possibly simplified and improved in terms of definitions.Proposal 3: When introducing 6G RAT in MSR specifications, RAN4 should further evaluate the need of specifying new category sets supporting 6G with GSM and UTRA.Proposal 4: In the 6G scope, FR2-1 support should be added to MSR AAS specifications.Proposal 5: When introducing 6G RAT, RAN4 should further investigate the following 2 alternatives:* Alt1: Create a new TS for 6G single RAT and update the existing MSR specifications (TS 37.104 and TS 37.105) adding 6G support for MSR configurations.
* Alt2: Add support for 6G single RAT and MSR configurations in existing MSR specifications (TS 37.104 and TS 37.105).

Proposal 6: Similar and aligned with the core specifications decision, RAN4 should further investigate the following 2 alternatives: * Alt1: Create a new TS for 6G single RAT and update the existing MSR specifications (TS 37.141, TS 37.145-1 and TS 37.145-2) adding 6G support for MSR configurations.
* Alt2: Add support for 6G single RAT and MSR configurations in existing MSR specifications (TS 37.141, TS 37.145-1 and TS 37.145-2).

Proposal 7: 6G requirements need to be designed to enable compatibility with 5G operation and MRSS. |

## Open issues summary

### Sub-topic 3-1 – 6G MSR and considered RATs

**Issue 3-1-1: RATs to be considered and new capability sets**

* Proposals
	+ Proposal 1: 6G, LTE and NR (Nokia, Ericsson)
	+ Proposal 2: Similarly as for NR, do not define single-RAT 6GR capability set in MSR specifications. (Nokia)
	+ Proposal 3: Prioritize 6G and NR (CMCC)
	+ Proposal 4: When introducing 6G RAT in MSR specifications, RAN4 should further evaluate the need of specifying new category sets supporting 6G with GSM and UTRA. (Ericsson)
	+ Proposal 5: In the 6G scope, FR2-1 support should be added to MSR AAS specifications. (Ericsson)
* Recommended WF

It might be acceptable to only consider 4G and 5G for MSR with 6G, not 2G and 3G, to be confirmed.

Also, further discussion would be needed to include FR2-1.

**Issue 3-1-2: RF requirements**

* Proposals
	+ Proposal 1: BS RF requirements related to MSR should be studied. (CMCC)
	+ Proposal 2: 6G requirements need to be designed to enable compatibility with 5G operation and MRSS. (Ericsson)
* Recommended WF
	+ Those aspects should be acceptable.

**Issue 3-1-3: Applicability and band category**

* Proposals
	+ Proposal 1: Applicability rule, band category, and the relationship between MSR and single-RAT requirements from TS 37.104 could be re-used in introducing MSR requirements for 6G BS (Samsung)
* Recommended WF
	+ To be further discussed, pending on issue 3-1-1 as well.

### Sub-topic 3-2 Spefication structure

**Issue 3-2-1: Specifications**

* Proposals
	+ Proposal 1: The complexity of BS specifications must be minimized in terms of number of options, variations and combinations of features. Requirements can be re-used from NR but need to be re-evaluated and if possibly simplified and improved in terms of definitions (Ericsson)
	+ Proposal 2: Do not define single-RAT 6GR capability set in MSR specifications (Nokia)
	+ Proposal 3: When introducing 6G RAT, RAN4 should further investigate the following 2 alternatives (Ericsson):
		- Alt1: Create a new TS for 6G single RAT and update the existing MSR specifications (TS 37.104 and TS 37.105) adding 6G support for MSR configurations.
		- Alt2: Add support for 6G single RAT and MSR configurations in existing MSR specifications (TS 37.104 and TS 37.105).
* Recommended WF
	+ Different views and alternatives are proposed for the MSR specification’s structure, one alternative impacting also the structure of the 6G specification (if 6G standalone is included in MSR specification), discussed in issue 1-6-2

# Topic#4: BS RF timing

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513327**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513327.zip) | ZTE Corporation, Sanechips | Proposal 14: for the MIMO TAE requirement for 6GR BS, propose to conduct the relevant physical layer evaluation with the TAE and different MIMO layers taken into account to define the more appropriate TAE requirement; Proposal 15: for TAE requirement among different transceivers for 6GR BS beamforming, propose to discuss the necessity and how to define the requirement for it in 6G day 1. Proposal 16: For the intra-band contiguous CA for 6G BS, propose to consider the different requirements for different use case if necessary firstly e.g. the orthogonality to reduce the inter-carrier interference for communications, SSB-less for fast scell activation and spectrum aggregated positioning, then further discuss how and whether to specify the unified TAE requirement.Proposal 17: For the intra-band non-contiguous CA for 6G BS, propose to discuss the necessary requirement from both with the consideration of NES with SSB-less operation in FR1 and the potential interruption due to Rx sweeping in FR2-1.Observation 1: the FR1 inter-band CA TAE requirement in co-located scenario as 260ns is feasible.Proposal 18: for the inter-band co-located CA for 6G BS, propose to discuss the optimal TAE requirement considering the NES with SSB-less operation in FR1 and FR2 UE Common beam management (CBM) in FR2-1,etc.Proposal 19: for the potential new spectrum utilization mechanism, RAN4 need to discuss and define the corresponding TAE requirement to enable the potential RRM measurement across different carriers. Proposal 20: for cell phase error requirement in 6G, propose to consider both the worst error requirement 3us and achievable cell phase error requirement under the normal operation mode to guide the relevant RRM requirement definition.Proposal 21: for cell phase requirement for CJT transmission, propose to have further discussion on the potential required phase alignment requirement with the associated UE measurement reporting information for timing misalignment, freq/ phase offset measurement and reporting. The accuracy of UE measurement reporting will also have direct impacts on the achievable performance at BS side. |
| [**R4-2513339**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513339.zip) | Ericsson Limited | Observation 3: Its essential to conduct a comprehensive background analysis for each feature and function, where such analysis should address if and why synchronization is necessary, the conditions or assumptions under when it is required, and what level of synchronization needed.Proposal 16: When RAN4 defines time and sync requirements, RAN4 should conduct a comprehensive background analysis for each feature and function, where such analysis should address if and why synchronization is necessary, the conditions or assumptions under when it is required, and what level of synchronization needed.Proposal 17: When RAN4 defines time and synchronization requirements, it should consider system robustness and deployment flexibility. Features and functions should be designed to operate effectively with a base level of synchronization, ensuring reliable performance in common and typical scenarios, even without strict synchronization. Where possible, the design may optionally utilize strict synchronization to enhance performance or extend support to less common use cases in situations where such synchronization can be achieved.Proposal 18: When RAN4 defines time and synchronization requirements, for requirement clarity link each requirement to specific features or functions, when needed clearly defining the conditions under which they apply—such as co-location scenarios, particular band combinations, or other relevant constraints—and, where applicable, to specific UE capabilities. Proposal 19: If feasible, opt for using a total budget that allows flexible allocation among subcomponents instead of specifying sub-requirements on part of the system., like defining MRTD in RRM and avoid stating TAE between ARP.Observation 4: $N\_{TA offset }$(RRM) , Cell Phase Synchronization (RRM) and TDD transient times (RF) are inter dependent and has to be discussed together, since: $N\_{TA offset}\geq Cell\\_Phase\\_Synchronization+Transmitter transient period$. |

## Open issues summary

### Sub-topic 1-4 General rules and TAE

**Issue 1-4-1: General rules**

* Proposals:
	+ Proposal 1: When RAN4 defines time and sync requirements, RAN4 should conduct a comprehensive background analysis for each feature and function, where such analysis should address if and why synchronization is necessary, the conditions or assumptions under when it is required, and what level of synchronization needed (Ericsson).
	+ Proposal 2: When RAN4 defines time and synchronization requirements, it should consider system robustness and deployment flexibility. Features and functions should be designed to operate effectively with a base level of synchronization, ensuring reliable performance in common and typical scenarios, even without strict synchronization. Where possible, the design may optionally utilize strict synchronization to enhance performance or extend support to less common use cases in situations where such synchronization can be achieved (Ericsson).
	+ Proposal 3: When RAN4 defines time and synchronization requirements, for requirement clarity link each requirement to specific features or functions, when needed clearly defining the conditions under which they apply—such as co-location scenarios, particular band combinations, or other relevant constraints—and, where applicable, to specific UE capabilities (Ericsson)
	+ Proposal 4: If feasible, opt for using a total budget that allows flexible allocation among subcomponents instead of specifying sub-requirements on part of the system., like defining MRTD in RRM and avoid stating TAE between ARP (Ericsson)
		- $N\_{TA offset }$(RRM) , Cell Phase Synchronization (RRM) and TDD transient times (RF) are inter dependent and has to be discussed together, since:

 $N\_{TA offset}\geq Cell\\_Phase\\_Synchronization+Transmitter transient period$.

* Recommended WF

Those general rules might be acceptable in the scope of the 6G SI, they might need be further discussion.

**Issue 1-4-2: TAE requirement**

* Proposals:
	+ Proposal 1: for the MIMO TAE requirement for 6GR BS, propose to conduct the relevant physical layer evaluation with the TAE and different MIMO layers considered to define the more appropriate TAE requirement (ZTE).
	+ Proposal 2: for TAE requirement among different transceivers for 6GR BS beamforming, propose to discuss the necessity and how to define the requirement for it in 6G day 1 (ZTE).
	+ Proposal 3: for the potential new spectrum utilization mechanism, RAN4 need to discuss and define the corresponding TAE requirement to enable the potential RRM measurement across different carriers, (ZTE)
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

**Issue 1-4-3: CA and TAE requirement**

* Proposals:
	+ Proposal 1: For the intra-band contiguous CA for 6G BS, propose to consider the different requirements for different use case if necessary firstly e.g. the orthogonality to reduce the inter-carrier interference for communications, SSB-less for fast scell activation and spectrum aggregated positioning, then further discuss how and whether to specify the unified TAE requirement (ZTE).
	+ Proposal 2: For the intra-band non-contiguous CA for 6G BS, propose to discuss the necessary requirement from both with the consideration of NES with SSB-less operation in FR1 and the potential interruption due to Rx sweeping in FR2-1 (ZTE).
	+ Proposal 3: for the inter-band co-located CA for 6G BS, propose to discuss the optimal TAE requirement considering the NES with SSB-less operation in FR1 and FR2 UE Common beam management (CBM) in FR2-1,etc (ZTE)
* Recommended WF

To be further discussed if those aspects should be studied in the scope of the 6G SI.

**Issue 1-4-4: Cell phase error discussion**

* Proposals:
	+ Proposal 1: for cell phase error requirement in 6G, propose to consider both the worst error requirement 3us and achievable cell phase error requirement under the normal operation mode to guide the relevant RRM requirement definition (ZTE).
	+ Proposal 2: for cell phase requirement for CJT transmission, propose to have further discussion on the potential required phase alignment requirement with the associated UE measurement reporting information for timing misalignment, freq/ phase offset measurement and reporting. The accuracy of UE measurement reporting will also have direct impacts on the achievable performance at BS side (ZTE).
* Recommended WF

This might require joint discussion with RRM as cell phase error is RRM requirement, to discuss how to best proceed here and not duplicate the discussion.

# Topic #5: NTN

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513045**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513045.zip) | Samsung | Observation 12: In 5G NR/IoT NTN studies, the NR-NTN were introduced in a late phase where all TN requirements are ready, hence the interference transmitted and received from NTN stations are not fully addressed as the TN devices cannot be easily upgraded with new requirements.Proposal 8: For 6G new radio co-existence study, it is possible for RAN4 to consider the NTN scenario in relatively early phase in co-ex study, and in determine requirements for better co-existence for 6G Radio on both NTN and TN.Proposal 9: The isolation distance between NTN and TN from Rel-17 should be re-evaluated when consider NTN in 6G Radio co-existence.Proposal 10: The UE density and its distribution in one and all beams/cell from a single SAN/satellite should be better modeled if we are targeting a more general overlapping co-ex between 6G NTN and TN.Observation 13: Previous RAN4 did not really study NTN-NTN co-existence, due to the facts that NTN-NTN interference management and negotiation usually follows regulatory framework and out of 3GPP scope.Observation 14: With a more flexible trend of spectrum usage between NTN and TN, along with a common design purpose of 6G Radio for NTN and TN, the co-existence between NTN and TN, and even between NTN and NTN can be more critical than 5G.Observation 15: If het-net structure between different satellite orbits are pursued as a key deployment in 6G NTN, the interference between NTN and TN, NTN and TN may be also studied. |
| [**R4-2513179**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513179.zip) | CATT | Proposal 5：Coexistence for TN/NTN study should be revisited for some assumptions as:1. Lower satellite altitude such as 300km,
2. Antenna array for satellite,
3. An isolation distance of 1500m
4. Cross link interference for NTN DL to TN UL and TN UL to NTN DL
 |

## Open issues summary

### Sub-topic 5-1 - Coexistence

**Issue 5-1-1: General consideration**

* Proposals
	+ Proposal 1: to consider the NTN scenario in relatively early phase in co-ex study, and in determine requirements for better co-existence for 6G Radio on both NTN and TN (Samsung)
* Recommended WF

This general principle should be acceptable.

**Issue 5-1-2: Areas to further study**

* Proposals
	+ Proposal 1: The isolation distance between NTN and TN from Rel-17 should be re-evaluated when consider NTN in 6G Radio co-existence (Samsung, CATT)
	+ Proposal 2: The UE density and its distribution in one and all beams/cell from a single SAN/satellite should be better modeled if we are targeting a more general overlapping co-ex between 6G NTN and TN (Samsung)
	+ Proposal 3: Lower satellite altitude as 300km (CATT)
	+ Proposal 4: Antenna array for satellite (CATT)
	+ Proposal 5: Cross-link interference for NTN DL to TN UL and TN UL to NTN DL (CATT)
	+ Proposal 6: NTN to NTN? (from Samsung’s observations)
		- Previous RAN4 did not really study NTN-NTN co-existence, due to the facts that NTN-NTN interference management and negotiation usually follows regulatory framework and out of 3GPP scope
		- With a more flexible trend of spectrum usage between NTN and TN, along with a common design purpose of 6G Radio for NTN and TN, the co-existence between NTN and TN, and even between NTN and NTN can be more critical than 5G
	+ Proposal 7: Other observation (Samsung)
		- If het-net structure between different satellite orbits are pursued as a key deployment in 6G NTN, the interference between NTN and TN, NTN and TN may be also studied.
* Recommended WF

RAN4 should further discuss which areas should be considered in the scope of the 6G SI, prioritizing them. Note there was no input from satellite companies on this topic, this might be missing here.

### Sub-topic 5-2 – Frequency bands for 6G

**Issue 5-2-2: NTN bands to be considered**

* Proposals: NTN bands to be considered
	+ Proposal 1: Consider FR1, Ka and Ku-bands (ZTE)
* Recommended WF

Those bands are already included for 5G NTN, they should also be included for 6G.

# Topic #6: SBFD

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513045**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513045.zip) | Samsung | Observation 11: The SBFD and dynamic TDD studied prior to Rel-19 were performed under the assumption similar to TR 38.803, which has significant difference to the 6G considerations.Proposal 7: The Rel-20 5GA SBFD-SBFD co-existence study and results should be leveraged as much as possible in considering co-ex of SBFD in 6G Radio co-ex related topics.Proposal 13: To be efficient and not duplicating work, the Rel-20 BS evolution WI outcomes, e.g. SBFD-capable gNB unwanted emission and Rx in-band blocking, can be taken as starting point for 6G BS requirements discussions in normative phase. |
| [**R4-2513129**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513129.zip) | CMCC | Observation 1: Research related to SBFD BS has been continuously conducted in recent releases and has received supports from numerous operators and BS vendors.Observation 2: Frequency around 7 GHz has the large bandwidth, which is beneficial for the deployment of SBFD BS.Proposal 1: SBFD BS should be defined in the 6G Day1. |
| [**R4-2513179**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513179.zip) | CATT | Proposal 2: 3GPP new study on full-duplex should be based on SBFD deployment experience in real network.  |
| [**R4-2513280**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513280.zip) | Xiaomi | Observation 3: SBFD in 6GR new frequency may be require new co-existence study.Proposal 3: RAN4 can discuss the necessity of SBFD coexistence study in new frequency rangesObservation 4: Potential new duplexing types depending on RAN1 progress including “FD-FDD, Semi-static TDD, gNB semi-static SBFD, HD-FDD on UE side and Dynamic TDD”.Proposal 4: RAN4 can discuss the necessity of coexistence study of the duplex types of “FD-FDD, Semi-static TDD, gNB semi-static SBFD, HD-FDD on UE side and Dynamic TDD” as the beginningProposal 5: RAN4 should not study those new potential duplex modes “gNB dynamic SBFD, UE SBFD and gNB FD” until RAN1 have new conclusion |

## Open issues summary

### Sub-topic 6-1 – SBFD in 6G

**Issue 6-1-1: SBFD in 6G**

* Proposals
	+ Proposal 1: The Rel-20 5GA SBFD-SBFD co-existence study and results should be leveraged as much as possible in considering co-ex of SBFD in 6G Radio co-ex related topics (Samsung)
	+ Proposal 2: To be efficient and not duplicating work, the Rel-20 BS evolution WI outcomes, e.g. SBFD-capable gNB unwanted emission and Rx in-band blocking, can be taken as starting point for 6G BS requirements discussions in normative phase (Samsung)
	+ Proposal 3: SBFD BS should be defined in the 6G Day1 (CMCC)
* Recommended WF

RAN4 should confirm if the above proposals and starting points are acceptable for 6G.

### Sub-topic 6-2 – SBFD coexistence studies

**Issue 6-2-1: new coexistence study for SBFD**

* Proposals
	+ Proposal 1: 3GPP new study on full-duplex should be based on SBFD deployment experience in real network (CATT)
	+ Proposal 2: RAN4 can discuss the necessity of SBFD coexistence study in new frequency ranges (Xiaomi)
	+ Proposal 3: RAN4 can discuss the necessity of coexistence study of the duplex types of “FD-FDD, Semi-static TDD, gNB semi-static SBFD, HD-FDD on UE side and Dynamic TDD” as the beginning (Xiaomi)
	+ Proposal 4: RAN4 should not study those new potential duplex modes “gNB dynamic SBFD, UE SBFD and gNB FD” until RAN1 have new conclusion (Xiaomi)
* Recommended WF

AS for the other coexistence studies, RAN4 should further discuss the scope for the 6G SI and prioritize the different options.

# Topic #7: Other aspects

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2513045**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513045.zip) | Samsung | Observation 16: The interference suffered by ISAC system can be classified into two types: 1) self-interference, which can be defined as the received undesired signal from the transmit antennas of the same sector in the same site 2) neighboring cell interference, including 2.1) co-site inter-sector co-channel interference and 2.2) inter-site TRP-TRP co-channel interference, which can be defined as the received undesired signal from the transmit antennas of neighboring sector in the same site and the received undesired signal from the transmit antennas of neighboring sites, respectively.Observation 17: When the ISAC system working in TDM mode, there is no self-interference between sensing and communication service. However, the self-interference between the sensing transmitter and the sensing receiver may exist under some circumstances.Observation 18: When the ISAC system working in FDM mode, the self-interference exists between 1) the sensing receiver and communication transmitter, 2) the communication receiver and the sensing transmitter, as well as 3) the sensing transmitter and the sensing receiver.Proposal 11: RAN4 could investigate the interference modelling and decides basic criteria to distinguish the interference signals from the desired target signal based on the sensing result. |
| [**R4-2513327**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513327.zip) | ZTE Corporation, Sanechips | Proposal 9: for the efficient coverage extension, propose to consider the RIS deployment in 6G day1.Proposal 10: for the sensing technology, propose to consider the 6G ISAC BS in 6G day1 at least. |
| [**R4-2513339**](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_116bis/Docs/R4-2513339.zip) | Ericsson Limited | Observation 2: RAN4 should discuss how to specify RF requirements for the new 6G features (e.g. ISAC), creating or not a new Technical Specification. |

## Open issues summary

### Sub-topic 7-1

**Issue 7-1-1: Repeater and NCR**

* Proposals: Repeater and NCR’s support in 6G
	+ Proposal 1: Consider Repeater and NCR (ZTE)
* Recommended WF
	+ To be further discussed if that’s common understanding and if any specific study should be considered for 6G.

**Issue 7-1-2: RIS and ISAC**

* Proposals
	+ Proposal 1: For the efficient coverage extension, propose to consider the RIS deployment in 6G day1 (ZTE)
	+ Proposal 2: For the sensing technology, propose to consider the 6G ISAC BS in 6G day1 at least (ZTE)
	+ Proposal 3: Coexistence studies might be needed with the introduction of new 6G features (Ericsson)
	+ Proposal 4: RAN4 should discuss how to specify RF requirements for the new 6G features (e.g. ISAC), creating or not a new Technical Specification (Ericsson)
* Recommended WF

Some proposals (e.g. sensing) might be out of scope of this AI and should be further discussed in the “sensing” AI.