**3GPP TSG-RAN WG4 Meeting # 104-e R4-22**

**Electronic Meeting, 15– 26 August, 2022**

**Agenda item:** 11.4.2

**Source:** Huawei, HiSilicon

**Title:** WF on investigation of mmWave multi-band BS

**Document for:** Approval

# Background

On investigation of mmWave multi-band BS, the following contributions have been discussed in RAN4#104-e 1st round discussion.

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Title** |
| [R4-2211658](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211658.zip) | CATT | General consideration on mmWave multi-band BS |
| [R4-2211775](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211775.zip) | Huawei, Hisilicon | General consideration on mmWave multi-band BS |
| [R4-2211811](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211811.zip) | Nokia, Nokia Shanghai Bell | Proposals on topics for investigation of mmWave multi-band BS |
| [R4-2211812](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211812.zip) | Nokia, Nokia Shanghai Bell | Discussion on possible issues on performance of wideband RF and antenna architectures |
| [R4-2212622](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212622.zip) | Ericsson | Multi-band BS in mm wave |
| [R4-2213700](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213700.zip) | ZTE Corporation | Discussion on FR2 multi-band operation |

And the status summary of 1st round can be found in following table [R4-2214174].

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| --- | --- |
|  | **Status summary**  |
| **Issue 2-1: FR1 multi-band BS methods and exceptions** | Based on 1st round discussion, companies are ok with the proposed list as a starting point. |
| **Issue 2-2: Definition of multi-band BS** | Based on 1st round discussion of the two options, it is proposed to further discuss the following proposals.* To investigate if the FR1 definition of multi-band RIB can be re-used for FR2
* To revisit the definition of multi-band BS for FR2, and clarify whether the following scenarios should be considered as multi-band BS

1) Multi-band transmitter and/or receiver with common active RF components2) Single-band transmitter and receiver 3) Configurable BS for different bands with the same hardware4) BS covers full-band or sub-band of band A and band B5) BS covers consecutive spectrums with different band number, for example, n258+n2616) BS covers overlapping spectrums with different band number, for example, n258+n257 |
| **Issue 2-3: Feasibility of FR2 multi-band BS** | Based on 1st round discussion, it is premature to have a conclusion on the feasibility study. Moderator suggest to discuss next step for future meetings. It is proposed to further discuss the following proposals.* The following technical challenges need to be studied for FR2 multi-band BS
	+ RF front-end
	+ Antenna array
	+ Phase shifters
	+ Beamforming architectures
	+ Others are not excluded
 |

# Way forward

## Definition of FR2 multi-band BS

* To investigate if the FR1 definition of multi-band RIB can be re-used for FR2
* To revisit the definition of multi-band BS for FR2, and clarify whether the following scenarios should be considered as multi-band BS

1) Multi-band transmitter and/or receiver with common active RF components

2) Single-band transmitter and receiver

3) Configurable BS for different bands with the same hardware

4) BS covers full-band or sub-band of band A and band B

5) BS covers consecutive spectrums with different band number, for example, n258+n261

6) BS covers overlapping spectrums with different band number, for example, n258+n257

**GTW discussion:**

* ZTE: We have comment on 4), do we need to consider sub-band B and full band A?
* Huawei: The intention to cover both.
* Nokia: For 4), 5), 6) what’s the difference for the treatment between FR1 and FR2?
* Huawei : Further study required for these aspects.
* Ericsson: We are ok to further study these items.
* Ericsson: In particular, whether FR2 multi-band definition is different compared to FR1.
* QC: We can focus on whether FR1 definition applicable for FR2.
* Huawei: In TR, we have definition for multi-band BS. In the specification we have definition of multi-band RIB.
* Nokia: In history discussion, from conformance test and requirements aspect, no need to specify multi-band BS into specification since the test and requirements are specified by RIB.

Agreement:

## Definition of FR2 multi-band BS

* To investigate if the FR1 definition of multi-band RIB can be re-used for FR2
* To revisit the definition of multi-band BS for FR2, and clarify whether the following scenarios should be considered as multi-band BS

1) Multi-band transmitter and/or receiver with common active RF components

2) Single-band transmitter and receiver

3) Configurable BS for different bands with the same hardware

4) BS covers full-band or sub-band of band A and band B

5) BS covers consecutive spectrums with different band number, for example, n258+n261

6) BS covers overlapping spectrums with different band number, for example, n258+n257

* FFS whether need to introduce the definition of multi-band BS for FR2 into specification

## Feasibility of FR2 multi-band BS

* The following technical challenges need to be studied for FR2 multi-band BS
	+ RF front-end
	+ Antenna array
	+ Phase shifters
	+ Beamforming architectures
	+ Others are not excluded
* The following topics should be considered for investigation of FR2 multi-band BS:

1) Additional declarations for FR2 multi-band BS

2) The applicability of multi-band requirements

3) OTA transmitter OFF power

4) OTA Adjacent Channel Leakage Power Ratio (ACLR)

5) OTA operating band unwanted emissions

6) OTA transmitter spurious emissions

7) OTA adjacent channel selectivity

8) OTA in-band blocking

9) OTA out-of-band blocking

10) OTA receiver spurious emissions

11) OTA receiver intermodulation

12) OTA EVM

13) EIRP accuracy

The largest feasible bandwidth for an FR2 multi-band BS should be studied and decided in the SI. ~~As a first step, the feasibility of supporting bands at both around 28 and around 40GHz should be decided, in particular whether the following multi-band combinations are feasible:~~

* + - * ~~28+39 GHz: n257/n261 + n260~~
			* ~~26+40 GHz: n258 + n259/n262~~
			* ~~28+40 GHz: n257/n261 + n259/n262~~

GTW discussion:

* Ericsson: The difficulty shall be multi-band RIB.
* Huawei: We don’t have definition for multi-band RIB for FR2, should be multi-band radio.
* Nokia: Multi-band BS aligned with SID. Whether need to include definition into specification is another issue.
* ZTE: I guess companies have same understanding, propose to multi-band BS supporting wideband radio.
* Ericsson: We are not considering the case to support separate bands with different hardware in the same box. We are considering multi-band with shared hardware.
* Ericsson: For third main bullet, we would like to have the decision on the possible supporting large bandwidth based on feasibility study.
* ZTE: We support the proposal to check the possibility supporting band combinations especially for 28 GHz around and 40GHz around band combinations.
* Nokia: This is already captured into SID. 26+28GHz missing in the list which also included in SID.
* Huawei: We share similar view as Nokia. Band combinations already included in the SID, it’s premature to down-selection. Feasible bandwidth just one of the aspects need to be considered for the feasibility study; we shall not conclude only based on this aspect.
* Ericsson: Band combinations list can be removed from the proposal. We would like to check the feasibility on wide bandwidth then we can focus on possible combinations.
* ZTE: We share similar view as Ericsson. We believe expect 28+26GHz combos, others quite difficulty.

Agreement:

## Feasibility of FR2 multi-band BS

* The following technical challenges need to be studied for FR2 multi-band BS
	+ RF front-end
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	+ Others are not excluded
* The following topics should be considered for investigation of FR2 multi-band BS:

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* The largest feasible bandwidth for an FR2 multi-band BS should be studied and decided in the SI.