

3GPP TSG RAN Rel-19 workshop

Taipei, June 15 - 16, 2023

Agenda Item: 6

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CMCC views on Rel-19 RAN4 topics

Principles and Timeline

- For Rel-19 RAN4 topics, technologies to meet clear and concrete commercial applications from operators should be prioritized.
- Enhancement WIs for FR1 RF, FR2 RF, RRM, gap and demodulation have already been conducted for 3 releases, only essential and effective enhancements that has clear benefits and deployment demand should be prioritized in Rel-19.
- Timeline for Rel-19 RAN4 WIs
 - **Non-spectrum topics to be approved in March 2024** (RAN Chair guidance)
 - **Performance only topics to be approved in June 2024** considering the completion of Rel-18 performance part.
 - **No hard timeline for spectrum topics approval.** Reserve dedicated TU for spectrum topics to meet operator deployment demand.

ATG enhancement (1/2)

Motivations

- As promising solution for aviation internet, ATG network attract operators and aircraft industry's interest to provide services for all passengers during the whole journey.
- In May 2023, Chinese Ministry of Industry and Information Technology release trial spectrum to CMCC for ATG technical testing.
- In R18, RAN4 start the standardization that only focus on **FR1 single carrier scenario**.
- Following issues are found during R18 which needs further enhancement in R19.
 - **Mitigate severe ATG gNB-to-TN gNB interference**
 - To avoid severe ATG BS to TN BS interference, larger than 10km isolation distance is required for FR1 which will introduce huge burden for ATG and TN cooperation deployment because FR1 TN network usually have contiguous coverage and difficult to adopt isolation distance to avoid gNB-to-gNB interference
 - **Enhance throughput to meet ATG capacity demand**
 - 100MHz is not enough for ATG network especially for very-busy route, larger CBW or carrier aggregation is required.

ATG enhancement (2/2)

Potential Objectives

- **FR2 to enhance capacity and reduce ATG gNB-to-TN gNB CLI interference**
 - Compared with FR1, FR2 ATG BS to TN BS interference would be reduced due to larger propagation loss.
 - Usually FR2 is not deployed to provide contiguous TN coverage, which makes isolation distance solution more feasible
 - Simulation results show that tens of km cell range is achievable for FR2
- **CA to enhance capacity, including intra-band CA and inter-band CA for FR1 and FR2**
 - FR1 intra-band CA
 - FR1+FR1 inter-band CA
 - FR2 intra-band CA
- **Other Rel-18 leftover issues**, following issues are still OPEN. Leftover issues would be further discussed in Rel-19
 - Cell reselection mechanism
 - Location-based CHO mechanism and CHO
 - Measurement requirements related with directional antenna
 - Guard period optimization

RF enhancement (1/2)

Motivations: UL Tx switching

- In Rel-17, UL Tx Switching between one carrier in band A and two contiguous carriers in band B was specified.
- In our network, **both 2.6GHz (n41) and 4.9GHz (n79) has two contiguous UL carriers.** In order to further improve the uplink throughput, **UL 2Tx-2Tx switching between band A (2.6GHz) and band B (4.9GHz), each with two contiguous uplink carriers, should be supported.**
- Time mask requirements need to be specified for **UL Tx switching between two contiguous carriers in band A and two contiguous carriers in band B.**
- According to TS38.214 section 6.1.6.2 Uplink switching for carrier aggregation, it is specified that UE is not expected to transmit for certain duration on any of the uplink carriers, there is no differentiation on the number of uplink carriers on each band. **No RAN1 impact is observed.**

Potential Objectives

- Specify UE requirements to enable Tx switching between cases, where 2 contiguous aggregated carriers on band A and 2 contiguous aggregated carriers on band B, including both 1Tx-2Tx switching and 2Tx-2Tx switching.

RF enhancement (2/2)



中国移动
China Mobile



Enhancement for Handheld UE

- **Prioritize handheld UE enhancement compared to FWA**
 - **6Rx single band for handheld UE**
 - Example bands are n41, n77 and n78 (other bands to be introduced in the release independent way later from Rel-18)
 - Applicable frequency upper bound to support 6Rx.
 - **3Tx inter-band UL CA for handheld UE**

HPUE enhancement

- **Specify RF requirements for PC1.5 of following band combinations**
 - PC1.5 2Tx: intra-band CA, PC2 TDD/FDD band 1Tx + PC2 TDD band 1Tx (UL MIMO and TxD) if not included in Rel-18
 - PC1.5 3Tx:
 - TDD + TDD band, including PC2 + PC2, PC1.5 + PC2/PC3
 - TDD + FDD band, including PC2+ PC2(2Tx)

RRM enhancement (1/3)

Motivations: measurement gap

- In Rel-18 MG Enhancements WI, for case 2: NCSG and concurrent MGs (i.e., the network has provided UE with multiple measurement gap patterns where at least one gap pattern is a NCSG), parallel measurements upon NCSGs collision is not supported due to limited timeline
- From deployment point of view, parallel measurements upon NCSGs collision could help to reduce the impact on throughput while maintaining the benefit of concurrent MGs. It is beneficial to consider parallel measurements upon NCSGs collision

Potential Objectives

- Specify RRM requirements to support parallel measurements upon NCSGs collision
- UE capability and/or network indication, if needed

RRM enhancement (2/3)

Motivations: Mobility

- In Rel-18 further NR mobility enhancements WI, L1 inter-frequency measurement with NCSG and L1 inter-frequency measurement with NeedforGap are not considered in R18 L1/L2 based inter-cell mobility
- L3 and L1 measurement are coupled. NCSG and NeedforGap, which reduce the impact on throughput from measurement gap, are already supported for L3 measurement. NCSG and NeedforGap without supporting L1 measurement results in different type of MG for L3 and L1 measurement, which is not efficient. It is beneficial to support L1 inter-frequency with NCSG and L1 inter-frequency with NeedforGap

Potential Objectives

- Specify RRM requirements to support L1 inter-frequency with NCSG and L1 inter-frequency with NeedforGap

RRM enhancement (3/3)

Motivations: AI/ML based RRM

- It is observed that some of the FR2 RRM requirements allow excessively long delay with RX beam sweeping factor (e.g. for cell re-selection, the scaling factor (N1) could be up to 8 for FR2-1)
- In Rel-18, for the use case of AI/ML based beam management, UE could predict beams in time/frequency domain. This approach is also helpful for UE to perform RX beam sweeping, the RX beam sweeping factor could be reduced or eliminated with AI/ML, the FR2 RRM long delay requirements could be reduced

Potential Objectives

- With AI/ML based RX beam sweeping, define enhanced RRM requirements for FR2, including:
 - RRC_IDLE state and RRC_inactive state
 - Cell re-selection requirements
 - RRC_Connected state
 - handover delay
 - Radio link monitoring, BFD, CBD, e.g. evaluation period
 - SCell activation delay
 - Cell identification requirements for intra-frequency and inter-frequency measurements

THANK YOU !

Annex: ATG network capacity demand

100MHz is not enough for ATG network especially for very-busy route

- According to the analysis in [3], even if we assume ATG network always use 64 QAM modulation scheme and 144 seats per airplane with 80% passengers, of whom 50% use ATG services. for hexagon area,
 - 180km cell radius require 30M CBW for non-busy route;
 - 90km cell radius require 60M CBW for busy-route;
 - 90km cell radius require 100M CBW for very-busy routes
- If ATG use 16 QAM or even QPSK due to large propagation loss from service gNB. Larger than 100MHz CBW is required especially for very busy-route.

Table 1. capacity demand for each hexagon with different radius/Mbps

	Radius of one hexagon area/km				
	60	90	120	150	180
Equal to DL target throughput (39.25Mbps) in table 2 * corresponding number of airplanes in table 4					
Non-busy routes	20.2	45.4	80.8	126.2	181.7
Busy routes	93.2	209.8	373.0	582.8	839.2
Very busy routes	149.4	336.2	597.7	933.8	1344.7

Annex: FR2 operation for ATG

- Compared with FR1, FR2 ATG BS to TN BS interference would be reduced to some extent due to larger propagation loss.
- Usually FR2 is not contiguous coverage, making isolation distance solution more feasible
- Simulation results show that **tens of km cell range** is achievable for FR2
 - At 100km cell edge, SNR is -4.3 dB for 16*4*2 antenna configuration and -7.3dB for 16*2*2 UE antenna configuration
 - At 80km cell edge, SNR is -2.4dB for 16*4*2 antenna configuration and -5.4dB for 16*2*2 UE antenna configuration
 - At 60km cell edge, SNR is 0.19dB for 16*4*2 antenna configuration and -2.8dB for 16*2*2 UE antenna configuration

