3GPP TSG-RAN Meeting # 101
Bangalore, India, September 11 – 15, 2023

RP-232318
Agenda Item 8A.3

MediaTek Views on RAN4 Rel-19

MediaTek Inc.

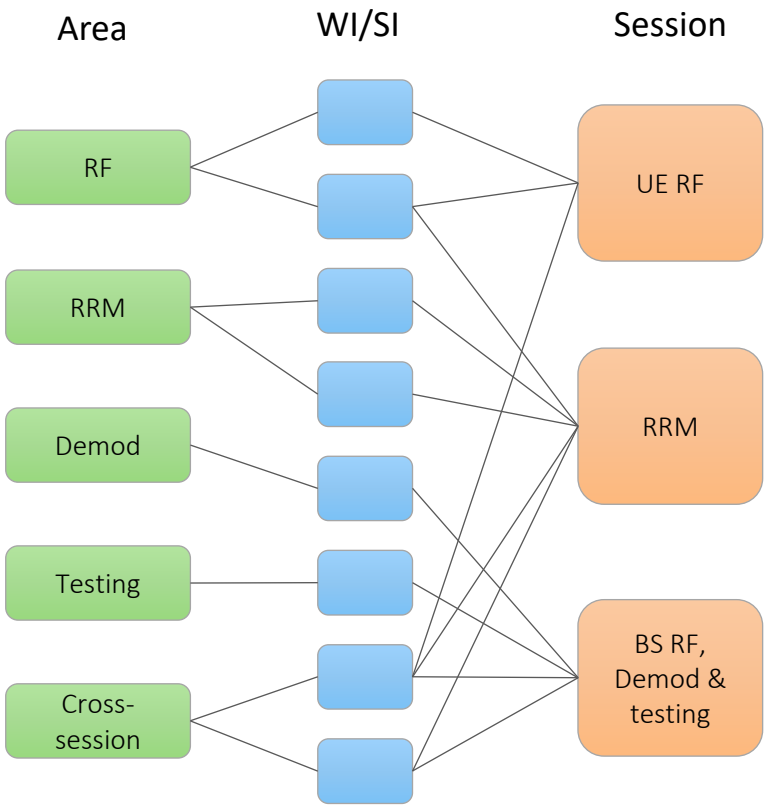
Outline

- General views on RAN4-led WI handling
- Proposals to individual areas

General views on handling RAN4-led WIs [1/1]

- Continue work on existing areas with balanced workload among sessions
  - **RF:** Spectrum-related, FR1 RF, FR2 RF, BS RF
  - **RRM:** RRM enh, MG enh
  - **Demod:** Demod enh
  - **Testing:** (OTA) testing
  - **Cross-session:** Others (e.g., NTN, HST, mRx..)

- No more than non-spectrum 12 WIs with ≤ 2 objectives for each WI to better control the workload
  - For RAN4-led Rel-18 items, total 16 WIs were approved in RP#95
  - An experience learned from Rel-17/18 discussions is that RAN4 spent a lot of online time clarifying RAN1, RAN2 and legacy RAN4 specs, before really moving forward. This overhead is expected to get larger and larger in Rel-19.
  - Leave sufficient margin for the uncertainty of RAN1/2/3-led work and RAN-tasks



A figure of concept on mapping from area to WI/SI and the impacted RAN4 sessions

Proposals to individual areas [1/3]

Area	Potential Objectives
RRM	HO interruption minimization
	Relaxed RLM/BFD measurement for Redcap
	Spec clean-up: calc. of K_p
Demod	Pre-configured NCSG
	NCSG enh for Scell

Area	Potential Objectives
Testing	Enhanced NTN testing for NGSO
NR NTN Enh.	NTN RedCap UE Support
	NR NTN 3MHz CBW
IoT NTN Enh.	NTN IoT HPUE support
	In-band/guard-band co-existence of NB-IoT w/ NR

Area	Potential Objectives
FR1 RF	New req. antenna correlation for FR1 multiple Tx (SI)
	Study of Tx req. for Redcap UEs for UL coverage enhancement
Spectrum	NTN NR Ku Band
	Uu+PC5 concurrent operation in licensed bands

Spectrum-related: NR NTN Ku band

- Motivations
  - Studying the introduction of Ku band for NR NTN offers the opportunity to expand spectrum resources, improve capacity and efficiency, ensure global compatibility, meet evolving application needs, and drive innovation in the telecommunications sector.
    - Significantly expand the available frequency resources for NTN
    - Is essential for ensuring global harmonization and compatibility. By understanding the technical considerations and regulatory aspects of deploying NR NTN in the Ku band, we can work towards establishing a standardized approach that facilitates interoperability and seamless operation across different regions and networks.
    - Aligns with the evolving needs of emerging applications and use cases and supports the development of innovative NTN applications, such as autonomous vehicles, remote sensing, and advanced industrial automation.
    - Foster technological advancements and drive innovation in the telecommunications industry, leading to the creation of new solutions, technologies, and services that leverage the unique characteristics and capabilities of the Ku band, and ultimately enhancing the overall performance and capabilities of NR NTN systems.

- Objectives
  - Investigate spectrum availability and regulatory considerations:
    - Evaluate the availability of Ku band spectrum for NR NTN deployments in different regions and countries.
    - Study the regulatory frameworks and spectrum management policies to understand the licensing requirements, coordination mechanisms, and potential challenges associated with utilizing the Ku band for NR NTN.
  - Study the feasibility of deploying NR NTN in the Ku band:
    - Evaluate the technical and operational feasibility of utilizing the Ku band for NR NTN, including applicable channel modeling etc.

Spectrum-related: Uu+PC5 concurrent operation in licensed bands

- Motivations
  - In Release 17 and 18, the specification includes inter-band concurrent operation of Uu in licensed bands and PC5 in unlicensed bands.
  - In Release 19, some particular scenarios involving UE collaborative operation are being considered, where one UE acts as a relay to another UE via sidelink. From a network perspective, both UEs are considered as a virtual UE with more antennas, allowing for increased layers. The sidelink communication between the two UEs operates in a licensed band.
  - To support this use case, concurrent operation of Uu and PC5 both in licensed bands is required. However, the current basket of work items introduced in Rel-17 and Rel-18 is limited to Uu in licensed bands and PC5 in unlicensed bands.

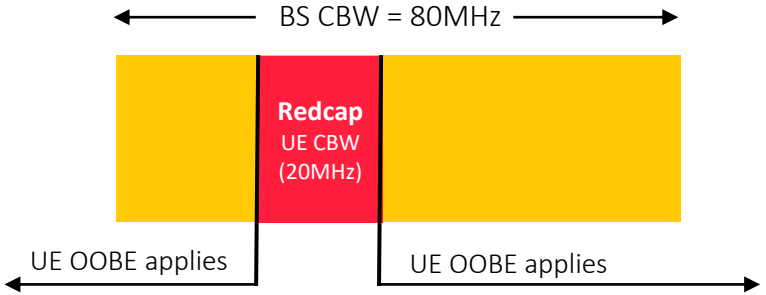
- Objectives
  - Specify band combination specific RF requirements for concurrent operation between NR Uu band and NR PC5 band
    - Both NR Uu band and NR PC5 band are licensed bands

FR1 RF: Study on UE antenna correlation

- Motivations
  - There is a gap between conducted and real-field performance for both Tx and Rx.
  - OTA TRP measurement for FR1 results in a randomized value by nature, and further analysis indicates that the deviation of TRP randomized measurements is directly associated with UE antenna correlation, e.g., an ECC with value larger than 0.3 may correspond to up to 2dB 2Tx TRP deviation.
  - From Rx perspective, correlated antennas may offset the diversity gain from multiple antennas. And even for advanced receivers, antenna correlation may reduce its potential gain.
  - With escalated interests of equipping a UE more and more antennas for both Tx and Rx while there is a limitation on the device size in particular for smart phones, understanding the impacts of antenna correlation on requirements and performance is essential to have robust and optimized operations at UE for both Tx and Rx.
  - Studying the impacts of antenna correlation on RF requirements and performance from standardization perspective is crucial for advancing the UE design and optimization thus contributes to the development of future UEs that can meet the increasing demands for high-speed, reliable, and seamless connectivity in various application domains.
  - A study item could be a suitable start for this purpose.
- Objectives
  - Study potential impacts of UE antenna correlation on Tx requirements
  - Study potential impacts of UE antenna correlation on Rx requirements and performance
  - Study potential test methodologies for UE antenna correlation

FR1 RF: Study of Tx requirements for RedCap UEs for UL coverage enhancement

- Motivations
  - RedCap UE always had to apply 20MHz channel BW Tx OOBE requirements even when it operates inside a wider Base Station channel with the RedCap BWP not allocated at the BS channel edge. Non-RedCap UE with same BWP config may apply IBE instead in such a scenario.
  - Where ACLR/SEM drive MPR for lower order modulations, not having to apply Tx OOBE from the 20MHz UE channel edge may allow MPR to be reduced, and UE UL link budget improvement



- Objectives
  - Study potential RF emission enhancement and associated MPR improvement for the scenario where a RedCap UE is located in an inner region of a wider BS channel bandwidth, without additional hardware complexity/impact for the UE
  - Identify mechanism that allows the network to signal to the UE that it is allowed to apply such relaxation.

RRM enhancement

- Motivations
  - HO interruption minimization
    - In current spec, UE stops source cell data Tx/Rx after receiving HO command. However, during HO delay, most of the time were spent waiting for SSB of the target cell. This waiting time can be better leveraged to reduce interruption.

  - Relaxed RLM/BFD measurement for Redcap
    - Power saving is very important to Redcap UE, but unfortunately these 2 Rel-17 features did not consider jointly in Rel-17 due to parallel discussions.
  - Spec clean-up: calculation of K_p
    - Current RRM spec contains 2 different approaches of calculating Kp (the delay extension parameter due to RS punctured by MG or shared between L1/L3 measurements).
      - One inherited from Rel-15
      - One introduced by Rel-17 MG enh.
    - This makes the spec difficult for maintenance and for new features to be added.

- Objectives
  - HO interruption minimization
    - Introduce an enhanced HO delay requirement by leveraging the waiting time of SSB to reduce interruption.
    - Phase 1: Start from Rel-15 HO requirements.
    - Phase 2: FFS whether and how to extend to conditional HO, HO with PSCell and LTM cell switch.
  - Relaxed RLM/BFD measurement for Redcap
    - Extend Rel-17 RLM/BFD measurement relaxation requirements to Redcap UEs
  - Spec clean-up: calculation of K_p
    - Study and decide a unified approach for the calculation of K_p.
    - Revise the spec before RANP#[106] meeting. So that other Rel-19 WI can be implemented based on the unified spec.
    - Note: No technical core requirements changes are expected

Measurement gap enhancement

- Motivations
  - Pre-configured NCSG
    - Leftover of Rel17/18 MGE
    - Benefit for faster and low-overhead on-off NCSG in scenarios like BWP switch or Scell activation/deactivation, i.e., avoid the delay and overhead RRC reconfiguration.
  - NCSG enh for Scell
    - Issue identified in Rel-18.
    - Current UE capability report of NCSG for serving cell does not distinguish whether
      - Scell is deactivated, or
      - Scell is activated with SSB outside of active BWP
    - This leads to ambiguity in UE behavior or more conservative reporting.

- Objectives
  - Pre-configured NCSG
    - Introduce the RRM requirements when UE is pre-configured with NCSG
  - NCSG enhancement for SCell
    - Introduce an additional UE capability to distinguish the support of NCSG for deactivated SCell and activated SCell with SSB outside of active BWP
    - Define the corresponding RRM requirement.
    - Consider to extend the concept to NeedforGap after the discussions of NCSG are stable.

Demod enhancement

- Motivations
  - Application layer throughput enh: OLLA and 4-layer
    - Leftover of Rel-18 Demod work. Extending the current scope to consider OLLA and 4-layer provides an even better assessment of UE performance in the real deployment scenario.
  - CQI report for R-ML SU-MIMO receiver
    - Advanced R-ML SU-MIMO receiver is already considered in current PDSCH demodulation test, but not in the CQI test. This mismatch needs to be fixed to improve close-loop link adaptation efficiency.

- Objectives
  - App layer throughput enh: OLLA and 4-layer
    - Specify absolute physical layer throughput requirements with link adaptation with
      - Outer-loop link adaptation at gNB side enabled, and/or
      - 4-layer MIMO
  - CQI report for R-ML receiver
    - Introduce the CQI test cases for advanced R-ML receivers

Enhancend NTN testing for NGSO

- Motivations
  - RAN4 RRM and demod requirements for NR NTN (NR_NTN_solutions) was introduced in Rel-17, and for IoT NTN (LTE_NBIOT_eMTC_NTN_req) the requirements have just been completed early in Rel-18.
  - Two different types of satellites were considered, e.g., Geostationary orbit (GSO) and Non-geostationary orbit (NGSO)
    - In the current RRM and Demod test cases, the DL arrival timing and Doppler frequency offsets of the modelled channel were agreed to be fixed.
    - Under an NGSO field scenario, a large/continual variation in DL arrival timing and Doppler frequency will likely be observed at the UE. As these characteristics are not well represented by the current RAN4 modelling, it may lead to unpredictable UE performance in the field for an NGSO deployment.
  - To fix this, a new WI is needed to introduce a new channel model which reflect correctly the ephemeris seen by UE.
  - Note: this is related to the ongoing LS R5-233672 and R4-2314001

- Objectives
  - Phase I (study phase)
    - Collect inputs of satellite trajectory and UE locations
    - Derive the following time-varying channel parameters as well as the testability based on above inputs
      - Arrival timing
      - Doppler
      - [Sampling rate]
  - Phase II (work phase)
    - Define the SIB19 message and introduce new channel models based on phase I study outcome
    - Define corresponding test cases and requirements

NR NTN Evolution

- Motivations
  - There is a growing interest in NTN networks, and a wide range of vendors are providing support for terminal, chipset, and infrastructure development. This has led to the initiation of normative activities in 3GPP, including the creation of work items in Rel-18 for IoT NTN and NR NTN to define enhancements for various use case requirements.
  - In addition, the introduction of RedCap UE in Rel-17 aims to reduce UE complexity and cater to use cases such as industrial wireless sensors and video surveillance. There is an increasing interest and demand to extend the benefits of RedCap UE for NTN systems.
  - Furthermore, there is a recognized need to support less than 5MHz in NR NTN for licensees operating regionally and nationally in the USA, Europe, SE Asia, and Africa. By leveraging the work item for NR support for dedicated spectrum less than 5MHz for FR1, there is an opportunity to improve uplink and downlink coverage in NTN by considering NTN characteristics such as large propagation delay and satellite movement.

- Objectives
  - Specify support for the UE complexity reduction (RedCap) features for NTN

    Note:
    - Re-use existing RedCap UE requirements as much as possible
    - Coexistence with non-RedCap NTN UEs is to be ensured.
    - Focuses on SA mode and single connectivity with operation in a single band at a time.

  - Specify necessary RAN4 requirements to support deploying NR in spectrum allocations from approximately 3 MHz up to below 5 MHz for NTN

    Note:
    - Re-use outcome of Rel-18 dedicated spectrum less than 5MHz for FR1 UE requirements [NR_FR1_lessthan_5MHz_BW] as much as possible

IoT NTN Evolution

- Motivations
  - With the increasing demand for IoT devices and applications, there is a growing need for high power UE for IoT NTN. High power UE can provide better signal strength and UL coverage, which is essential for IoT devices that operate in challenging environments. High power UE for IoT NTN can drive innovation in the IoT industry, and also create new business opportunities by enabling new use cases and applications.
  - In-band/guard-band NB-IoT with NR NTN offers the advantage of utilizing the existing spectrum for NB-IoT deployments. This allows for efficient use of resources and enables seamless coexistence with other services, and reduces the need for additional spectrum allocation. By leveraging in-band/guard-band NB-IoT with NR NTN, operators can maximize the coverage and capacity of their existing networks, and also provide a cost-effective solution for IoT connectivity. The combination of in-band/guard-band NB-IoT with NR NTN offers enhanced performance and reliability for IoT applications, and ensures a seamless and robust connectivity experience for IoT devices, hence opens up new opportunities for innovative IoT use cases and applications.
- Objectives
  - Specify HPUE support for IoT NTN
  - Specify In-band/guard-band co-existence of NB-IoT w/ NR NTN

Thank you!