

Views on the 3GPP RAN Rel-19

Overview of 3GPP Rel-19 RAN topics

- As the rapid development of 5G network and operators can providing the 5G to rural area, 5G network provides the service to a larger population. In the upcoming years, the 5G data volume is increasing quite significant and exceeds to 4G data volume soon.
- Although 3GPP continue work on the evolution of 5G standards, the new market demands are still very hard to be satisfied quickly, due to the long time are spending to discuss on the use cases, possibility study on the real needs and potential solutions, etc.
- The new technologies for Rel-19 shall meet the potential market demands and develop to provide at least the fundamental solutions for operators' deployment, other than the purely study work on the requirements, evaluation without the outcome of standardization progress for 5G commercial deployment.
- As the 2nd release of 5G-A technology, 3GPP Rel-19 is aiming to evolve on the basis of 5G network enhancement and explored the new areas, such as ISAC and ambient IoT.

Overview of 3GPP Rel-19 RAN topics

- 3GPP Rel-19 shall aim to develop the further enhancement on the features in Rel-18 as well as to support the new features, such as ISAC and ambient IoT.

R19 New Area

Rel-19 New Area

➤ Integrated sensing and communication (ISAC)

➤ Ambient IoT

5G-A Evolution Topics (evolution from Rel-18)

Network Functionalities

- MIMO further enh
- Mobility enh
- NR CA/DC enh
- Positioning enh
- MUSIM

5G new Service

- XR enh
- Sidelink/Sidelink Relay enh
- Multicast/Broadcast enh

Coverage extension

- NTN enh
- UAV enh

5G Networking technology

- NCR enh
- IAB enh

5G Network Intelligence

- AI/ML for PHY and NG-RAN

5G transmission

- Flexible/Full Duplex enh

Energy Saving

- Network ES enh
- Low power WUS enh

Network maintenance

- SON/MDT enh
- QoE enh

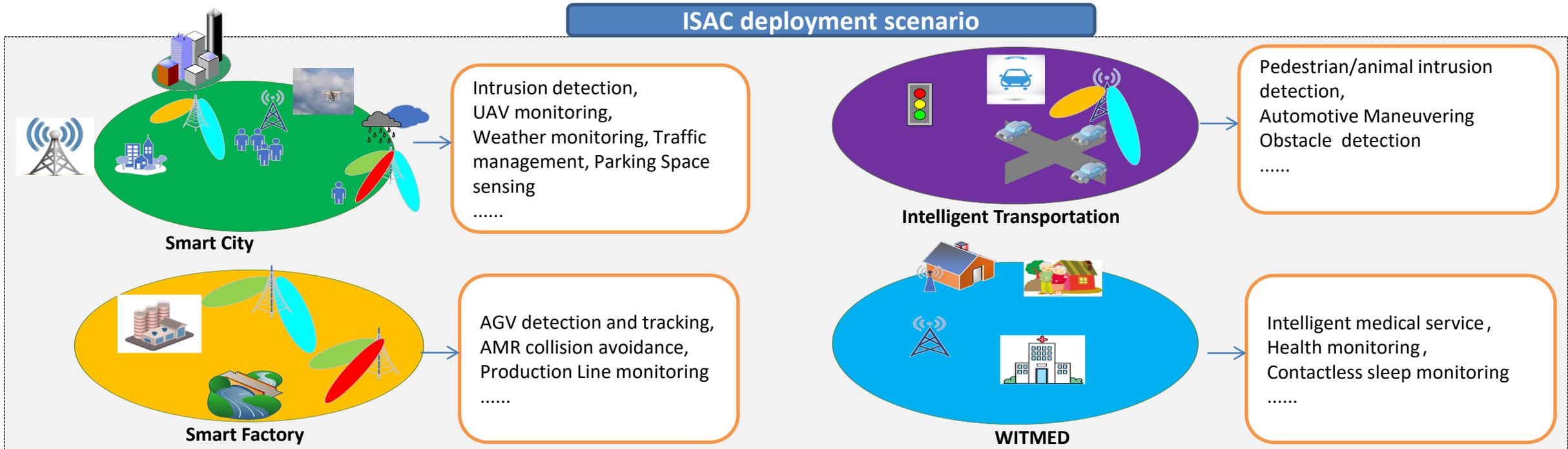
1. Integrated sensing and communication(1/2)

□ Motivation:

- ISAC provides with the new type of service combing of communication and sensing on the infrastructure of 5G network.
- ISAC is designed to utilizes NR bands (both FR1 and FR2) to provide customs with the new sensing assisted service, e.g. objective detection, tracking and monitoring. ISAC is intending to provide at a low cost of commercial 5G network.

□ Scenarios

- ISAC deployment scenario: smart city, intelligent transportation, WITMED, smart factory.



1. Integrated sensing and communication (2/2)

□ Considerations for the work plan of ISAC in RAN Rel-19

- 3GPP is target to design and support for the preliminary service of ISAC in Rel-19, otherwise, there are no competitive 5G new service for industry customs.
- One or separate Rel-19 SI+WI for ISAC :
 - RAN1 SI for channel modeling, evaluation and PHY design.
 - RAN3/2 SI+WI for ISAC related architecture and functionality

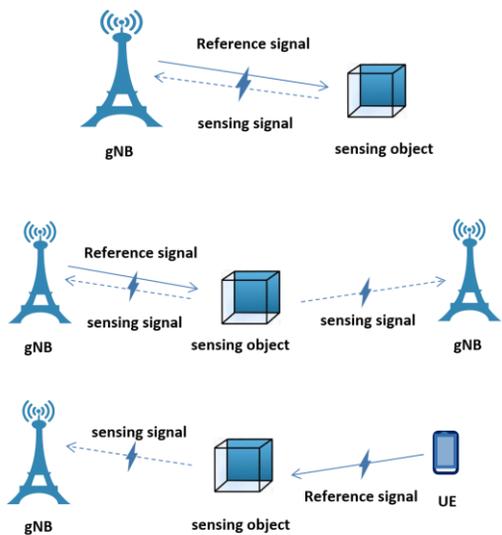


Fig 1. gNB sensing mode

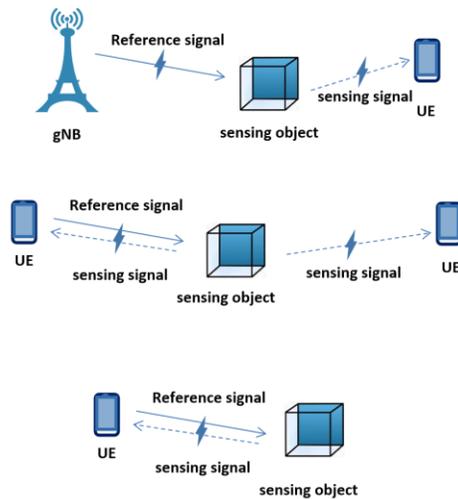


Fig 2. UE sensing mode

□ Objective (SI in RAN1+ RAN3/2 SI+WI):

- Identify the target use cases and KPIs for each use cases.
- Study on ISAC channel models (based on TR 38.901) and evaluation.
 - gNB mono-static/ bi-static sensing, UE to/from gNB bi-static sensing;
 - Note: restrict the performance evaluation for typical use cases and the KPIs, e.g. accuracy, range, velocity and angle, if needed.
- Study physical layer related design and specification impacts for ISAC
 - Take the legacy reference signals (e.g. CSI-RS, SRS, PRS) as the baseline, evaluate the performance
 - Study the enhancement on RS, to fulfill the performance requirements if needed(2nd priority).
- Study the potential solutions related with ISAC, e.g. interference mitigation on sensing, synchronization btw the transmitter and the receiver for bi-static sensing, multi-TRP, etc
- Study and specify the ISAC potential architecture and functionality
 - Sensing mode: gNB sensing, gNB and UE coordinated sensing;
 - sensing resource configuration, sensing information report, etc.
 - sensing service continuity for multiple gNBs.

2. FR2 enhancement

- ❑ **Motivation 1:** The larger scale of antenna array elements will be utilized to fulfill the needs for improving the FR2 macro cell coverage, with a large number of narrow BS beams.

- Issue 1: Transmitting more CSI-RS over the air interface will lead to more UE power consumption and RS overhead.



The UE will measure 2~8x CSI-RSs.
 Fig.1 BS will transmit more BM-CSI-RS to the UE.

- Issue 2: UE's RSRP will fluctuate violently due to the FR2 narrow beam switching in UE mobility scenario.

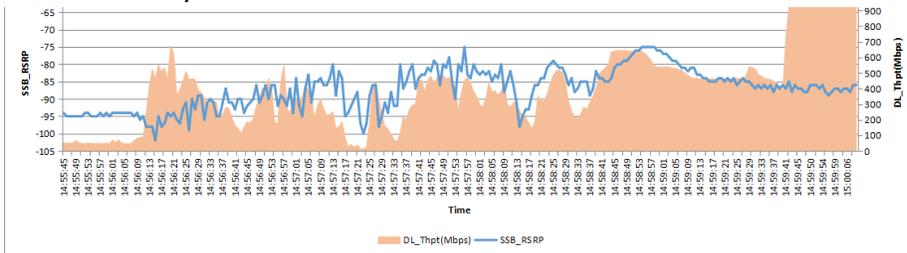


Fig.2 RSRP fluctuates greatly will degrade the UL/DL throughput performance

Potential Objective:

- ❑ **Support beam management and CSI enhancement to with large antenna array.**
 - BS overhead reduction / UE BM power saving / narrow BM tracking.
- ❑ **Support fast activation mechanism for FR2 cell in NR-CA scenario.**
 - Beam management enhancement, e.g. FR1-assisted beam determination for FR2 cell, and enhancement for FR2 RS.
- ❑ **Support Fast failure detection and recovery in FR2 ONLY scenario.**
 - Enable fast failure detection for Pcell, and enable fast failure recovery for Scell.
- ❑ **Support RRM measurement optimization of FR2 handover process, targeting at reducing the measurement delay.**

- ❑ **Motivation 2:** For NR-CA scenario, how to quickly (less than 100ms) activate the FR2 cell to fulfill user's requirements of large bandwidth and higher data rate.

- Issue: It costs more than 500ms delay (SSB period × sweeping time) for FR1 to activate the FR2 cell, which have negative impact on user experience.



Fig.3 More than 640ms delay (32 SSB) for FR2 cell activation Fig.4 Omnidirectional Beam vs 8 beams

- ❑ **Motivation 3:** Failure recovery is not supported for CA case.
 - Issue: If RLF is detected on Pcell, the re-establishment delay will be very long due to multi-beam mechanism for FR2.
- ❑ **Motivation 4:** Short handover delay is needed for better experience.
 - Issue: Handover delay for FR2 is longer comparing to FR1 due to longer searching time (8 beams for FR2 UE vs Omnidirectional beam for FR1).

3. Further enhancement on NR QoE

□ Motivation

- Rel-17/Rel-18 QoE and enhancement is design to specify the unified mechanism for SA and MR-DC architecture to collect and optimize the experience parameters for the traditional eMBB service, and MBS service.
- In Rel-18, there are also some leftover issues rely on the progress of other WGs, such as SA4. It need to be further studied in Rel-19.
- Considering the new requirements, such as RVQoE enhancement, AI+QoE, new architecture of sidelink relay, 5G+WLAN.
- The AI/ML applied for QoE optimization can be used for QoE data analysis, model training for resource optimization and user experience prediction. Since the RAN visible QoE metrics and transmission mechanism are all studied and specified in QoE WI, it is better to continue discuss the new metrics and service type of QoE in Rel-19.

□ Further enh on QoE can include the following objective.

- Specify RAN visible QoE metrics for XR, MBS service, etc (rely on SA4 QoE metrics progress).
- Support QoE collection for MBS multicast service in INACTIVE/IDLE state.
- Support QoE continuity during Inter-RAT HO
 - Multiple QoE configurations for one UE during inter-RAT HO;
 - QoE continuity for intra-system (5GC)/ inter-system scenarios (e.g. HO btw 5G and 4G).
- New metrics and enhancement on mechanism for supporting AI/ML new use case of QoE analysis.
 - The metrics related with QoE prediction, QoE assisted access control and mobility;
 - Correlation for RVQoE and radio related measurements in gNB.
- Support for new architecture, e.g. sidelink relay, 5G+WLAN.

4. NTN enhancement (1/2)

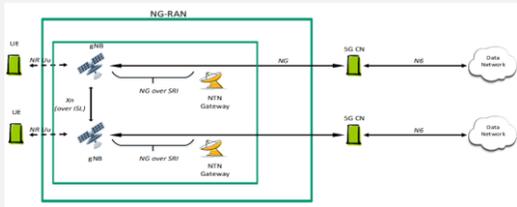
□ Motivation:

- NTN standards were designed and built on the terrestrial specifications, which enables communication between users and satellites, and provides communication services in areas without cellular network.

□ Scenarios

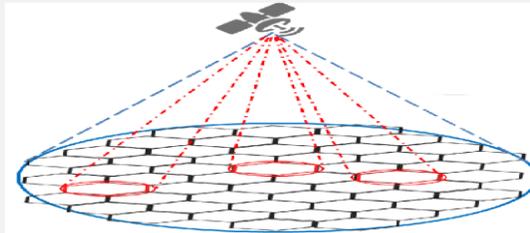
- Supplementary coverage for the cellular network: aviation, ocean and other scenarios.
- Backup for the cellular network: emergency communication.
- Smart phones connected to satellite directly.

Non-terrestrial networks



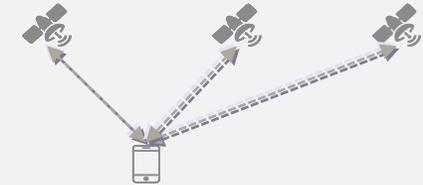
Regenerative structure

Architecture and functionality, interface, performance.



Beam hopping

Beam hopping in transparent and regenerative mode.



Positioning without GNSS

Multi-point positioning by single satellite,
Multi-satellite positioning,
Performance evaluation.

4. NTN enhancement(2/2)

□ Objectives:

- Regenerative structure: study on communication functions on board
 - Study CU/DU splitting mechanism for NTN, new option or following split options in TS38.801.
 - Considering impact of feeder link performance (e.g., latency, peak data rate) for different CU/DU splitting options.

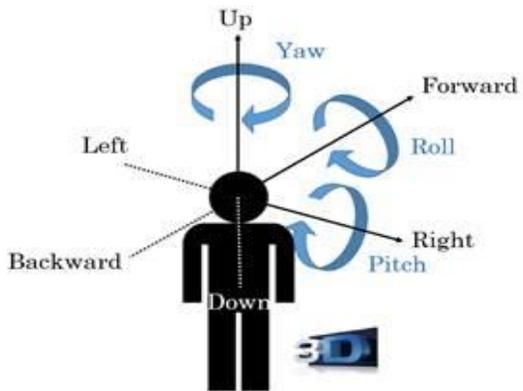
- Study the beam hopping mechanism for NTN satellite:
 - Performance evaluation of beam hopping mechanism for both transparent and regenerative modes.
 - Study and define the interface between satellite and base station, beam coverage on demand in transparent modes.

- Positioning without GNSS:
 - Study on using other positioning methods for NTN UE (e.g., satellite positioning, cellular positioning) to obtain location information).

5. XR enhancement

□ Motivation:

- As an emerging business, the popularity and ecosystem scale of XR business have shown an explosive growth trend in the past two years. R18 XR has completed SI work and is carrying out WI standardization work.
- In R19, XR enhancement WI should be further standardized. New requirements from SA, such as multi-modal and meta-universe, should be considered. And outcome and leftover issues of R18 XR should also be involved.



XR interaction mode- 6DoF



Gaming



VR education

Typical scenarios of XR

□ R18 XR WI focus on the standardization of XR power saving enhancement, capacity and service identification.

- Power saving enhancement : DRX supporting XR frames.
- Capacity enhancement: Multiple CG PUSCH transmission opportunities, dynamic indication of unused CG PUSCH transmission opportunities, BSR enhancement, delay reporting of uplink cache data, and discarding operation of PDU sets.
- XR awareness and identification: QoS flow, PDU set information and interactive signaling, UE XR service assistance information, RAN to CN congestion information signaling.

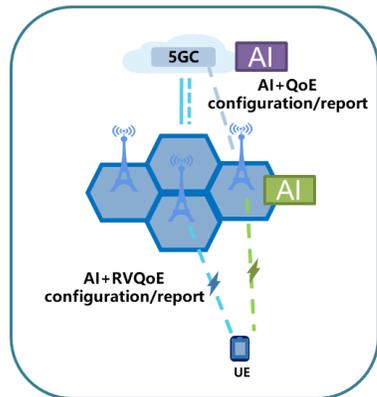
□ Potential scope for Rel-19

- Define RAN multi-modal traffic model and KPI.
- RAN-aware multi-modal XR parameters and corresponding scheduling enhancements at RAN.
- Capacity enhancement and low latency enhancement especially considering multi-user XR scenarios.

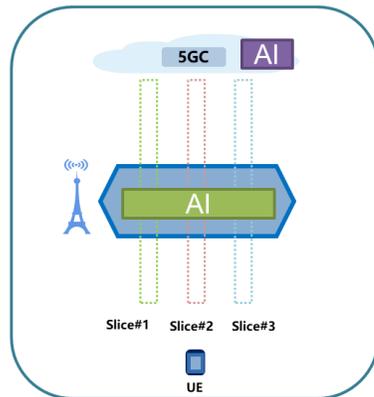
6. AI/ML enhancement for NG-RAN

□ Motivation:

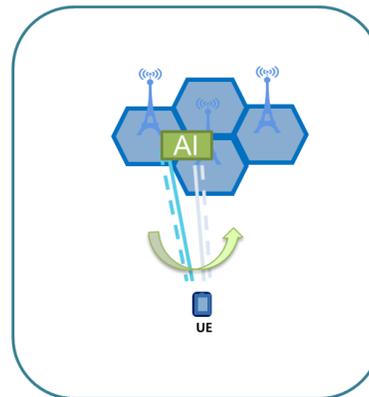
With the evolution of 5G network intelligence, AI has been considered as a key technology for improving network performance. In the next release, other potential use cases could be further discussed to identify the AI enabling features based on Rel-18, e.g. QoE, network slicing, etc. Meanwhile NR-DC scenario can be supported for latency reduction and performance optimization during NR-DC setup/release procedure.



AI + QoE



AI + RAN slicing



AI in NR-DC

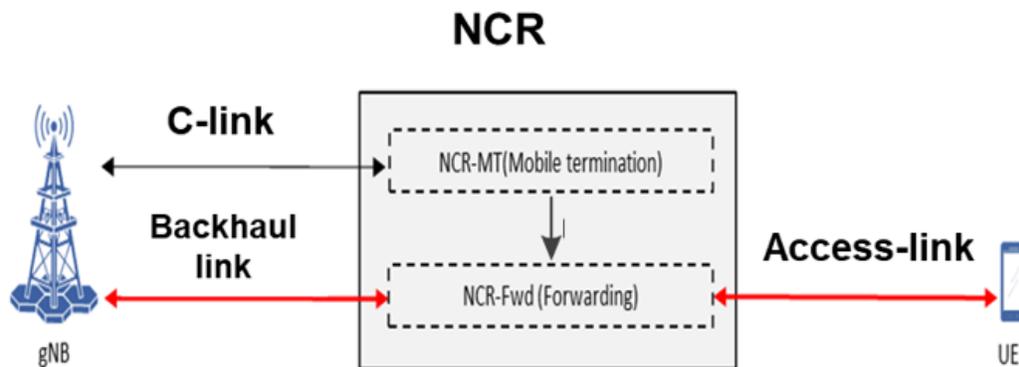
□ R19 potential scope to study new use cases to improve network performance.

- For AI-based network slicing use cases, e.g. predict user traffic, resource status, and other information, intelligently and dynamically allocate network resources to different network slices.
- For AI-based QoE use cases.
 - Predict the QoE requirements of 5G service type, aiming to optimize resource allocation, and improve user experience
- Study and specify for AI/ML feature in NR-DC:
 - Assist in DC establishment and update with UE trajectory prediction.

7. NCR Enhancement & RIS

□ Motivation:

- A large number of theoretical innovations and prototype tests have demonstrated that NCR has advantages in low cost, low power consumption and easy deployment, which generates many potential opportunities and broad application prospects in the 5G and future 6G networks.



□ R19 potential scope.

- Side control information: beamforming/ON-OFF/timing/power control.
- L1/L2 signaling: beamforming/ON-OFF/timing/power control.
- Performance and power consumption evaluation.
- Study Channel Model for RIS
 - Scatting pattern, reciprocity and cross polarization of RIS with GBSM and hybrid modeling methods.
 - Large/ small scale channel model.

8. Ambient IoT

- ❑ **Aiming to support the commercial deployment for ambient IoT in Rel-19, the SI plus WI is preferred(e.g. SI is for 9 mons and WI is 9 mons).**
 - RAN level SI will be completed by Sep. 2023, and the potential scopes of Rel-19 will be decided in RAN plenary.
- ❑ **Rel-18 Ambient IoT SI will study the use cases, deployment scenarios, KPIs and requirements of potential solutions, etc.**
 - Lower frequency FR1 band is preferred(n8, n1).
 - Support for passive and active devices.
- ❑ **Potential scope of Rel-19 Ambient IoT (limits the impact in RAN1)**
 - On the basis of RAN-level study item, the use cases, typical scenarios, requirements are identified first.
 - Study and specify the air-interface design, related with waveform, channel coding, energy saving, etc. The potential evaluations are required for both link-level and system-level.
 - Study and specify the potential solutions for energy harvesting, low power design, etc.
 - Potential impact on network interface, e.g. NG, Xn, F1, E1.

9. Enhancement on Network Energy Saving

- ❑ **Rel-18 network energy saving WI has support the network energy saving solutions in spacial domain, time domain, frequency domain.**
 - The energy saving gain is expected significantly by switching off the PA transmission.
 - Support for both static power saving and dynamic energy saving.

- ❑ **Potential scope of Rel-19 enhancement on network energy saving**
 - Support for SIB1-less operation
 - For multi-carrier deployment scenario for energy saving, the anchor cell and non-anchor cell could coordinated to offload traffic dynamically and reduce the cost and power of SSB/SIB.
 - Support for On-demand SSB/SIB1
 - For cell dormancy, the cell could be waken up and SSB/SIB1 can resume to transmit.
 - Apply for both single cell and multiple cells.
 - Considering the potential use case of AI/ML for network energy saving for PHY layer.

10. Enhancement on CA/DC(Multicarrier)

- ❑ **Motivation 1:** For FR1-FR2 NR-CA scenario, when the XR terminals are served with FR2 band, the interruption latency for FR2 Scell switching needs to be very small to guarantee the user experience.
 - Issue: It still takes longer for Scell switching even with L1/L2 signaling in Rel-18 (e.g. ~50ms).
- ❑ **Motivation 2:** 3.5GHz (TDD) + 2.1GHz (FDD) CA has been deployed for 5G network, cells (3.5G/2.1G) are configured with different SCS (30KHz/15KHz), the signalling overhead needs to be further reduced while both cells are scheduled simultaneously.
 - Issue: PDSCH/PUSCH of cells with different SCSs cannot be scheduled by a single DCI in Rel-18.
- ❑ **Motivation 3:** When multiple co-located neighboring CCs(e.g. 1.8G+2.1G CA) are deployed in 5G network, the UE can only obtain individual channel information of each CC.
 - Issue: Only independent CSI measurement among multi carriers is supported in Rel-18.

❑ Potential scope

- Single DCI functionality enhancement
 - Support the scheduling of the PUSCH/PDSCH for 4 cells with different SCS;
 - Support the FR1 and FR2 with different SCS simultaneously;
 - Other potential enhancements: TB size, HARQ.
- Two stage DCI: extend to support more than 4 carriers.
- Support the “ms-level” carrier fast handover, e.g. L1 measurement will be more appropriate to adapt for the fast channel variation.
- Enhance the configuration capability of UL and SUL carriers to satisfy the requirements of 5G network deployment.
- Support joint CSI measurement across multiple carriers.
- Support to study about the Multi-band Single Cell mechanism: How to optimize the signalling procedure for unconventional inter-frequency scenario, e.g. 2.1G/1.8G, 800M/900M etc.

11. Enhancement on mobility

- ❑ **Motivation 1:** To achieve wider range mobility performance with low interruption and high throughput for XR terminals, inter-CU LTM is needed.
 - Issue: LTM is limited to intra-CU operation in Rel-18 mobility.
- ❑ **Motivation 2:** To enhance LTM in 5G networks and achieve seamless and reliable handover.
 - Issue 1: The goal of 0ms interruption time is not achieved in Rel-18.
 - Issue 2: Handover interruption time, RLFs and handover failure improvements.
 - Issue 3: Handover successful probability needs to be improved in case of radio link degradation.
- ❑ **Motivation 3:** To reduce the signaling overhead for handover in 5G networks.
 - Issue: Frequent update of handover parameters incurs high RRC signaling overhead.

❑ Potential scope

- To specify mechanism and procedures of L1/L2 based inter-cell mobility for inter-CU case.
 - Xn interaction for pre-configuration, data forwarding, etc.
 - Early DL/UL synchronization before L1/L2 HO command.
 - Security key update and L2 handling
- Specify DAPS enhancement:
 - Support DAPS for FR2 bands, CA scenario;
 - DAPS like for LTM, e.g. UE maintains the connection with source cell/TRP when connecting with target;
- Support handover failure handling for LTM.
- Support LTM-based CHO.
- Study and specify the group handover mechanism.

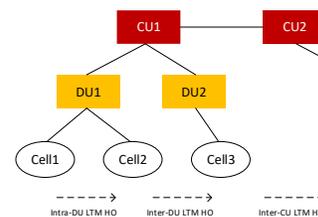


Fig.1 Different LTM HO Approach

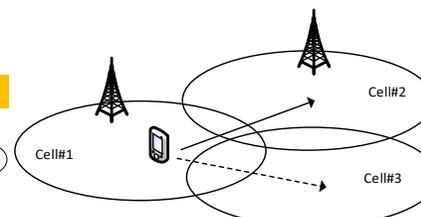


Fig.2 DAPS enhancements

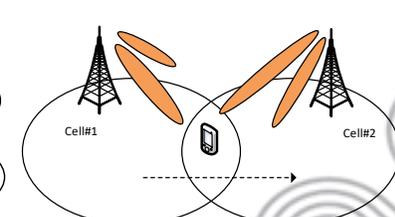


Fig.3 LTM-based CHO

Thanks!

Q&A

