

**3GPP TSG RAN Rel-19 workshop**

**Taipei, June 15 - 16, 2023**

**Agenda Item: 6**

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# **CMCC views on Rel-19**

# Views on Rel-19 topics

## Upgrade 5G-A and lay foundation for future



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<b>New features</b>	<ul style="list-style-type: none"><li>• NR duplex evolution, Ambient IoT, AI/ML, Collaborative UEs, Wired-terminal RSU, Elastic cell, LP-WUS</li></ul>
<b>Foundation for future</b>	<ul style="list-style-type: none"><li>• Integrated sensing and communication</li><li>• Realistic channel information collection for AI/ML</li></ul>
<b>Feature evolution &amp; Problem solving</b>	<ul style="list-style-type: none"><li>• MIMO, Positioning, NES, NCR, eLTM, XR, MultiSim, NTN, UAV...</li></ul>



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# NR duplex evolution



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## Motivations

- NR duplex evolution including both SBFD and dynamic/flexible TDD is being studied in Rel-18.
- A follow-up WI is expected based on the conclusion of the study.

## Potential Objectives (exact scope pending on Rel-18 SI conclusion)

- Specify subband signalling and UE behavior for SBFD operation within TDD carrier [RAN1]
  - Subband time and frequency locations indication
  - UL transmission and DL reception behavior in SBFD symbols for half-duplex UE, including UE collision handling
- Specify enhancements for physical channels/signals transmissions and receptions for SBFD [RAN1]
  - Enhancement of PDSCH/PUSCH resource allocation and precoding granularity in SBFD symbol
  - Enhancement of CSI-RS resource allocation and CSI report
  - Enhancement of transmissions and receptions across SBFD symbols and non-SBFD symbols within a slot or across SBFD slots and non-SBFD slots
- Specify inter-gNB CLI handling schemes for SBFD and dynamic/flexible TDD [RAN1, RAN3]
  - Inter-gNB CLI measurement and/or channel measurement
  - Network information exchange, including exchange of SBFD time and frequency configuration, inter-gNB CLI measurement resource and results
- Specify inter-UE CLI handling schemes for SBFD and dynamic/flexible TDD [RAN1]
  - Inter-UE CLI-RSSI measurement and report across downlink subbands
  - L1/L2 inter-UE CLI measurement and report.
- Define RF core and performance requirements for SBFD gNB and UE if needed [RAN4]

## Motivations

- Current status:
  - RAN level SI will be completed in 2023Q3, and has studied on 4 representative use cases, 3 device categories and 4 connectivity topologies.
- Our views:
  - If all the above open scopes will be studied in Rel-19, it would take 18 months for evaluation and study. While, if we only focus on the basic and common design for the above options, although still challenging, it would be possible to finish SI and WI in Rel-19. The benefit is to meet the vertical customers' requirement in a faster way at 2025Q4..
  - We propose to have 9 month SI + 9 month WI in Rel-19, with focused scope :
    - focus on the basic and common design for inventory use case, passive device and ambient-link air interface for topology 1&2
    - If active device is considered into the scope, it should reuse the design of passive device as much as possible

## Potential Objectives

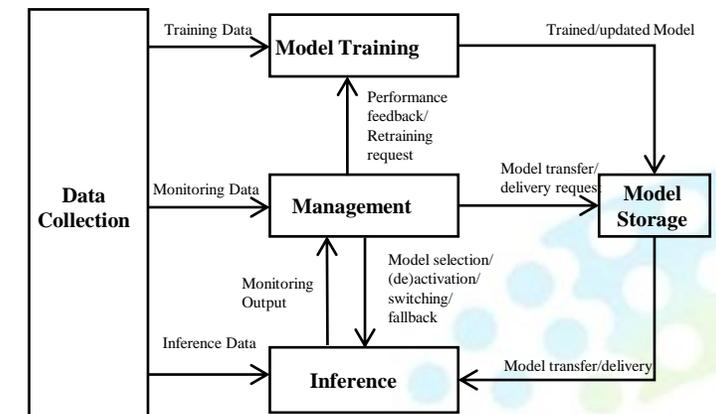
- Identify evaluation methodology and KPIs based on RAN design target [RAN1]
  - Simulation parameters used to evaluate physical layer designs, link budget template for coverage evaluation
- Study on the physical layer aspects, focusing on the basic and common design for inventory use case, passive device and ambient-link air interface for topology 1&2, including [RAN1]
  - Fundamental physical layer signal structure including waveform, frame structure, line/channel coding, (de)modulation, etc.
  - Physical signal and channel design including T/F synchronization/tracking, physical uplink and downlink channel
- Study on L2/L3 control plane and user plane for passive device, including
  - Identify the minimum CP functions, e.g., access/collision control, paging, security, mobility management[RAN2]
  - Identify the minimum UP protocol layer and procedures, e.g., RLC/PDCP-less protocol, random access, packet structure[RAN2]
- Study on the RAN architecture, including either gNB or UE act as reader, with/without CN connection [RAN3]
- Coexistence with UEs and infrastructure with existing 3GPP technologies, e.g., LTE, NR, NB-IoT [RAN1/RAN4]
- Study on the spectrum for Ambient-IoT [RAN4]

## AI/ML for Air interface

- Specify procedures, protocol and signaling aspects to support the sub-use cases studied in Rel-18 SI
  - Sub-use cases selection for Rel-19 standardization in air interface, considering
    - One-sided model based sub use cases and two-sided model based sub use cases, respectively
  - Specify LCM related procedures and signaling enhancements for selected use cases, including functionality identification/ activation/ deactivation, model identification/ activation/ deactivation, model training/ inference/ monitoring etc.
  - Specify the procedure and signaling for model transfer/delivery between the UE and network entities
  - Model and functionality related UE capability signaling
- RX beam sweeping factor in FR2 RRM delay requirements could be reduced with AI/ML, and the FR2 RRM delay requirements could be enhanced

## AI/ML for NG-RAN

- Study and specify data collection enhancements and signaling support within existing NG-RAN interfaces and architecture (including non-split architecture and split architecture) for AI/ML-based new use cases:
  - Inter-frequency measurements prediction, QoE, Slice, MR-DC
- R18 leftovers:
  - NG-RAN interface enhancement to support AI for RAN
  - CU-DU split scenario



## Motivations

- By data collection for the new features introduced in Rel-17/Rel-18, SON and MDT could be the powerful enabler for a more intelligent network to meet the challenges of consistent optimization of network deployment and user experience
- R18 AI/ML has studied on the data collection to enable AI/ML model life cycle management, including model training, management and inference. Considering there will be more use cases identified in the future, specify data collection mechanisms would be beneficial for forward compatible

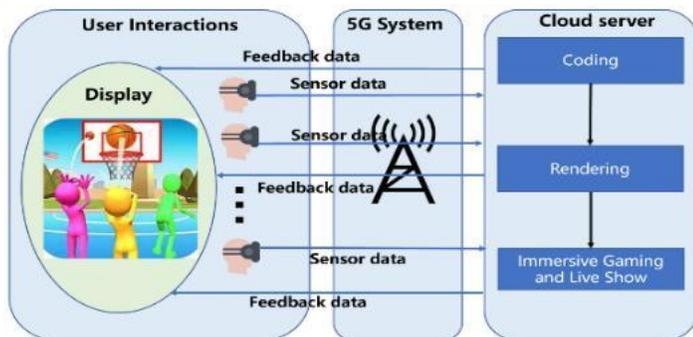
## Potential Objectives

- Support the new use cases based on the new features introduced in Rel-17/Rel-18
  - SON/MDT enhancements for R18 NR mobility enhancements, Network Slicing, MR-DC (SCG activate/deactivate), MBS, ...
- Specify data collection mechanism(s) for the use cases identified in AI/ML for air interface and NG-RAN
  - SON/MDT enhancements based on the legacy framework
  - RAN-initiated data collection
  - New entity introduced for AI/ML to meet the requirements of computing capability for model training and storage in NG-RAN
- Specify the leftover issues of Rel-18 SON/MDT, if any

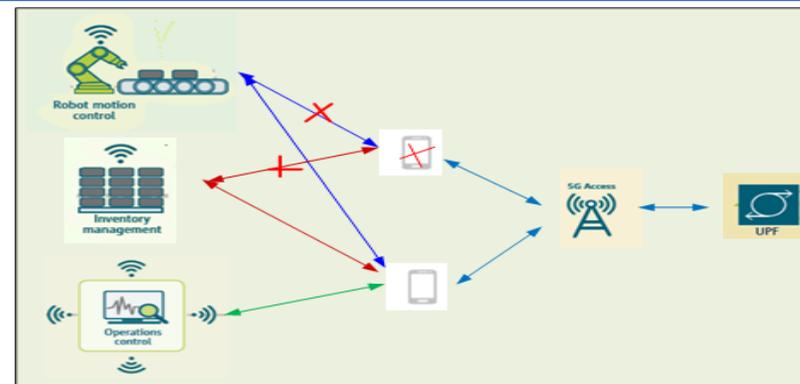
# Collaborative UEs (1)

## Motivations

- To ensure various scenarios which require different manners of UE co-ordination via a quasi-unified scheme, including synchronization and coordination for multi-flow of single UE/multiple UEs, and support of high reliability of data delivery for URLLC services.



Mobile Metaverse for Immersive ;  
Gaming and Live Shows [TR22.856]



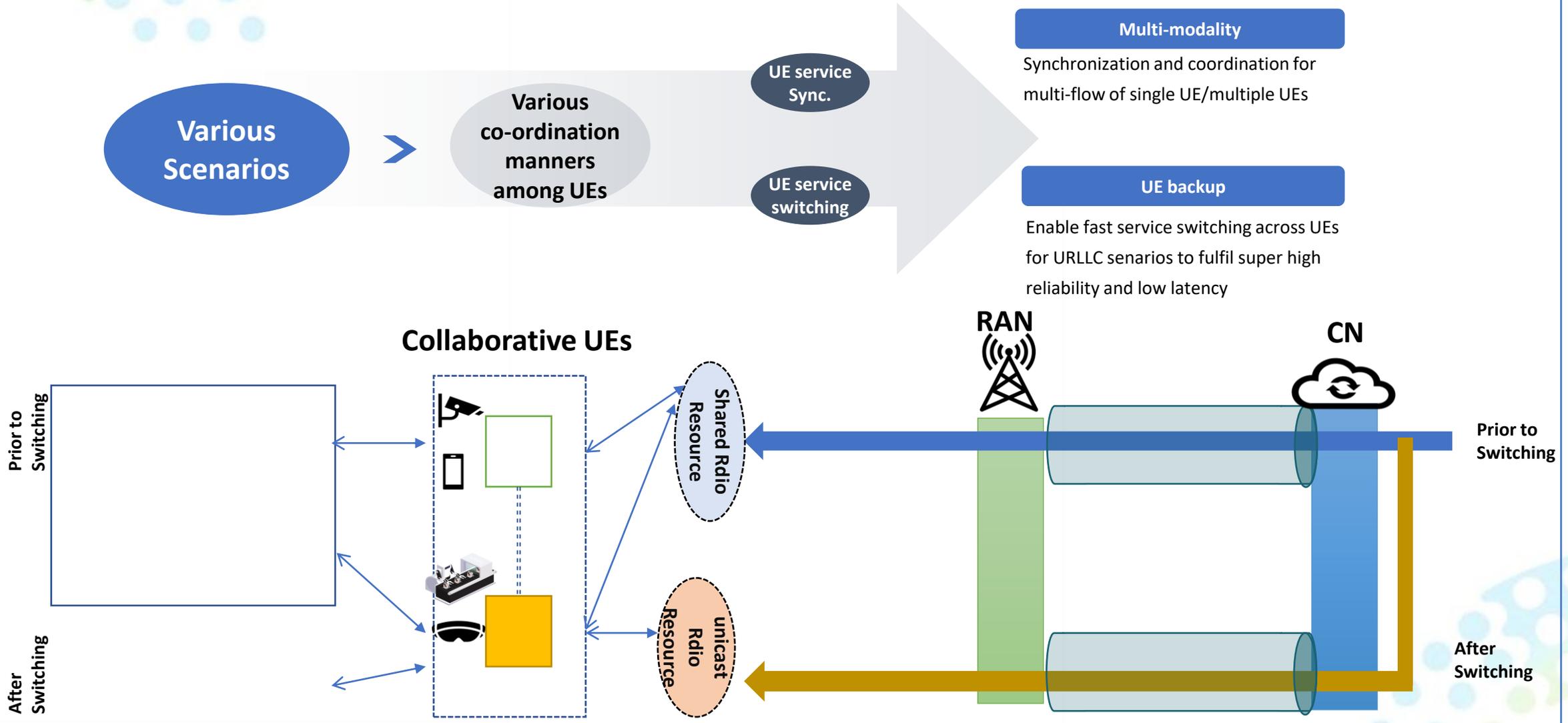
Real time multiple-UE backup in normal case

## Potential Objectives

- To investigate the mechanism of different manners of UE co-ordination via a quasi-unified scheme
  - Study the use cases and benefits of UE co-ordination, e.g., multi-modalities, real-time multiple-UE backup [RAN2, RAN3]
  - Study necessary procedures and/or information to support for UE co-ordination of data/signalling delivery and reception without data disorder or data duplication [RAN1, RAN2, RAN3]
  - Coordinated/Group scheduling and synchronized transmission for multiple UEs [RAN1, RAN2]
  - Study the support for basic mobility with service continuity [RAN2, RAN3]

# Collaborative UEs (2)

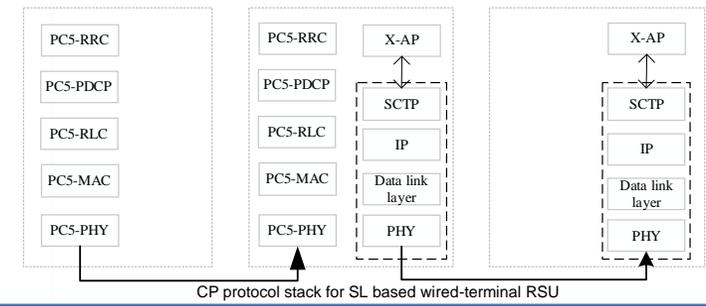
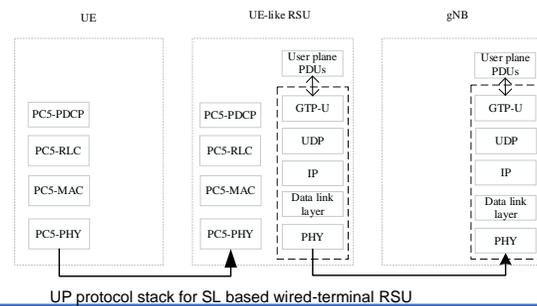
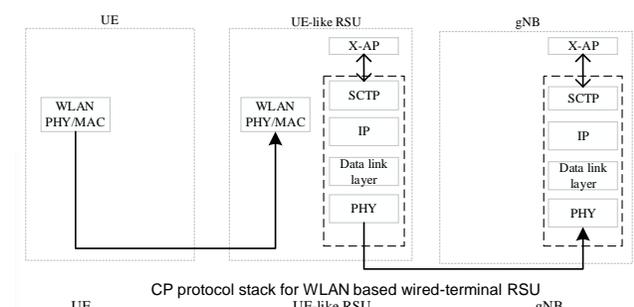
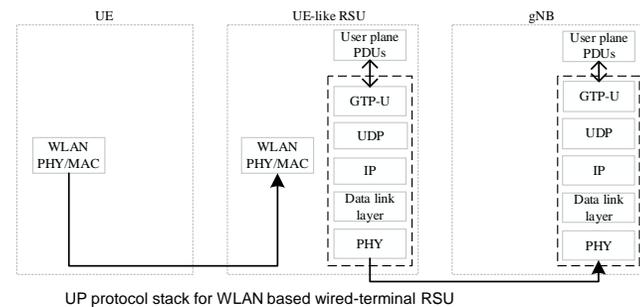
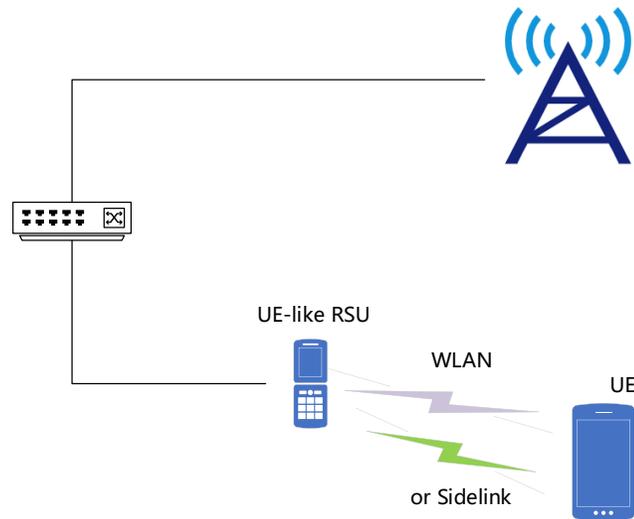
- Quasi-unified scheme for Collaborative UEs



# Wired-terminal RSU

## Motivations

Currently, there are still coverage issues in some areas, especially in residential areas. Meanwhile, it seems it is acceptable by consumers to be provided communication service via terminal hotspots (such as WIFI). In addition, the cost of terminal hotspots is lower than that of pico/femto gNB or WIFI AP, and the protocol stack of CP/UP is basically ready. What lacks is just to take wired transmission into account. Therefore, we propose to study the usage of a wired terminal as an RSU.



## Potential Objectives

The objective of this study item is to investigate the two scenario and identify their standardization impacts.

- Study the benefits of the Wi-fi based and Sidelink based Wired-terminal RSU deployment [RAN3]
- Study the network interface between Wired-terminal RSU and gNB [RAN3]
  - Study the basic functions for control plane and user plane
  - Study interface management procedure, e.g., RSU to gNB interface setup/release/configuration update
  - UE authorization
- Study the impacts on NGAP, if needed [RAN3]
- Study the supporting of service continuity (path switch between Wired-terminal RSU and direct Uu connection) [RAN3, RAN2]

# Elastic cell

## Motivations

- Lack of general multi-carrier architecture for efficient IDLE/INACTIVE offloading and IDLE/INACTIVE carrier selection flexibility
  - CA only applied to CONNECTED UEs, cannot realize efficient idle/inactive mode offloading, connected handover is needed
  - Supplementary uplink is used for coverage improvement, but only limited to only one SUL band
  - Lack of unified band utilization scheme, e.g. TDD, FDD, SUL,SDL
- Cell management overhead is high due to multiple cells operation of current CA framework
  - Each carrier corresponds to one cell, RRC reconfiguration signaling overhead is high for cell handover, waste of network resource

## Potential Solution

- Frequency combination based elastic cell configuration
  - Different duplex types of co-located frequency resources(FR), either intra-band or inter-band, are configured as a single cell
    - Cell management overhead will be reduced by replacing handover to L1/L2 switching
  - For idle/inactive UEs
    - SI only broadcasted in anchor FR, non anchor FRs can be visible and accessed by UE based on SI obtained from anchor FR, flexible access cell selection and offloading can be realized for IDLE/INACTIVE UE
    - SSB availability and periodicity on non-anchor FR be configured by anchor FR, overhead reduction than default SSB periodicity
    - Idle/inactive UEs only monitor paging on anchor FR
  - For connected UEs, similar but more flexible behavior as UE in CA, R18 L1/L2 mobility enhancement can be reused

**Proposal 1: Study enhancements to support more general multiple carrier/frequency resource utilization, applied to both IDLE/INACTIVE mode and CONNECTED mode**

**Proposal 2: Study enhancements to simplify multiple carriers management effort and overhead**

**Proposal 3: Frequency combination based elastic cell can be studied in R19 for multi-carrier enhancement**

# LP-WUS

## Motivations

- LP-WUS can realize reduced power consumption with less latency increase.

## Potential Objectives

- LP-WUS signal design
- LP-WUS based wake-up operations and procedures
- LP-WUS based RRM procedures
- Specify RAN4 core requirements, including LP-WUR RF and demodulation requirements

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# Integrated sensing and communication

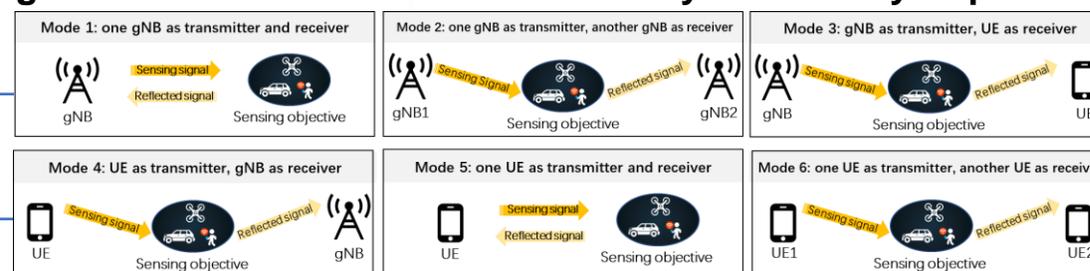


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## Motivations

- **ISAC is expected to be a promising native feature in 6G**
  - Support low-cost, high-precision, seamless and ubiquitous sensing capability through joint design of new radio and network architecture, reuse of software and hardware equipment, and spectrum resource sharing.
- **32 use cases have been studied in SA and captured in TR 22.837. Based on the requirements from government and industries, the use cases with higher priority include V2X, UAV and indoor intrusion detection.**
- To enable these use cases, potential enhancement may include signal design, resource allocation, measurements based on existing waveform and reference RS, and sensing architecture for supporting sensing application.
  - The detailed design of potential solutions require a reliable and comprehensive understanding of sensing channel. **Adequate channel model representing the multipath of sensing signal is very important for performance evaluation for different sensing modes and different scenarios.**
  - Based on sensing signal, it is important to **process the sensing measurements at RAN side to satisfy low latency requirement of the use cases, such as  $\leq 100\text{ms}$  for V2X.**



## Potential Objectives

- R19 SI:
- **Identify prioritized use cases and corresponding requirements from TR 22.837 [RAN1]**
  - **Study the channel modeling for integrated sensing and communication for both FR1 and FR2 [RAN1]**
    - Taking into account sensing signal and reflected signal modeling, sensing related parameter, such as RCS
  - **Study of RAN side sensing architecture, including functional interfaces, protocol, and procedures, e.g. measurement processing is within RAN node, or measurement data is directly delivered from RAN node to non-3GPP entity [RAN3]**

# Realistic channel information collection for AI/ML



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## Motivations

- Motivation for have a separate SI for collecting realistic channel information for AI/ML
  - Current dataset is generated based on 3GPP channel model due to the difficulty to reach consensus on any field dataset for the time being.
  - Realistic channel information dataset is critical for making AI/ML for air interface trustable, from training, testing and verification perspective.
  - Realistic channel information dataset can lay a solid foundation for the performance tests of AI functionality in RAN4 and the study of future use cases in 5G-A and 6G

## Potential Objectives

- Investigate the requirements of universal dataset of realistic channel information and corresponding format
- Investigate gNB based autonomous collection and UE-reporting based collection
- Investigate the potential architecture for improving the application of realistic channel information dataset

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# MIMO enhancement

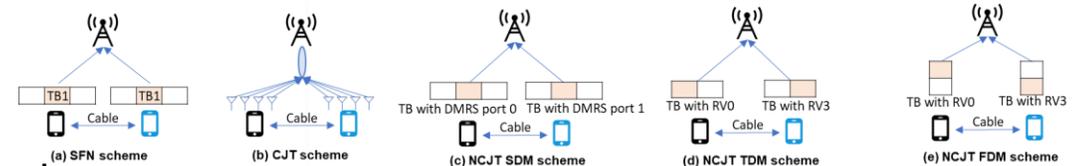
## Motivations

- ① Support L1/L2 based UE aggregation to improve UL/DL data rate/reliability and reduce latency, given ideal link connection between UEs.
- ② 5G indoor gNBs and outdoor gNBs are deployed at the same frequency, macro site may cause severe interference towards indoor micro site. The data rate decrease of indoor UEs has been observed in current network deployment.
- ③ CJT in Rel-18 considers only ideal time/frequency synchronization among TRPs, which is not realizable for deployment. It restricts that the TRPs should be under ideal backhaul and could not enable large area cooperation.

## Potential Objectives

### ① Multi-UE UL/DL transmission

- UL enhancement: support SFN/C-JT/NC-JT with SDM/TDM/FDM
- DL enhancement: support C-JR/NC-JR with SDM/TDM/FDM

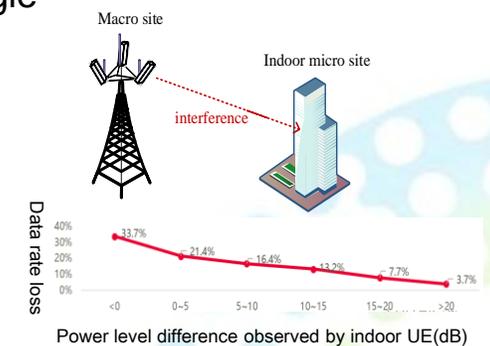


### ② Interference mitigation schemes for Outdoor-Indoor HetNet scenario, e.g.,

- Exchange of macro gNB's slot pattern (reduced-power/normal-power) between macro gNB and indoor gNB
- CSI-RS/CSI report enhancement for UEs under macro gNB to support two transmit power levels for a single CSI-RS of macro gNB
- CSI report enhancement for UEs under indoor gNB to report two kinds of CSI corresponding to different macro gNB transmit power levels
- Advanced UE receiver

### ③ Enhancements on DL CJT transmission

- UE assisted calibration for non-ideal time/frequency synchronization among TRPs
- Consider air based antenna calibration among TRPs



# Other topics

## Positioning

- Sidelink positioning: low priority
- Enhancements for enabling LPHAP use case 6 as defined in TS 22.104 for UL positioning for UEs in RRC\_IDLE state

## NES

- Network energy saving techniques in time domain
  - WUS transmitted by UE to wake up gNB, especially for indoor office scenarios
  - Adaption transmission of common and broadcast signals

## NCR

- Power control
- Physical beam information reporting over the capability report
- Flexible BH link beam configuration/indication to reduce self-interference
- Cooperative transmission of RIS and gNB

## L1/L2 Mobility Enhancement

- Extend the scenario from intra-CU to inter-CU

# Other topics



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## XR

- Leftovers in R18, e.g. XR-awareness (inter-PDU set dependency scheduling enhancement), capacity improvement (multi-TB scheduling etc.)
- Dynamic split of round-trip RTT (UL/DL PBD various on the fly)

## MultiSim

- Enhancement to support two SIMs of one operator based on operator's demand

## NTN

- Regeneration architecture and functionalities (study Full gNB on board)
- DL coverage enhancement
- Beam Management in NTN (location/time-based (group) beam switching, the SSB number extension)
- Mobility enhancement (PCI unchanged for soft satellite switching )

## UAV

- Mobility enhancement (flying zone for vertical HO/ fixed flying path, conditional HO based on fixed flying path)
- Beam mangament for different altitude drones

**THANK YOU !**