

**3GPP TSG RAN Rel-19 Workshop**  
**Taipei, June 15 – 16, 2023**

RWS-230474

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# 5G-Advanced and Rel-19 Scope

## *Role of R19 within 5G-Advanced*

- Support and/or enhance functionality for 5G-Advanced features introduced in R18
- Initiate study of new services and verticals on the road to 6G

## *High-level considerations for R19 scope*

- The overall scope of R19 should include:
  - A limited number of Work Items of reasonable scope that continues and enhance existing features
  - A few items that aims to enable some differentiation in terms of use case or performance
- The scope of individual WIs/SIs should limit the fragmentation of work in smaller items as much as possible

## *Key focus for R19*

- New service/verticals (NTN, SL, XR)
- Higher performance (AI/ML, MIMO, Duplex, Positioning, Mobility)
- Lower NW operating cost (NES)
- Channel modeling for pre-6G study (FR3, Sensing, RIS)

# R19 WIs/SIs for RAN1/2/3-led items

## New services / verticals

- Non-terrestrial networks
  - Mobility, discontinuous coverage, regenerative payload, NTN Pos
- Sidelink enhancements
  - SL FR2, NR-specific CA Enh
- XR evolution
  - Multi-modality, new traffic

## Pre-6G Study

- Channel modeling
  - FR3, Sensing, RIS

## Higher performance

- AI/ML
  - Continue study in Rel-19
  - Study high layer Enh use cases
- MIMO
  - MTRP/MPUE Enh, Beam latency reduction, UL coverage Enh
- Duplex
  - SBFD, CLI meas. reporting
- Positioning evolution
  - SL-U positioning, Integrity of SL positioning, Rel-18 leftovers
- Mobility enhancements
  - LTM in inter-CU
  - FR2 enhancement (e.g., BFR)

## Lower NW operating cost

- Network energy saving
  - On-demand SSB/SIB1, clustered PO
  - LTM enhancement for NES
- Sidelink relay evolution
  - Multi-hop, Multi-path, UE agg.

## Energy efficient receiver

- Ambient IoT
  - Passive/active devices
- Lower-power WUS
  - non-OFDMA based

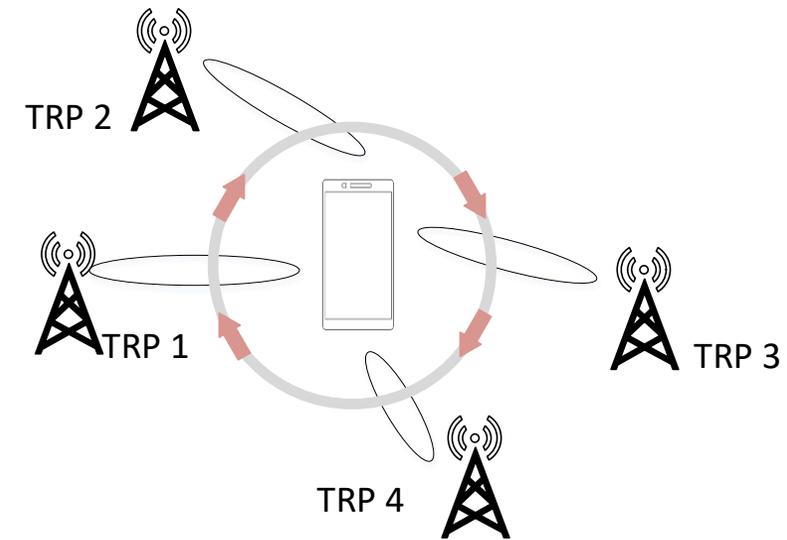
# NR MIMO evolution

## Motivation

- Further enhancement is necessary for mTRP and MPUE operation
  - CJT support up to 4 TRPs in R18 while UTCI is only applicable up to 2 TRPs
  - STxMP operation is limited to SFN-based Tx, single CW, and up to 2 panels. It can be further enhanced for high capability UE (e.g., 8Tx with 4 panels)
- BFR latency is considered as real-life issue to fully utilize FR2 spectrum
- UL coverage can be further enhancement especially with high capability UE (e.g., 8Tx UE introduced in R18)

## Proposed R19 WI scope

- mTRP and MPUE enhancements
  - BFR with UTCI, UTCI framework for 4TRPs, dynamic SRS configuration
  - UTCI framework for UE with multiple panels, STxMP for 8 layer transmission with multiple CWs, etc.
- BFR latency reduction
  - UE initiated event-driven/UE-based beam reporting and management
- Uplink frequency selective precoding
  - Indication of multiple TPMIs
- Open for other market urgent issues (e.g., 64ports CSI-RS)



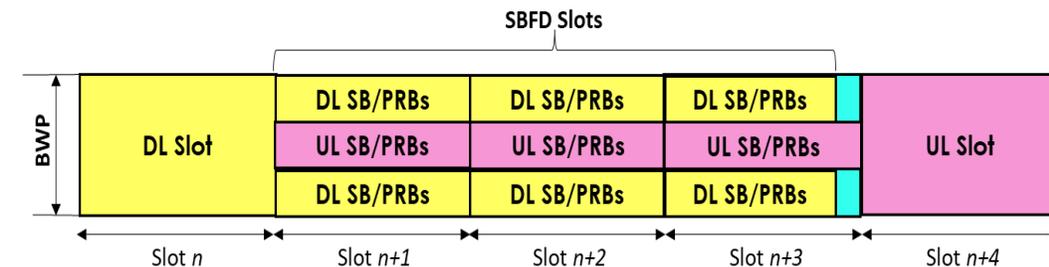
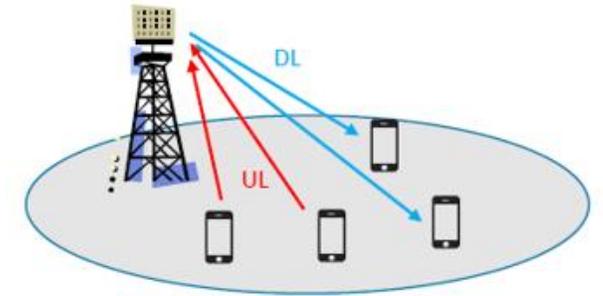
# Duplex enhancements

## Motivation

- Normative phase following completion of SI on Duplex enhancements
- Support **Subband non-overlapping Full Duplex** (SBFD) in unpaired spectrum
  - Enhanced UL coverage, reduced latency

## Proposed R19 WI scope

- SBFD configuration in frequency and time domains
- Collision handling between DL/UL signals across SBFD and non-SBFD symbols
- Cross-Link Interference (CLI) mitigation and avoidance
  - L1/L2-based CLI reporting for faster adaptation to interference
  - Uplink power control enhancements (see next slide)
  - Spatial-domain coordination among gNBs and UEs by information exchange
- Latency reduction by supporting HARQ-ACK/PRACH transmissions in SBFD symbols
- Handling of UL/DL timing misalignment due to non-zero TA of UL Tx



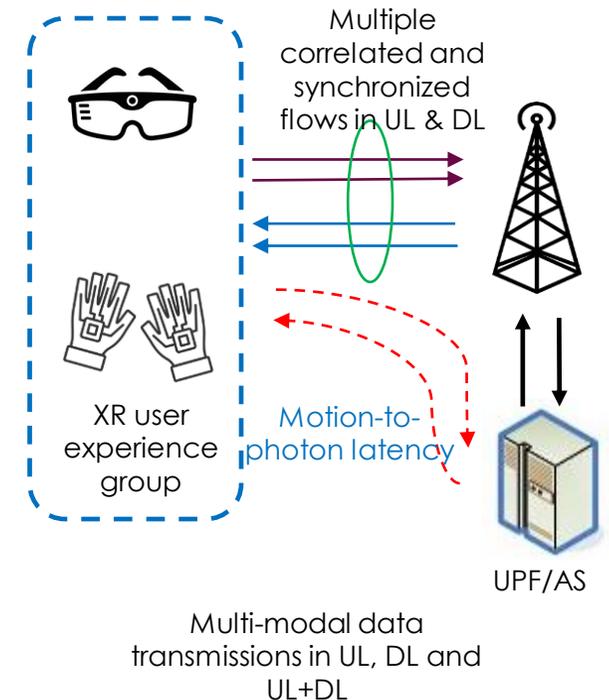
# XR evolution

## Motivation

- R18 provides support for baseline XR use cases: cloud gaming, VR, AR for smartphone
- R19 and beyond to consider more advanced use cases characterized by **multi-modality** and **more stringent target QoS**

## Proposed enhancements for R19

- Study RAN impacts of new / more stringent requirements
  - Use new traffic models for Video with RTP/WebRTC, haptic feedback
- XR awareness and scheduling enhancements
  - Flexible differentiation and prioritization of PDU sets
  - Synchronization across multiple correlated flows
- Mobility and service continuity enhancements
  - Service/experience continuity when supporting multi-modal flows
- Scheduling enhancements for enabling coordinated UL+DL transmissions of PDU sets within motion-to-photon (MTP) latency (if time allows for haptics use case)



# Sidelink Evolution

## Motivation

- Enable large bandwidth sidelink operation to achieve high throughput and reliability performance for indoor commercial use cases
- Expand sidelink support to low latency and high reliability applications (IIoT, XR)
- UE power saving is beneficial for SL commercial use cases

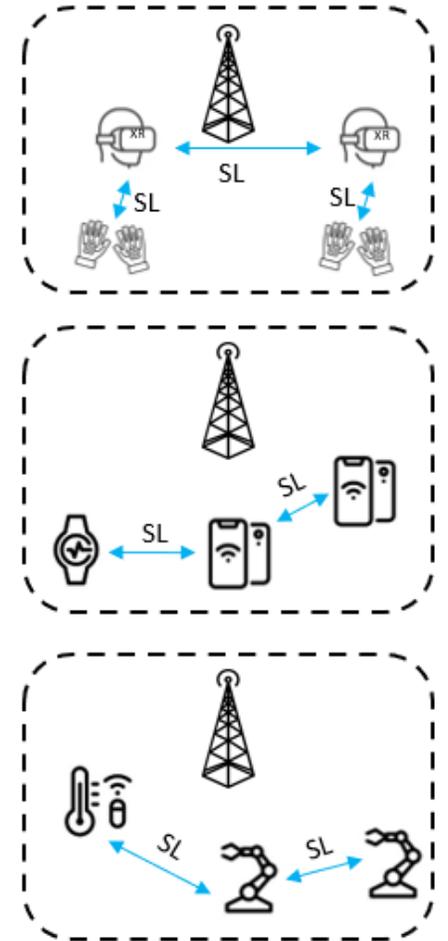
## Proposed R19 scope

### High priority

- Carrier aggregation with NR-specific enhancements (e.g., HARQ, RA)
- Sidelink FR2 normative work based on conclusions of R18 study
  - Beam management, beam failure recovery, CSI enhancements

### Medium/Low priority (if time allows)

- SL-U further enhancement (e.g., FBE channel access for IIoT factory environment)
- URLLC over SL (e.g., SL survival time, resource allocation and synchronization mechanisms to enable low latency)
- SL power saving enhancements (e.g., DRX in SL U, wake-up SL signaling)

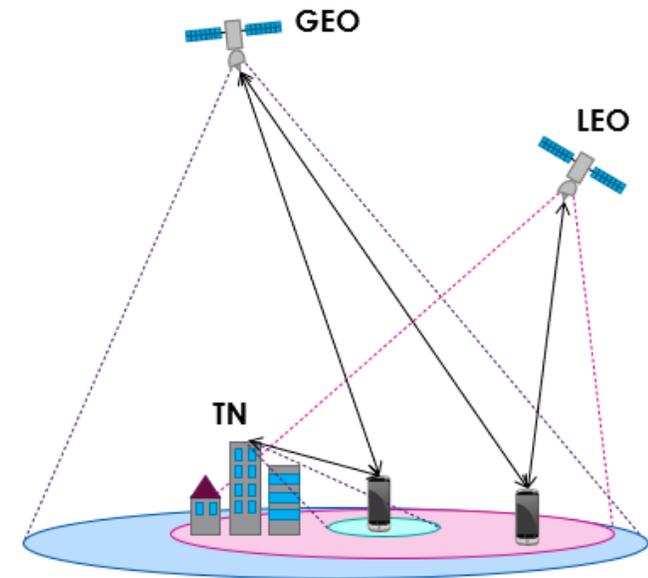


# NTN Enhancements

**Motivation:** Proposed enhancements will increase diversity of supported device types, QoS requirements, and network architectures to facilitate deployment + integration of NTN into existing networks.

## Proposed R19 scope

- **Improved flexibility for mobility and connectivity between different orbits and TN:** Leverages advantages of different orbits (e.g., latency and coverage characteristics) to support variety of device types and QoS requirements.
  - [NR + IoT] Optimization of NTN-NTN mobility and service continuity between orbits (e.g. LEO-GEO)
  - [NR + IoT] Dual connectivity between satellites, and between TN/NTN
- **Extension of discontinuous coverage support:** Supports sparse deployments of satellite constellations, which is critical during early NTN deployments and deeply rural areas where continuous NTN coverage is not guaranteed.
  - [NR] Support for discontinuous coverage scenario in NR (e.g. service continuity enhancements)
  - [NR + IoT] Enhanced support of discontinuous coverage in RRC\_Connected mode (e.g., suspend RLF/RLM)
- **Expansion of RAT dependent positioning in NTN:** remove GNSS dependency, reduces measurement gaps for NB-IoT devices with long connection times.
  - [NR + IoT] RAT dependent positioning improvement using satellites
    - May be either a new study item or merged into positioning W1.
  - [NR + IoT] Integration of NTN positioning and TN positioning
- **Support for regenerative payload:** Offers vastly improved latency characteristics (UE-gNB RTT reduced by half) to support lower latency services. Provides flexibility to different types of satellite deployments.
  - [NR + IoT] Regenerative payload case (including all or part of RAN functions) – can be it's own study item to downscope potential options (e.g., how many gNB functionalities at satellite) prior to standardization.



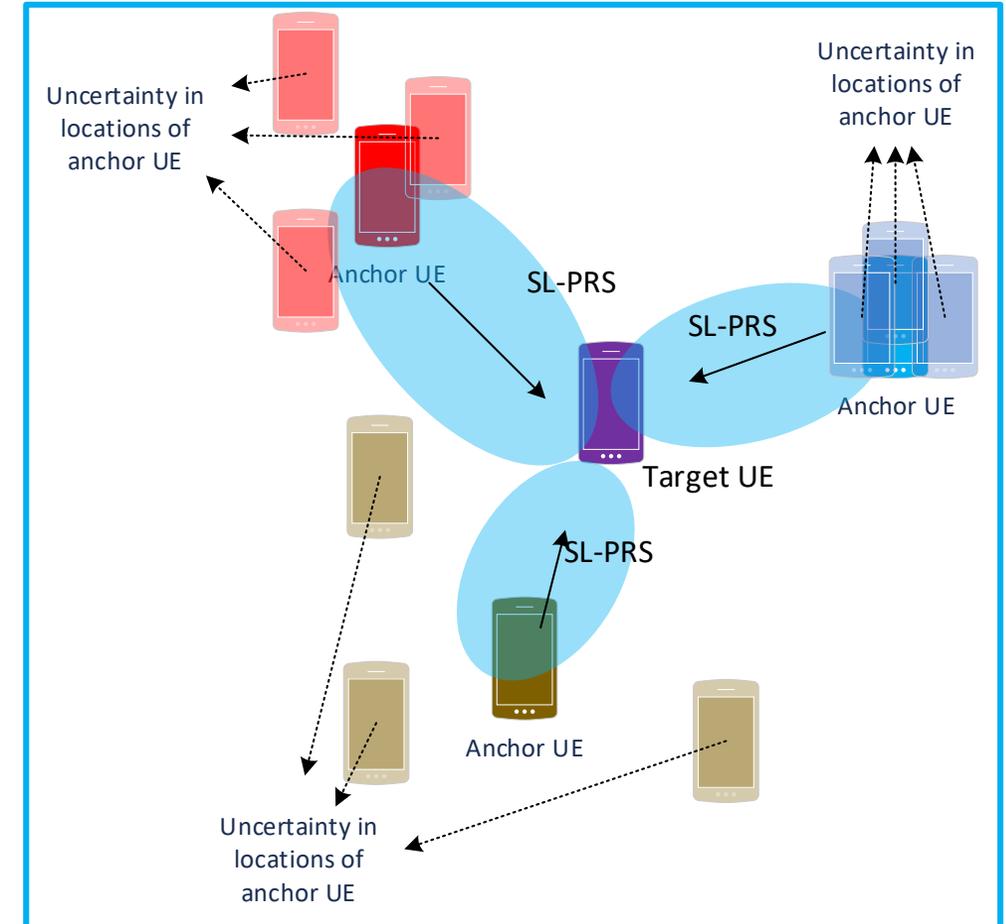
# Positioning Evolution

## Motivation

- Meet sub-1 meter accuracy (e.g. Set B for IIoT in TR 38.859)
- Use of wider bandwidth improves the positioning accuracy
- Ensure positioning integrity for industrial (IIoT) applications

## Proposed R19 scope

- Sidelink positioning in unlicensed bands
  - Leverage additional bandwidth from unlicensed bands to improve accuracy and reliability of sidelink positioning
  - Study and specify channel access mechanism for positioning signals
- Integrity for sidelink positioning
  - Study error sources for sidelink positioning
  - Specify signaling mechanisms to support UE/network-based integrity
- Open for Rel-18 leftover topics (e.g., CPP enhancement)



Examples of anchor UE location as error sources

# Channel Modeling (pre-6G SI)

## Motivation

- Develop **channel models** for use cases, scenarios and frequencies relevant for 5G-advanced and 6G

## Proposed R19 scope

- **FR3 (7-24 GHz)**
  - Study antenna types/models
  - Validate existing channel model for FR3 band with field measurement results
- **Sensing**
  - Identify use cases for sensing environment/obstacles
    - gNB-UE bi-static sensing mode is included
  - Develop channel models for the identified use cases in 3GPP frequency ranges (e.g. FR1, FR2-1, FR2-2)
- **RIS (Reflective intelligent surfaces)**
  - RIS technologies, categories and types
  - RIS potential use-cases and deployment scenarios
  - RIS channel modelling

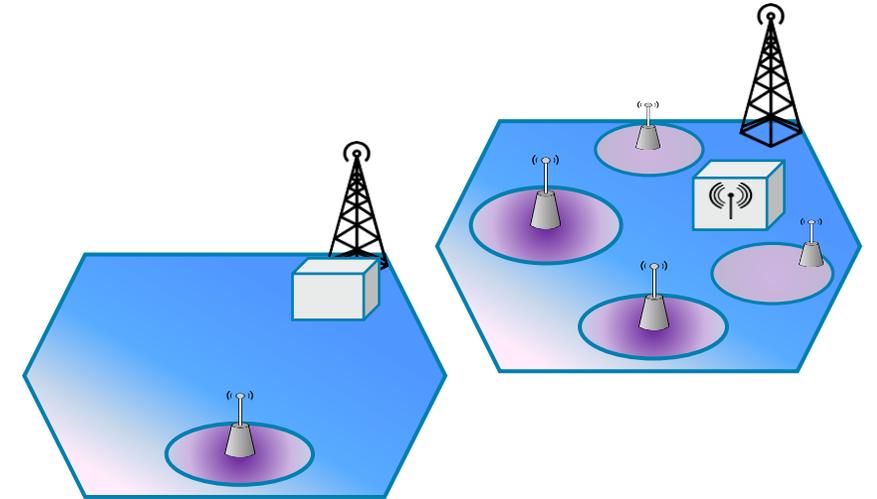
# Network energy saving

## Motivation

- Support additional means of network energy saving
  - Minimize activity required to support idle mode UEs
- Enable network energy saving in more scenarios
  - LTM mobility, cells with low-latency UEs

## Proposed R19 scope

- Enhancements for UE in idle/inactive
  - Time-domain adaptation of paging occasions
  - Cell re-selection rules to de-prioritize camping on cells with low activity
- Cell adaptation request
  - To receive on-demand SSB/SIB1 or adapt SSB/SIB1
  - To support UE with low-latency requirement during Cell DTX (if not R18)
- LTM enhancements for NES, e.g. indication of prioritized LTM candidate cells



# Further mobility enhancements

## Motivation

Improve usability of L1/2-triggered mobility (LTM) and conditional handover (CHO) features.

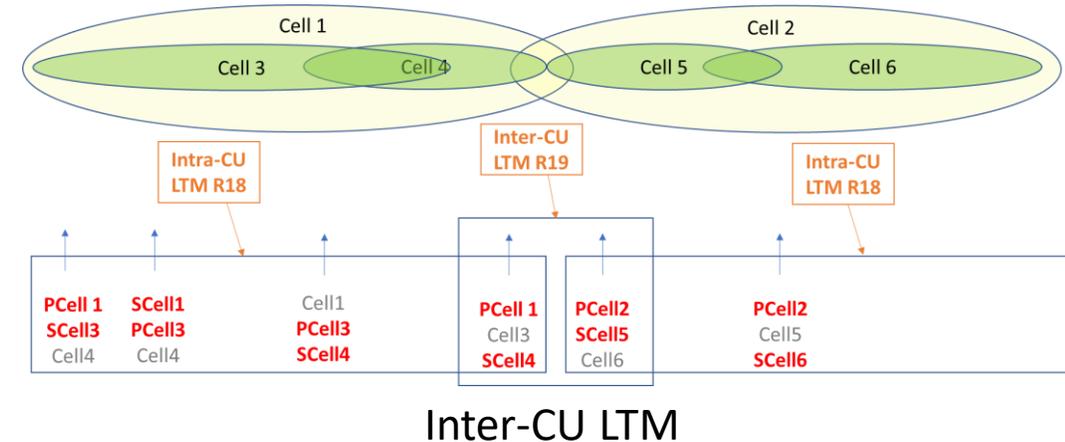
- L1/2-triggered mobility (LTM) in R18 enables low-latency mobility but applicability is limited to intra-CU scenarios
- CHO supports selected activation of SCG only

## Proposed R19 scope

- Support LTM in Inter-CU and Inter-SN MR-DC scenarios
- CHO with selective activation of MCG
- UE-triggered LTM for improved robustness
- Enhancements targeting FR2, e.g. BFR on non-serving cell

## Possible additional objective

- UAV-specific enhancements of LTM



# NR AI/ML

- **Motivation**

- Support subset of AI/ML use cases for which significant benefit is identified
- Rel-18 study may not be finished on time due to slow progress

- **Potential scope for R19 (SI+WI)**

- Continue study Rel-18 topic + few new use cases (RAN2-centric) within study phase in Rel-19
  - Including possible spillover work from Rel-18 (e.g., CSI prediction specification impact)
  - High-layer use case (e.g., RRM, Mobility management)
- RAN may start normative work on general framework and identified use cases providing significant gain within Rel-19
- Prioritize use cases/functionalities based on feasibility, e.g.,
  - One-sided model
  - Collaboration level x/y
- Prefer combined WI to do normative work for all identified use cases
  - Maximize commonalities between use cases for following aspects: Life cycle management, data collection, model identification/registration, model selection, switching, monitoring, activation/deactivation/fallback aspects

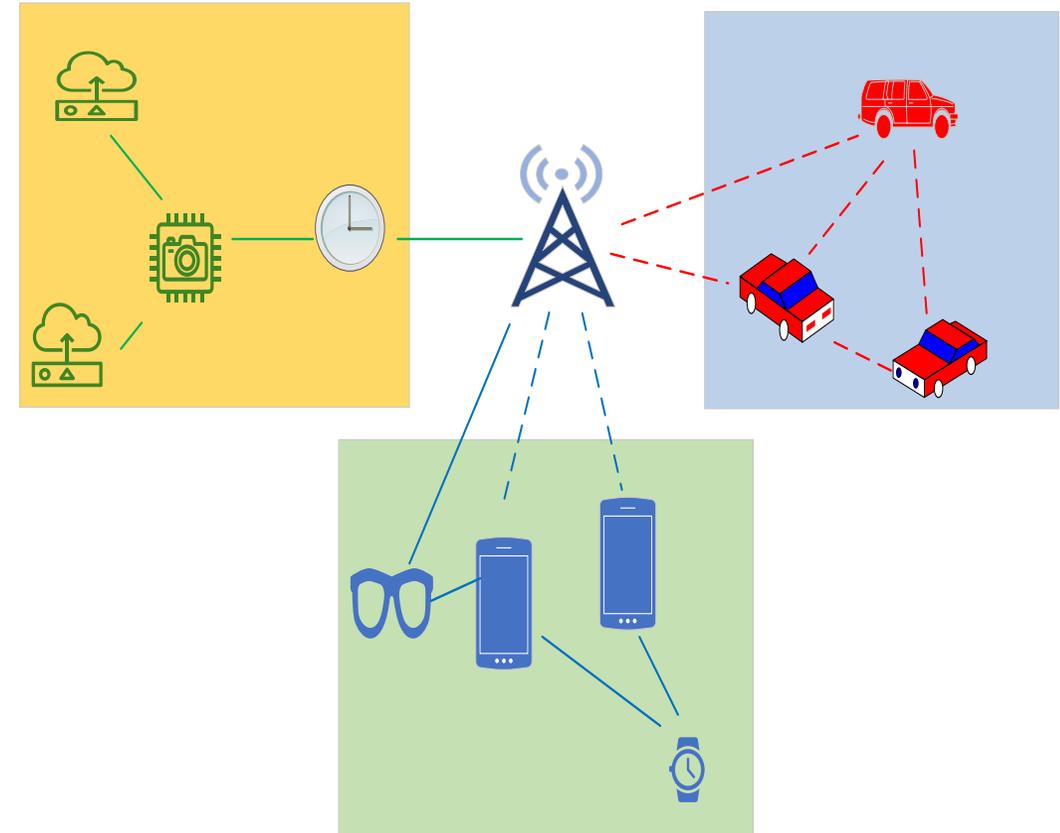
# Sidelink Relay / UE aggregation

## Motivation

- Rel18 SL Relays have several limitations that limit their applicable use cases
  - Only UEs close to in-coverage relay can be served (extension to service deep coverage holes would be needed)
  - Multipath feature is only available to in-coverage UEs
  - Mobility features which are key to NR (e.g., CHO) are not supported for remote UEs
- Support association of multiple UEs to same end user

## Proposed R19 scope

- Multihop Relays (UE-to-NW and UE-to-UE)
- Multipath via multiple relay UEs (e.g., for OOC remote UE)
- CHO for remote UE
- Service continuity upon switching Uu from one UE to another
- Service splitting and coordination between multiple UEs
- Fast discovery/selection, configuration of UEs in proximity, and dynamic group creation



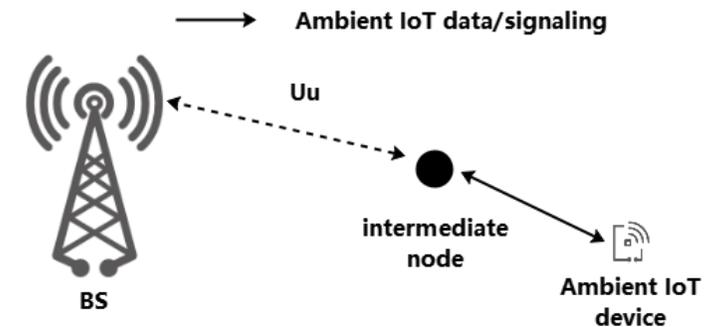
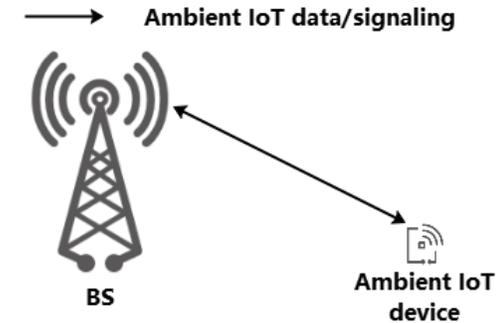
# Ambient IoT

## Motivation

- New markets with device types with no or limited energy storage
  - New IoT technology with complexity and power consumption orders-of-magnitude lower than existing technologies
  - High market demand to replace RFID tag with 3GPP infrastructure (better coverage, less cost, etc.)
- TR 22.840 identifies use cases while TR 38.848 includes the RAN SI input, e.g., device types, topologies and design targets.

## Proposed R19 SI scope

- Rel-19 is a SI (no WI components) with focusing on:
  - All device types for both indoor (passive devices) and outdoor (active devices) scenarios
  - Topologies with/without intermediate node
  - Licensed spectrum



Representative topologies (TR 38.848)

# Low Power – Wake Up Signal

- *Motivation*

- Support identified LP-WUS designs and structures which have significant benefits

- *Potential WI scope for R19*

- LP-WUS design and monitoring
  - OOK based single bit/multi-bit per OFDM symbol is preferred
  - FSK can be considered if time permits
  - UE monitoring procedure including duty cycle based and continuous monitoring
- Information design of LP-WUS
  - Including UE ID, SI change and paging indication is preferred
- Activation/deactivation of LP-WUR
  - Procedure for enabling LP-WUR when power saving is required and coverage of LP-WUR is sufficient
  - Procedure for disabling LP-WUR when frequent data transmission/reception are required and/or coverage of LP-WUR is not sufficient
- Mobility procedure for LP-WUR
  - Potentially include relaxed requirements