Ericsson views on Rel-18

3GPP RAN-Rel-18 workshop   RWS-210329
June 28th — July 2nd, 2021

Agenda Item: 4 — Proposals for Rel-18
Source: Ericsson

Ericsson

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  - massive MTC
    - Reduced Capability devices
  - time-critical communication
    - XR (AR/VR/cloud gaming)
    - URLLC/IIOT

- enhanced MBB
  - MIMO
  - Dynamic Spectrum Sharing
  - Network energy efficiency
- Public Safety
  - Drones/UAV
  - Multicast/Broadcast
- cross-domain
  - AI/ML PHY layer enhancements
  - AI/ML RAN enhancements
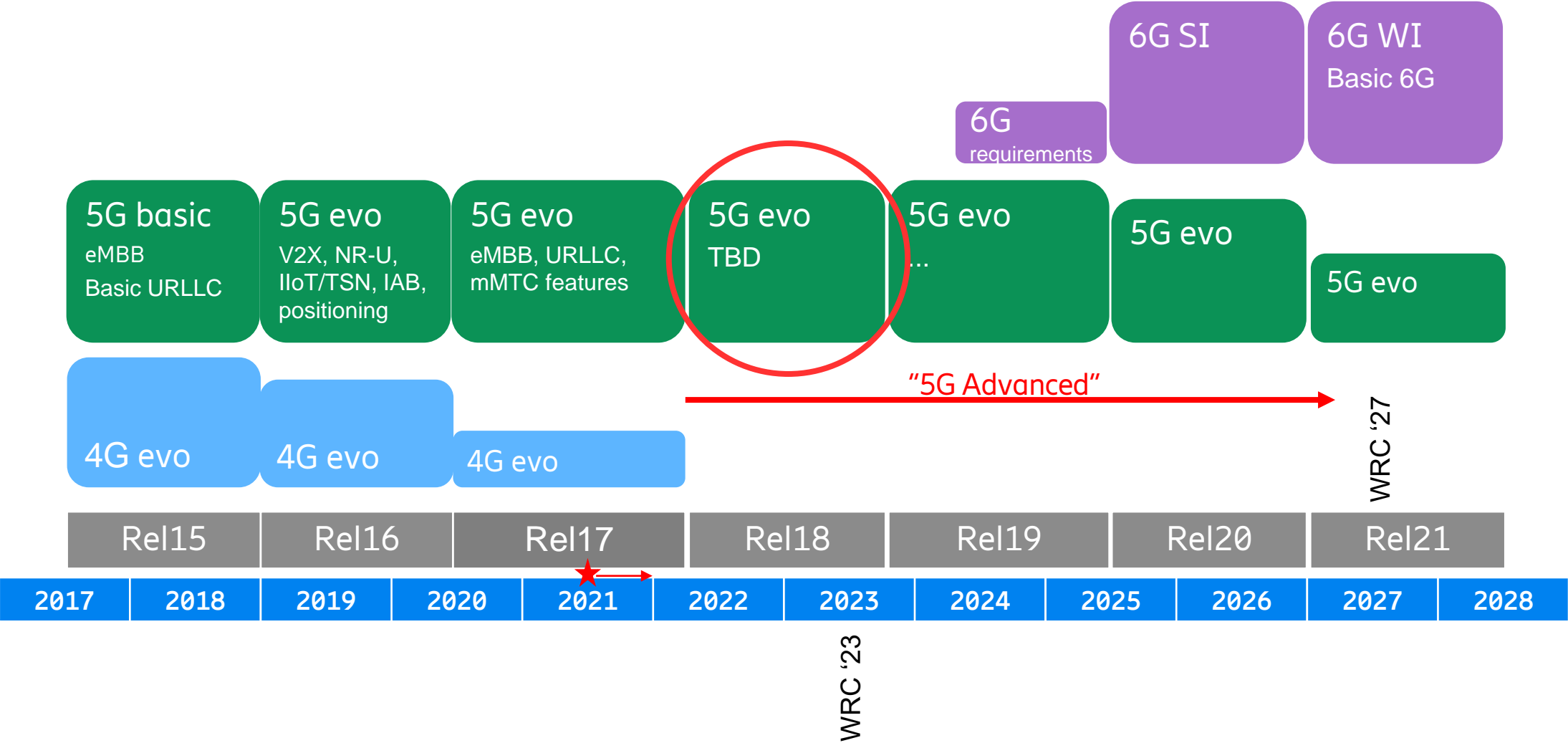 - Trustworthiness

Overall 5G/NR vision

Use case dimension

- Rel-15 started targeting eMBB and (selected) URLLC use cases
- Rel-N++ add support for selected use cases
  - Rel-16 example use cases: Vehicle-to-X, Industrial Ethernet / TSN, non-public networks, positioning
  - Rel-17 example use cases: public safety, (satellites*)
  - Rel-18 example use cases: drones, (XR**)
- End-goal: 3GPP NR to cover all relevant use cases (...everywhere, every time, everything connected)

Feature dimension

- Rel-N: start with basic support of a given use case, i.e., functionality addressing corresponding requirements
- Rel-N++: evolve existing functionality by increasing efficiency/effectiveness as long as it is commercially justified
  - Example functionality: IAB for cost reduction, NR-LAA / MIMO enhancements for even higher data rates and capacity

- Common to both dimensions:
  - Ensure that NR continues to support all use cases from one platform and not split into NR-per-use case
    - Ensure forward compatibility and sufficient configurability and maximize simplicity
    - Specify functionality in a common way such that it can benefit multiple use cases

*   not really a use case family
** can be enabled in earlier releases

Standardisation timeline

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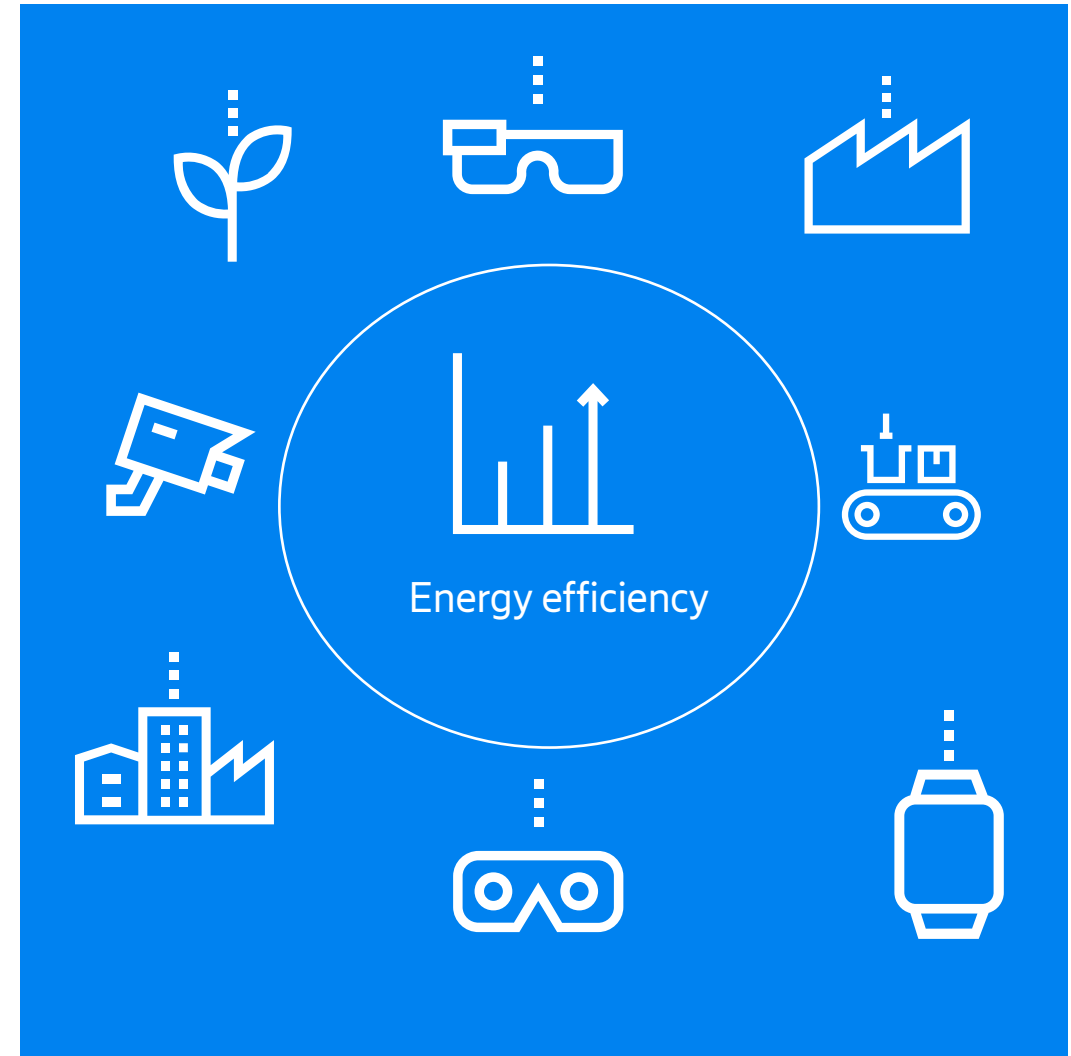 - Trustworthiness

eRedCap

- **Justification**
  - Rel-17 RedCap establishes framework for enabling reduced capability NR devices
    - Use cases: industrial sensors, wearables, video surveillance
  - Rel-18 eRedCap further enhances energy efficiency
    - Support devices operating on harvested energy
    - Enable energy efficient UE wake-up radio
  - Rel-18 can extend the specification support for RedCap UEs
    - E.g., improve support for mobility and positioning

- **Objectives**
  - Enable devices to operate on energy harvested from the environment
    - Introduce lower UE power class(es)
    - RRC protocol optimizations to consider potential variations of amount of harvested energy and traffic
  - Enable energy efficient UE wake-up radio
    - Wake-up signal for low-power wake-up radio at least in RRC_IDLE
    - Related extensions to the paging protocol
  - Mobility and positioning enhancements
    - Inter-RAT mobility to/from LTE
    - Specify RAN4 measurement requirements for positioning 1-Rx UE

Energy efficiency

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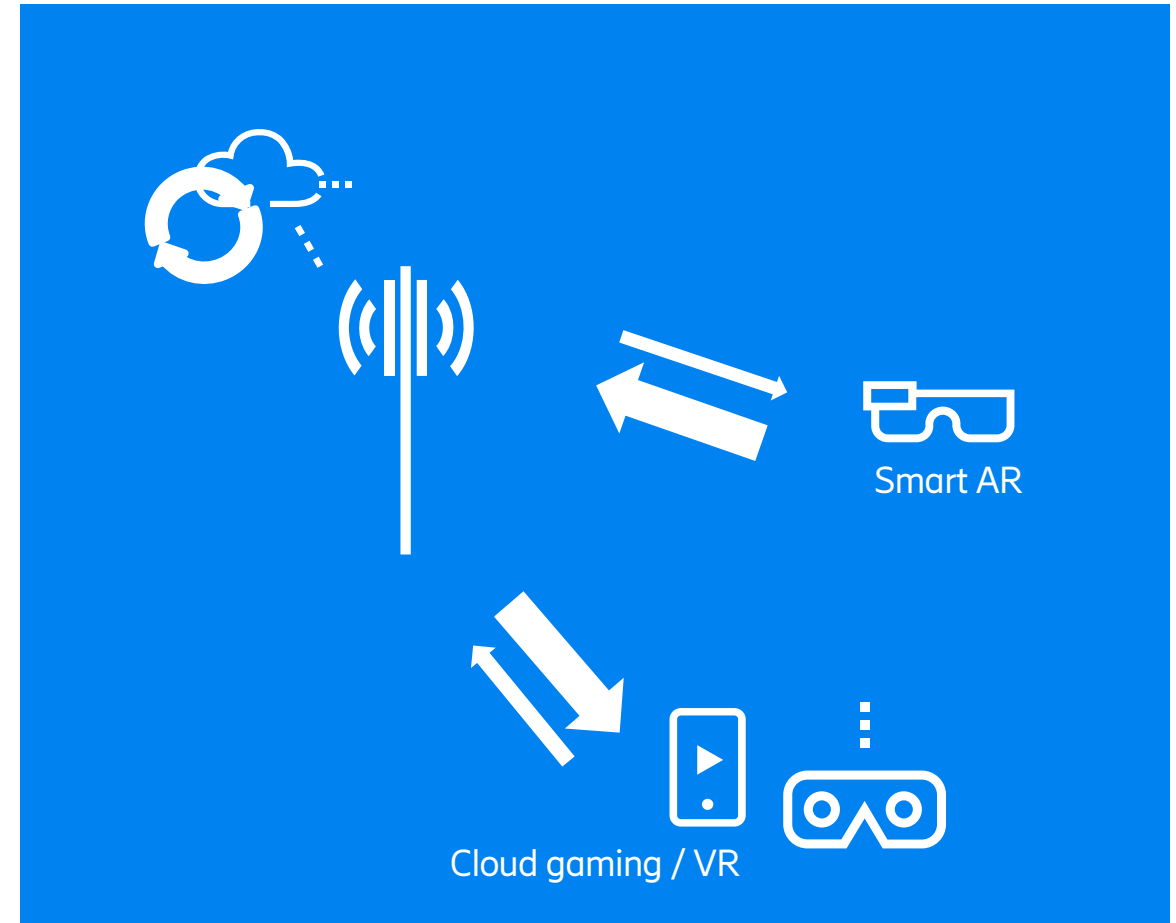 - Trustworthiness

XR

Justification

- Rel-17 XR SI identifies enhancement potential for XR use cases based on evaluations with a commonly agreed framework

  - Fundamental challenge is to handle high data rate/capacity with bounded latency

- Rel-18 to specify RAN features to enhance NR performance

Potential enhancement areas for XR

- XR traffic identification/handling for efficient & low-latency radio resource allocation

- XR mobility support with consistent data rate

- UE energy efficient operation compatible with XR traffic and latency requirements

Smart AR
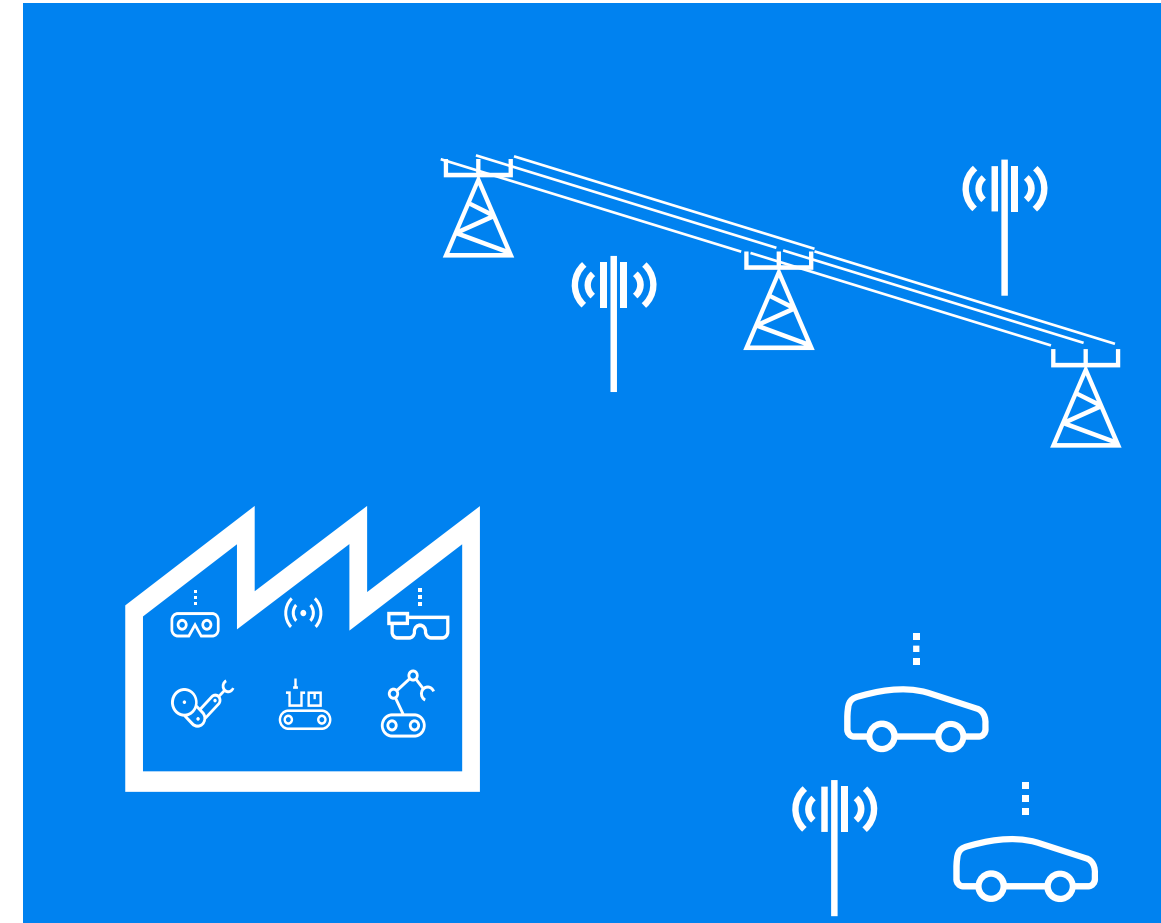
Cloud gaming / VR

URLLC/IIOT

Justification

- Extreme latency & reliability requirements for industrial use-cases addressed with Rel-17

- Rel-18 proposal is to broaden scope: URLLC enhancements for use-cases with moderate bounded latency but at higher data rates

  - Examples: real-time media (XR), mobility automation (remote control), industrial automation

  - Address requirement space of, e.g. 10-20ms, 99,9%, 10-20Mbps (and more)

Objectives

- Enhancements for high efficiency & capacity (in particular UL)

  - Examples: scheduling framework, carrier aggregation

  - Leftovers from Rel-17 (e.g. feedback enhancements)

- Ensure URLLC QoS with mobility

  - Consistent latency & data rate during mobility

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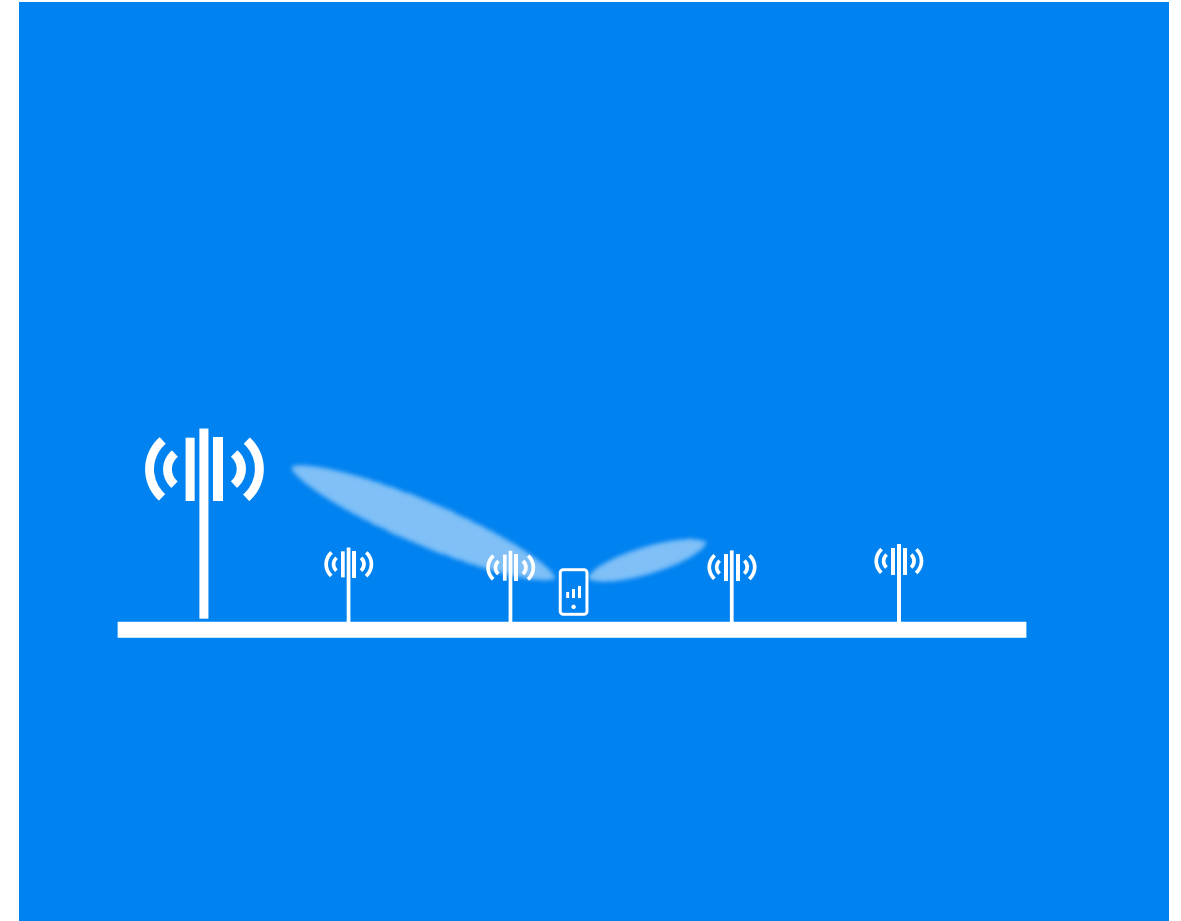 - Trustworthiness

Rel-18 MIMO

Justification

- **Multi-TRP** and dynamic point selection (DPS) requires excessive signaling of TRS switching that creates overhead and limits network deployment/operation flexibility

- **Multi-TRP for URLLC** still has limitations as there is a need to ensure improved spectral efficiency while providing high reliability; CSI feedback can be inaccurate as current CSI does not consider Multi-TRP URLLC schemes; URLLC CSI triggering is currently inflexible as it cannot be triggered when a normal latency CSI (e.g., CSI computation delay requirement 2 with Z_2 and Z_2') computation is ongoing.

- **Link adaptation** is coarse, erroneous and sensitive to channel/interference variations. This prohibits the full potential of MIMO, especially with bursty traffic.

- **UL MIMO** is limited to a single layer for DFT-s-OFDM (while four layers in LTE) and needs to be extended. The DMRS overhead limits UL performance when co-scheduling many users in UL MU-MIMO

Objective

- Enable transparent multi-TRP/DPS operation
  - Introduce TRS-less downlink reception in both FR1 and FR2 where the UE instead relies on DMRS for synchronization
- Enhance Multi-TRP for URLLC
  - Introduce multi-TRP CSI for multi-TRP URLLC schemes specified in Rel-16
  - Introduce flexible URLLC CSI triggering where ongoing normal latency CSI is dropped when URLLC CSI is triggered
  - Introduce mixed mode single-DCI and multi-DCI multi-TRP to support high reliability with improved spectral efficiency for intra-UE multiplexing (with eMBB and URLLC traffics)
- Enhance outer loop link adaption, faster CSI feedback and quicker use of MIMO
  - Introduce "true" CSI based on received PDSCH quality (e.g., based on DMRS or post-PDSCH decoding)
  - Enhance CSI feedback by improved CSI timeline and CPU occupation for triggered CSI report(s)
  - Enable early CSI measurement and reporting, before RRC
- Enhance UL MIMO
  - Increase the number of DMRS ports without increasing DMRS overhead for improved UL MU-MIMO (e.g., more cyclic shifts)
  - Introduce support for UL MIMO (rank>1) for DFT-S-OFDM
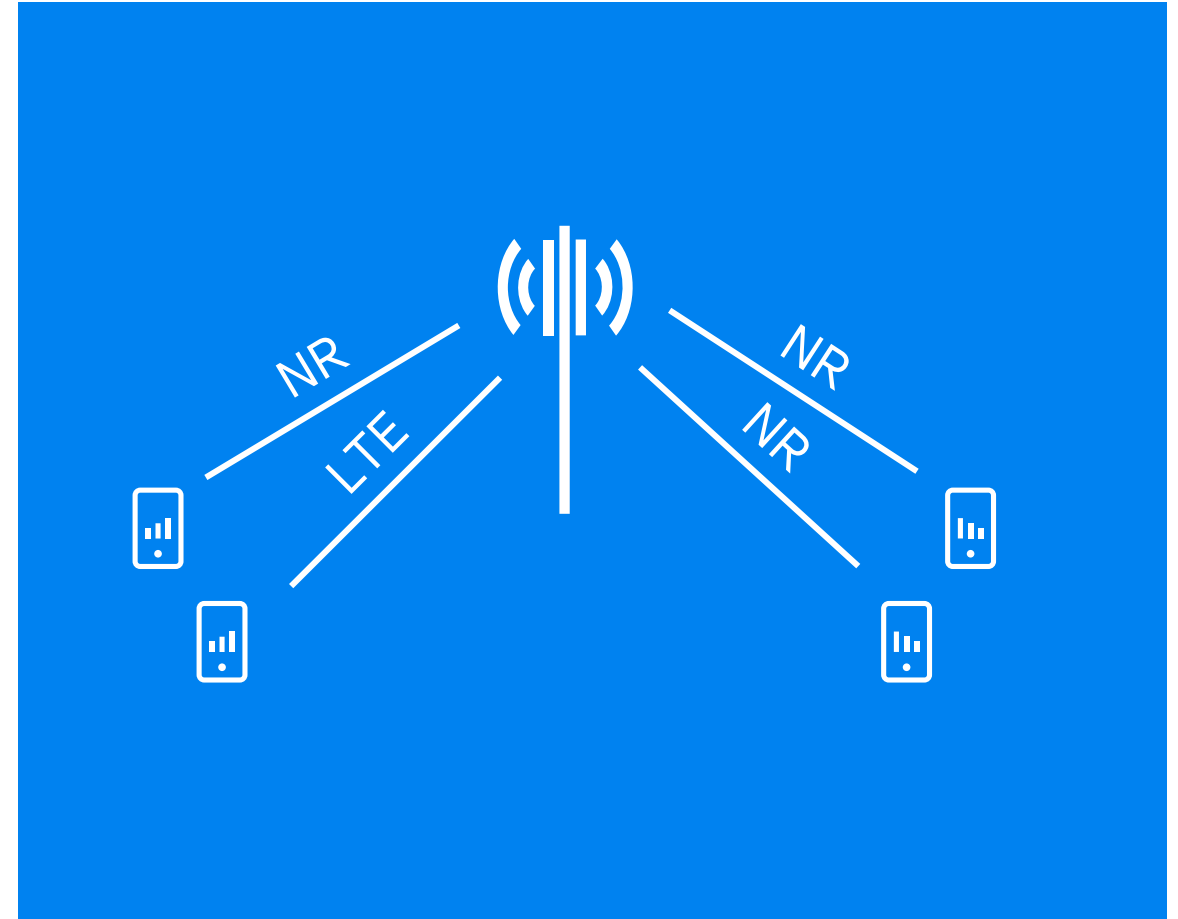
Dynamic spectrum sharing (DSS)

Justification

- Enable improved NR performance when the number of LTE UEs decreases

- Reduce impact on NR from strong LTE CRS interference

Proposed features

- Introduce CRS rate matching pattern switching via DCI
- Enable NR PDCCH reception in symbols with CRS
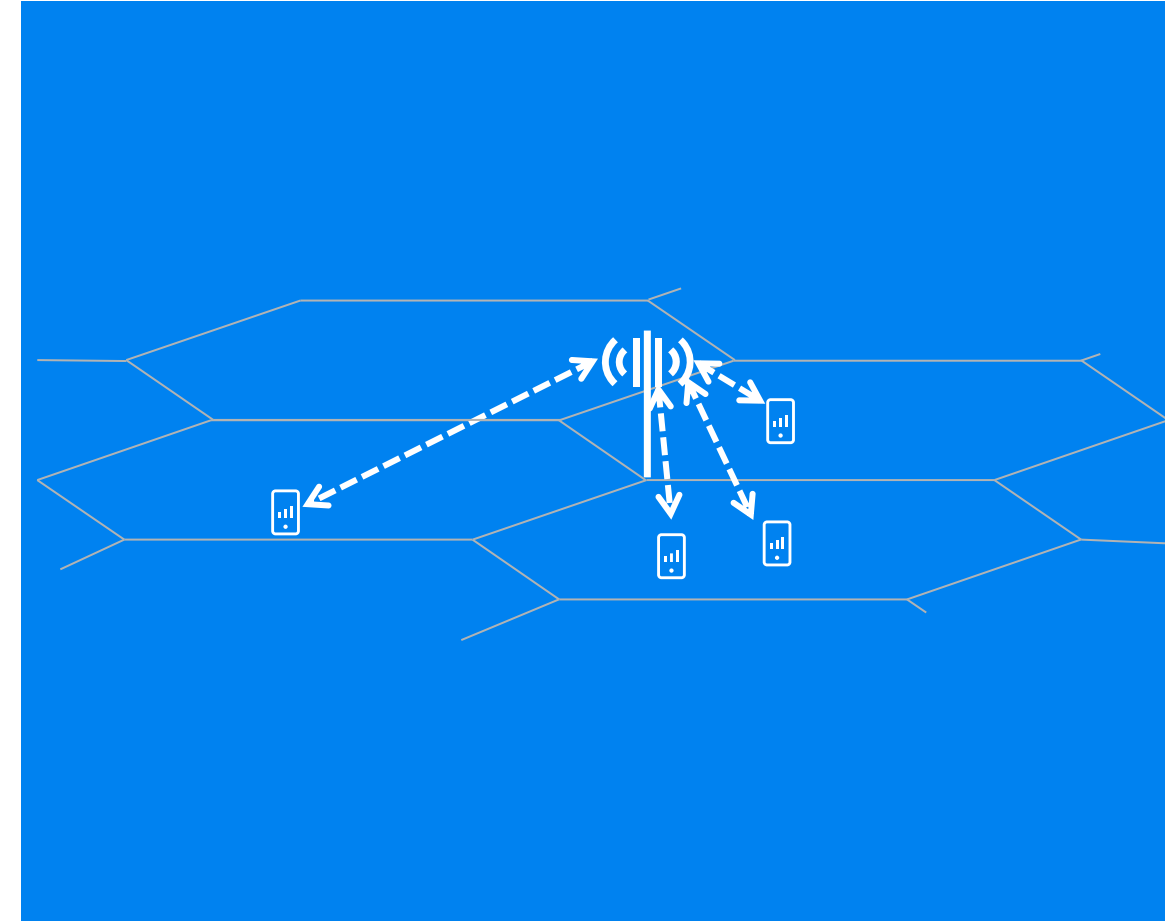
UE hooks for network power savings

- **Justification**
  - 3GPP focus on UE power savings in Rel-16/17
  - NW power consumption has not been in focus since Rel-15
  - NW transmission continues even if cell/beam is empty
  - Large power consumption due to higher number of ports (up to 64 in NR) both at the TX and RX sides

- **Objective**
  - Developing a NW power consumption evaluation methodology
  - Study potential NW power saving techniques with limited impact on legacy UEs
  - NW acquires a more predictable behavior from the UE side
  - The UE can inform the NW about its traffic type, time-criticality, expected volume, priority, mobility status, etc.
  - No NW transmission when there are no UEs listening
  - Reduce the number of ports when not needed

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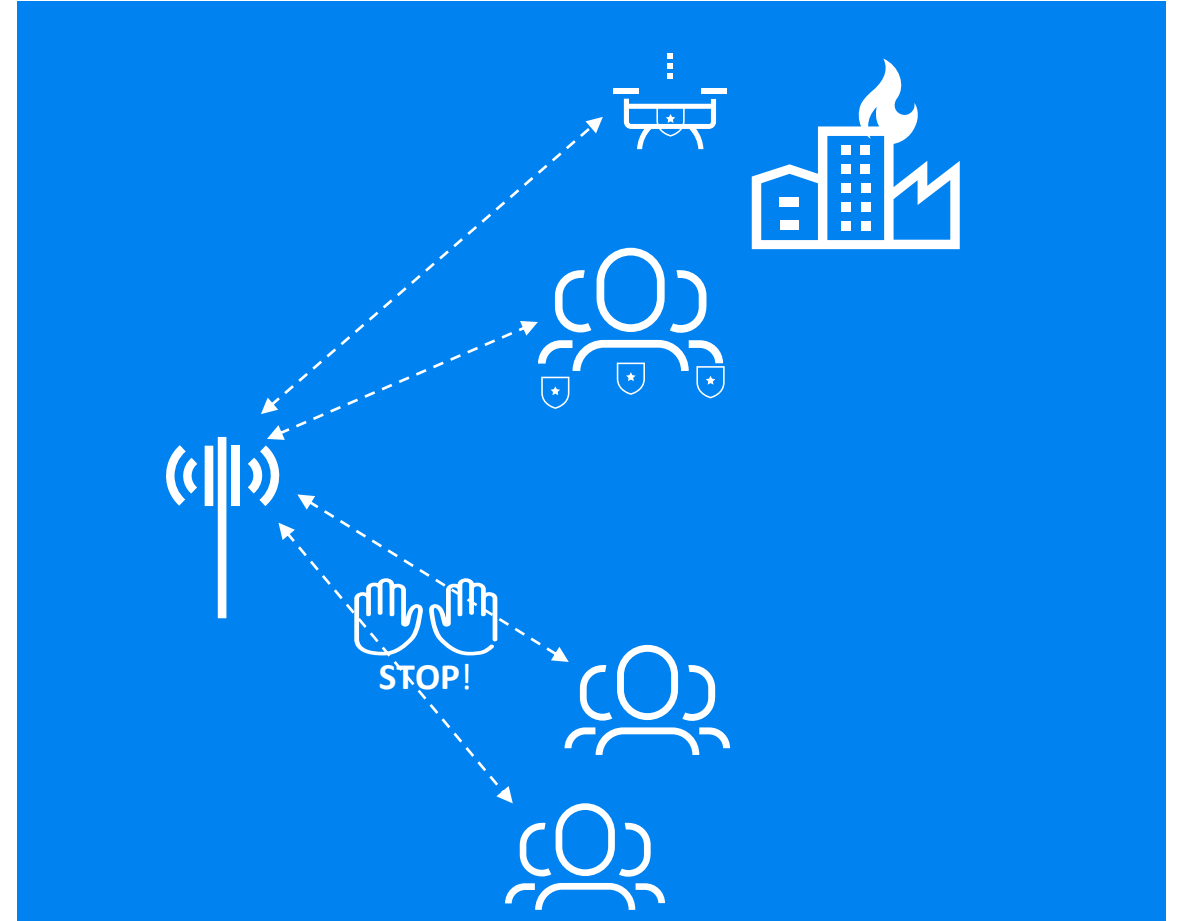
National Security and Public Safety

Priority handling enhancements for mission critical UEs/services in initial access:

- Finer differentiation between mission critical UEs/services
- Early identification of mission critical users
- Means to enhance robustness of Msg1/2/3/4 transmissions for mission critical users

Improved situational awareness using drone as UE:

- Remote control of drones, rogue drone detection
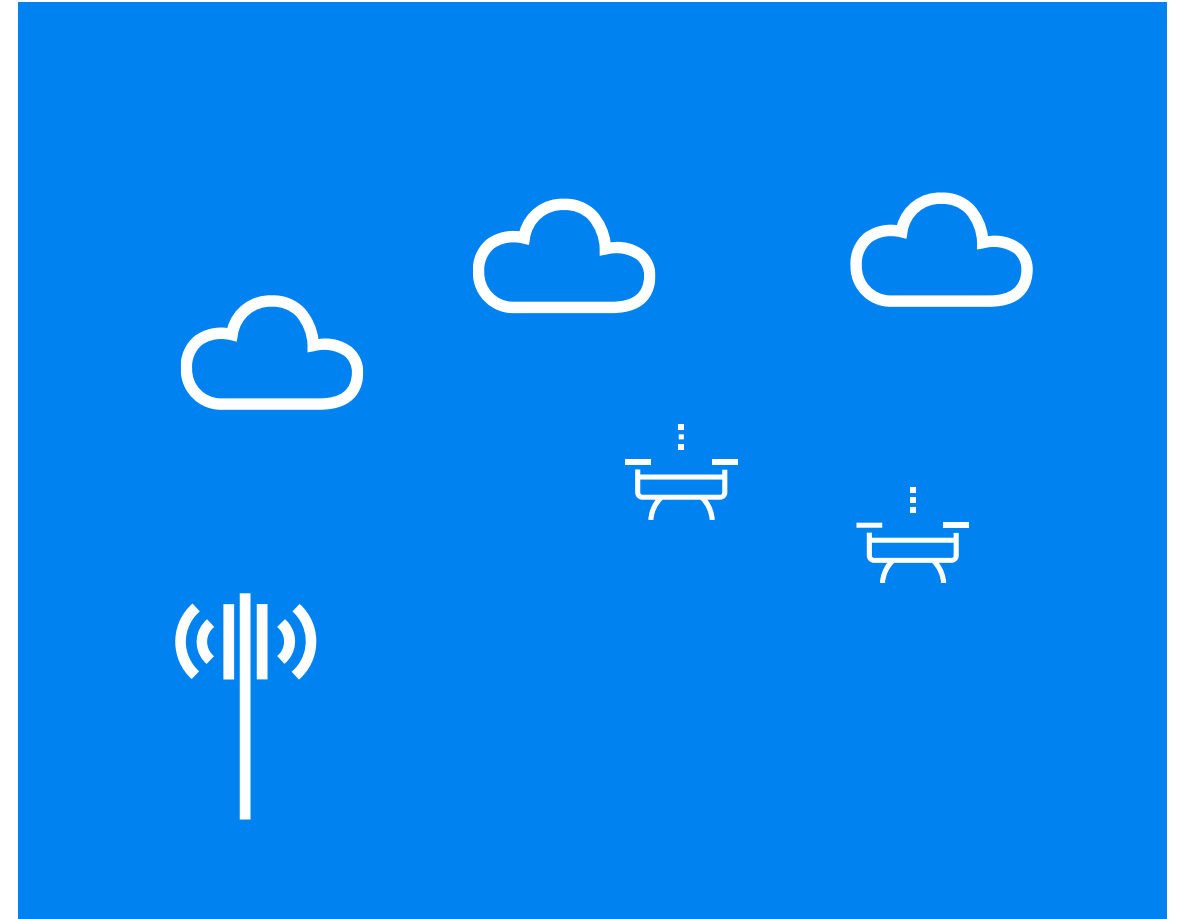
Drones / Unmanned Aerial Vehicles for NR

Rel-15 LTE study on connected drones identified beneficial drone-specific enhancements [3GPP TR 36.777]

Focus on the improvements that have also been discussed/introduced in Rel-15 LTE:

- Height, location, and flight path reporting
- Flexible configuration adjustment due to drone height
- Idle mode mobility enhancements
- Means to avoid frequent measurement reporting

Additionally:

- Drone remote identification reporting over PC5
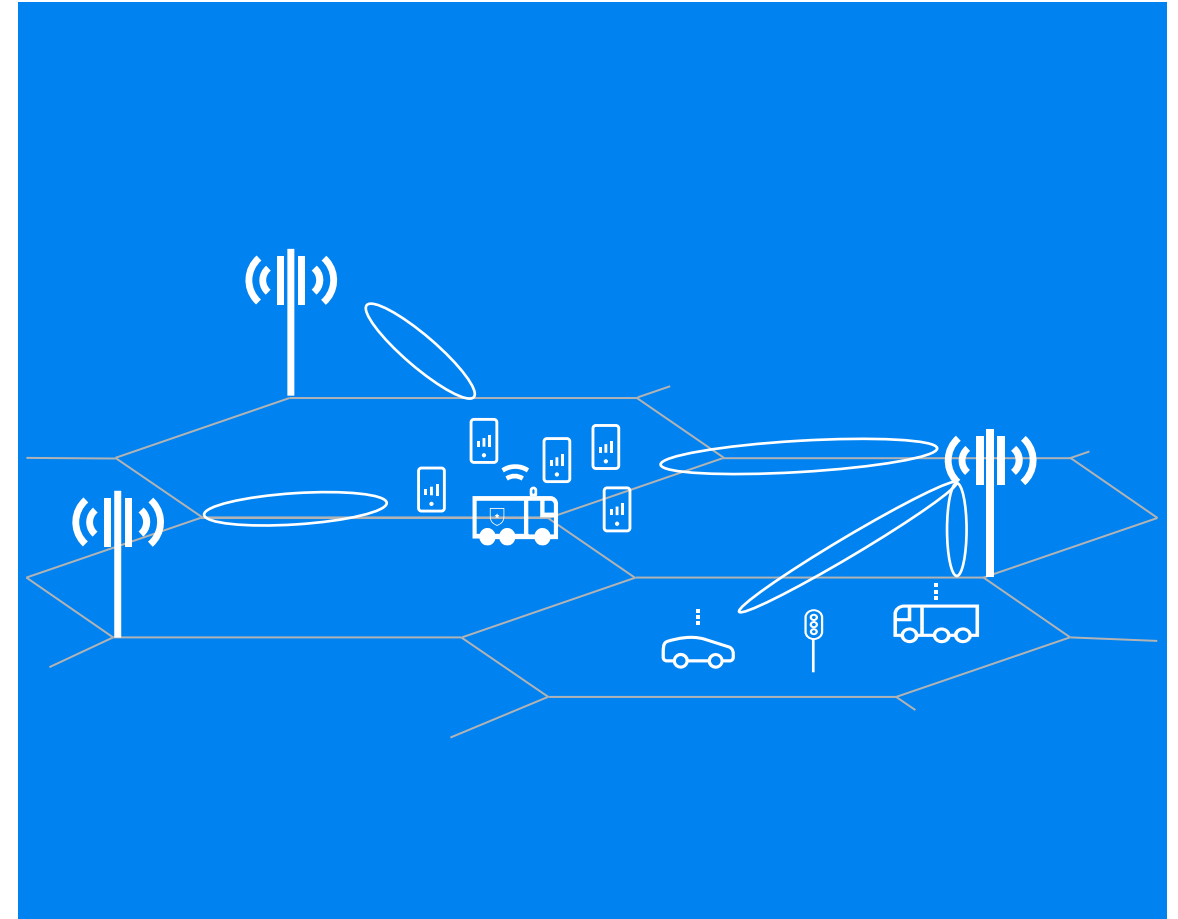
NR Multicast/Broadcast

SFN operation

— Rel-17 SFN operation upper-limited by cylic prefix (CP) duration

    — Extended CP would allow for larger SFNs and may enhance cell edge performance

    — But ext. CP would only be useful in practice if also implemented for unicast transmissions

Support for new spectrum bands

— The band 450-470 MHz (Band 31) is currently specified for LTE (Public Safety). With growing interest to use NR for NSPS it is natural to specify this band also for NR, including both unicast and MC/BC

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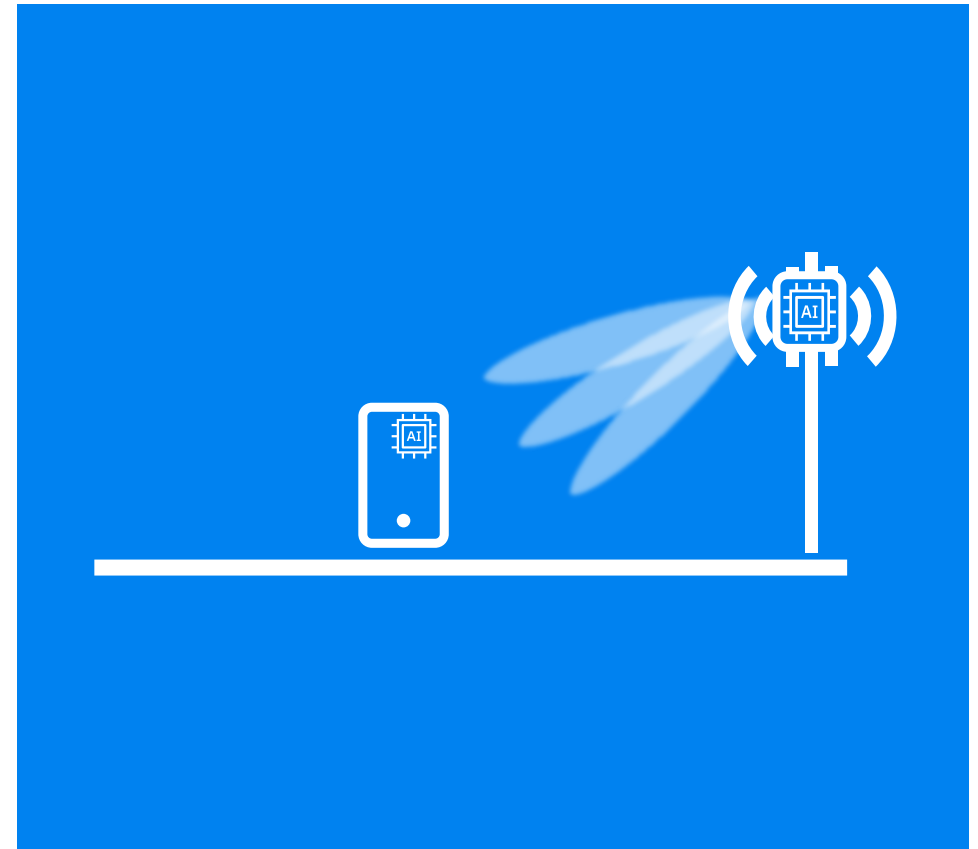
AI/ML PHY layer enhancements

Background:

- General expectation that AI/ML can improve PHY layer performance, e.g.
    - CSI acquisition, compression, feedback
    - Beamforming, beam tracking, beam management
- But unclear what needs to be specify and how to specify...

Objectives

- Study the framework required for AI/ML related PHY layer enhancements
    - AI/ML modelling
    - Evaluation methodologies
    - Standardization impact
        - incl. performance requirements and testing aspects
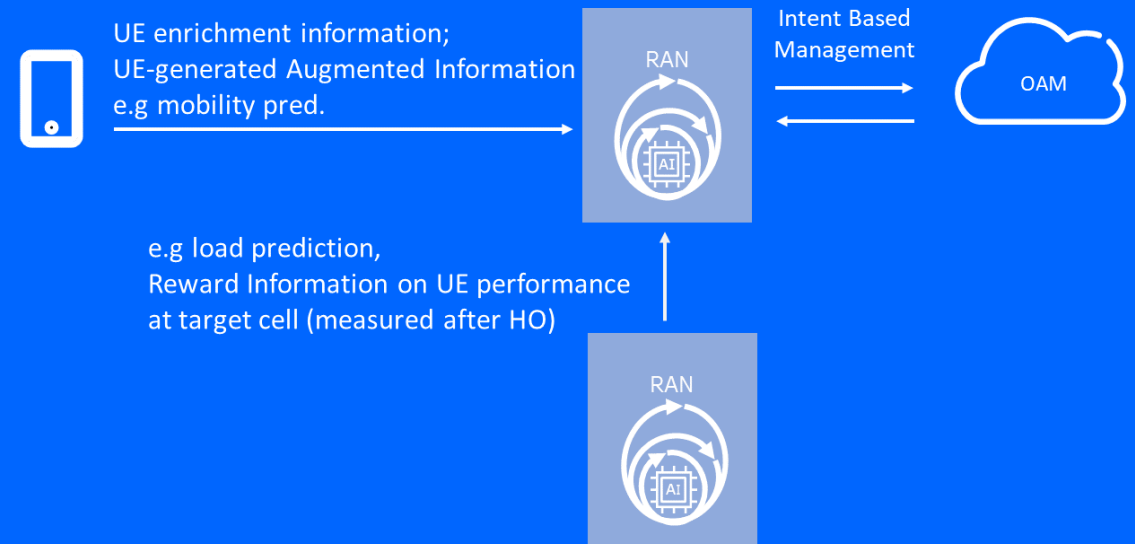
AI/ML RAN enhancements

- **Justification**
  - Perception that traditional human-machine interaction is slow, error-prone, expensive, and cumbersome
  - Ensure that 3GPP technologies support AI/ML in best possible way
  - Ensure ecosystem alignment on design aspects requiring interoperability, e.g. AI/ML input/output exchange

- **Objective**
  - Take selective use cases from Rel-17 technical report into normative phase
    1. AI/ML for efficient traffic steering
    2. AI/ML for load balancing
    3. AI/ML for energy efficiency
  - Support use cases via enhancements to current interfaces, to improve AI/ML functionality in the RAN while maintaining architecture
  - Ensure that AI models remain implementation specific => incentivize vendor competitiveness
  - Adopt an "intent-based" management for use cases involving RAN-OAM interactions

Example of AI/ML Use Cases

UE enrichment information; UE-generated Augmented Information e.g mobility pred.

Intent Based Management

RAN

OAM

e.g load prediction, Reward Information on UE performance at target cell (measured after HO)

RAN

Trustworthiness
topics driven by SA3

System Information (SI) protection

- Today, UEs cannot detect if SI messages were tampered or replayed by an attacker

- By adding periodic digital signatures, UEs can be enabled to determine the authenticity of SI messages

UP Integrity Protection for arch. option 1/3 (if not in Rel-17)

- Architecture Option 1 (LTE with EPC) and Option 3 (ENDC) still lacks integrity protection for user plane, leaving it vulnerable to tampering

- The vulnerability can be closed by introducing integrity protection as done for other options with 5GC

Virtualization friendly crypto algorithms for air interface

- Two crypto algorithms are mandatory. Only one of them is sufficiently fast in virtualized gNB.

- A second crypto algorithm is needed that meets performance requirements in virtualized gNB.