

# View on NR-REL 19



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# Overview on the Topics

## eMBB

- >32P CSI-RS[WI]
- UL Freq Selective Precoding [S+WI]
- Asymmetric MTRP[WI]

## NES

- Adapting tx/rx of common channels/signals
- WUS for gNB
- On demand SSB/SIB1
- Frequency domain adaptation at gNB and adaptation of BWP of UE

## SBFD

- Normative phase for SBFD and CLI mitigation enhancements[WI]
- SBFD with partially overlapping sub-bands[SI]

## NCR

- Multi-carrier & Multi-beam operation support at NCR[S+WI]

## NTN

- NCR support over NTN [WI]
- Support of Regenerative payloads [WI]
- Support of UE with GNSS independent operation [WI]
- NTN/TN Mobility Enhancement [WI]

## Positioning

- NTN positioning Enhancement
- Carrier phase-based Positioning Enhancement
- SL positioning enhancement

## Sidelink

- Sidelink FR2 optimization: (Normative Work)
- Carrier aggregation for Sidelink
- Energy saving in Sidelink

## AI/ML

- Positioning [S+WI]
- CSI prediction [WI]
- Mobility Enhancement [SI]

## RIS [SI]

- Study RIS with Rel18 NCR as baseline
  - channel model & performance gains

## ISAC [SI]

- Channel model requirements
- Identify use cases, KPIs and potential requirements

# eMBB Enhancements

## >32P CSI-RS

### Requirement

- Increased number of gNodeB RF capabilities requires more ports to be supported for CSI-RS

### Proposal

Enhance CSI-RS to support >32ports (atleast 64 ports)  
 Relevant Configuration  
 Optimized towards CSI-RS transmission, processing and reporting

## UL Precoder Enhancements

### Requirement

- UEs with more multipath and antennas are unable to utilize diversity across space and frequency of channel.
- Performance gap between CB and NCB SRS becomes considerably high for such Ues

### Proposal

- Support UL Precoder enhancements
  - TPMI enhancement for sub-band precoding
  - WB precoding with better resolution
  - processing and reporting

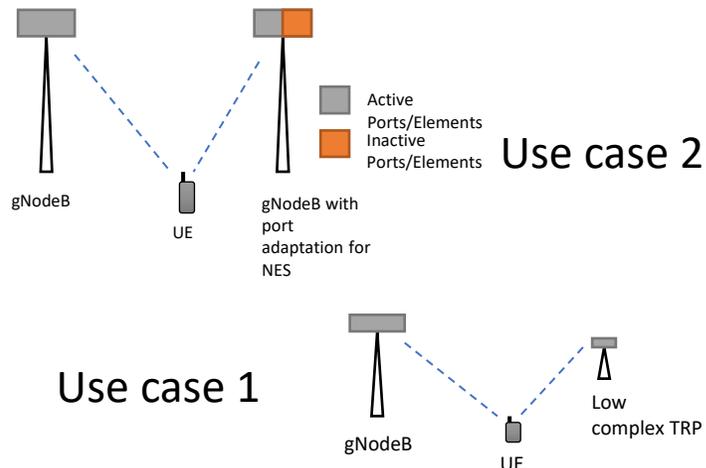
## Asymmetric MTRP

### Requirement

- Co-ordination between two TRPs with different TxRU configuration not possible as per Rel18
- Port adaption defined in NES can create asymmetric TxRU configurations across co-ordinating nodes

### Proposal

Support asymmetric TRP for NCJT / CJT CSI Configuration and Feedback



# NES Enhancements



- Rel. 18 studied various techniques in time, frequency, space and power domains
  - Analysed the techniques in terms of energy saving, impact on user performance, specification impact, etc.
  - Summary of the study is presented in TR 38.864
- Normative phase considered only spatial and power domain techniques



- Adapting transmission/reception of common channels/signals
  - Simplified SSB , Adapting periodicity of SSB and RACH , Skipping of SSB/CORESET0/SIB1
- Wake up signal for gNB and On demand SSB/SIB1
- Frequency domain adaptation at gNB and adaptation of BWP of UE
  - Dynamically adapting the bandwidth of the active BWP

# SBFD Enhancements

## Non-overlapping subbands

- Rel18 show reduced latency and improved UL coverage
- Companies have also shown throughput improvement

### Proposal

- Support normative phase for SBFD with non-overlapping subbands and enhancements for effective mitigation of CLI in dynamic/flexible TDD
  - Enhancements in configuration and signaling for SBFD
  - Enhancements in CLI measurement and reporting

## Partially overlapping sub-bands

- Partial overlapping can increase resource utilization and improve throughput in addition to latency reduction and coverage enhancement
- Overlapped subbands can be for specific signals/channels
  - Techniques (e.g., repetition) for minimizing the impact of interference
- Good starting point towards inband full duplex studies in 6G

### Proposal

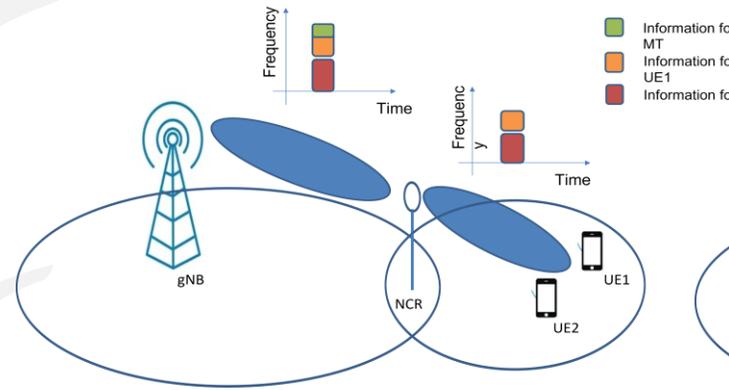
Study SBFD with partially overlapping sub-bands

- Interference modelling
- Impact on reference signal configuration/measurements/reporting
- Collision handling

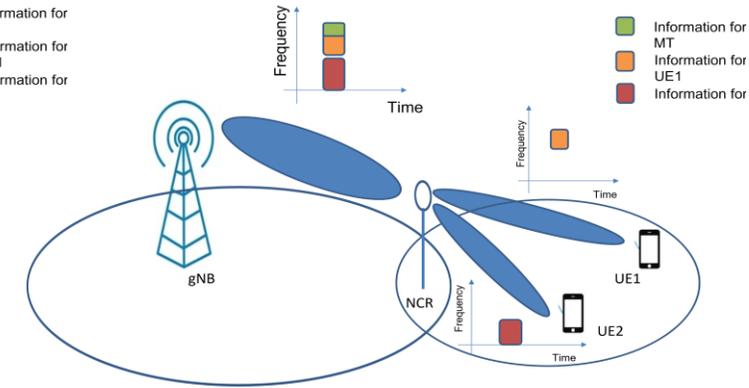
# NCR Enhancements

## Proposal

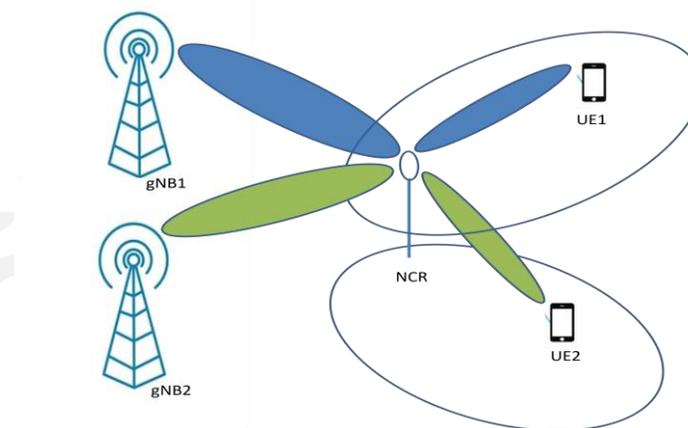
- Multi-carrier operation of NCR
  - NCR-MT and NCR-Fwd operating in separate carriers
- Multi-beam operation
- Sharing NCR among more than one gNB
- Joint transmission from multiple NCR to serve a UE



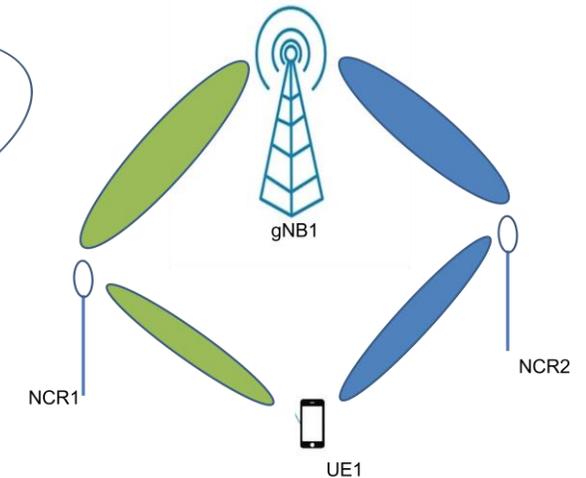
Multi-carrier support at NCR



Multi-beam operation



Sharing NCR among multiple gNBs

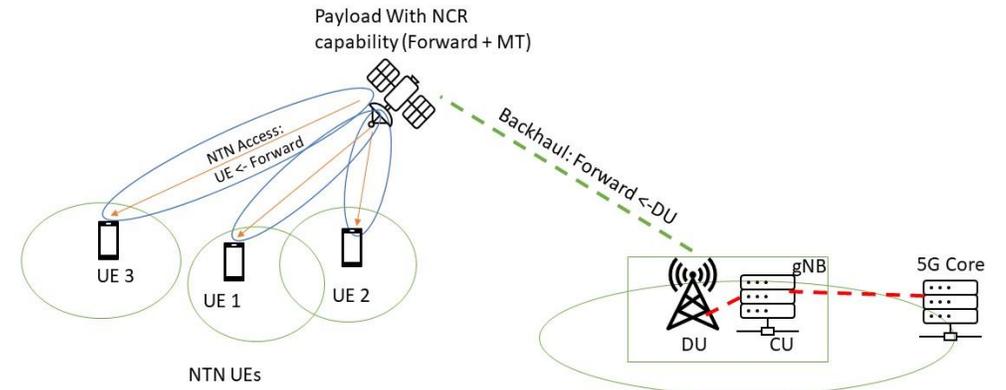


JT from multiple NCR



# Non-Terrestrial Networks

## Use case: NTN NCR



## NCR support over NTN

Extending service to coverage holes, e.g., remote villages, Suburban areas

- Improving link budget using configurable beamforming as per need
- Specific beamforming configuration at NCR to extend coverage to certain region/area
- Multi-beam operation at NCR can improve the scheduling flexibility
- Like footprint management based on UE location.

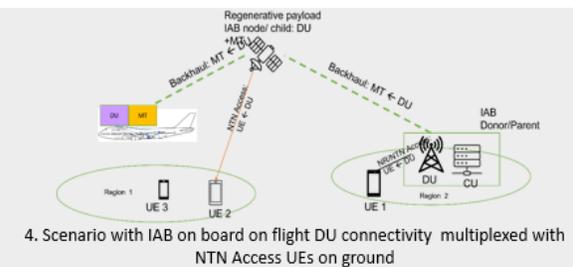
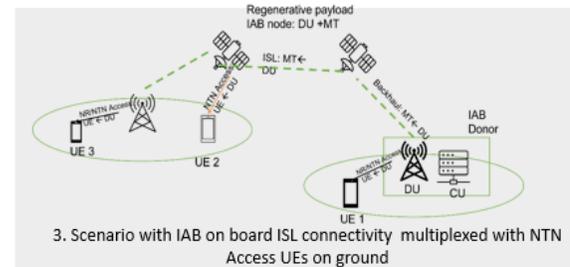
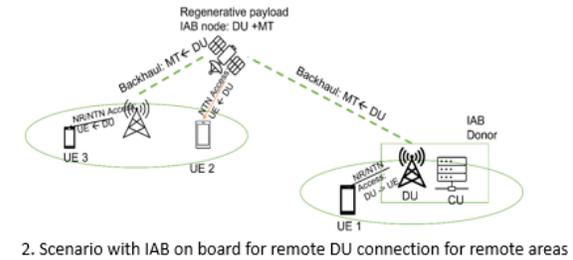
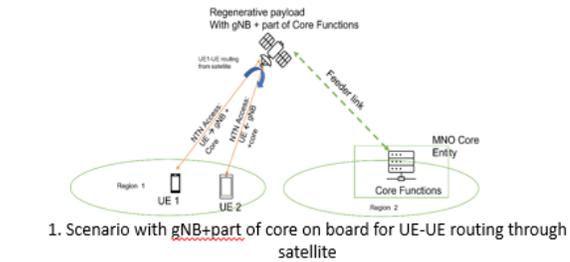
## Proposal

Enhancement NTN to support NCR operation

Support side control information for NCR over NTN



# Non-Terrestrial Networks



## Regenerative payloads

- Reduced user and/or control plane latency
- Communications without the ground network (loopback)
- Improving efficiency (incl. signaling overhead)
- Flexible traffic routing
- Simultaneous access and backhaul service

### Possible Payload configurations

1. DU on board
2. IAB on board (DU+MT)
3. Full gNB + Part of Core

## Proposal

- Support regenerative payload in NTN
  - Consider DU, DU + MT (IAB) and gNB + core functions option
  - Study the use case and requirements for each payload option
- Study the specification impact to support the above payload option
  - It should include at least TA, slot configuration, and synch aspects, timing offset enhancement for different interfaces (like F1, and BAP), spectrum aspects, etc.
  - Core functionality impact should be coordinated with SA2 and RAN3



# Non-Terrestrial Networks

## NTN/TN Mobility Enhancement

- Service quality and continuity for UE mobility between TN and NTN e.g., in the case of railways or vehicle-mounted UEs
- Rel-17 mechanism for service continuity and mobility between TN and NTN can be further optimized for continuous connectivity
- Introduction of dual connectivity and DAPS will serve the requirements

### Proposal

- Enhance the service continuity and mobility in NTN
  - Introduce dual connectivity and DAPS of NTN.

## GNSS independent operation

- Energy saving for power-critical UEs
  - IoT UEs , remotely deployed UEs, and handled devices in remote areas.
- Availability of reliable GNSS reception is not guaranteed
- Initial access latency can be reduced
  - Critical for LEO due to limited visibility time

### Proposal

- Support GNSS independent operation
- Study new method related to UL time for Timing advance (TA) in the initial access and the TA update & frequency compensation (Doppler) in idle and connected mode
- NTN positioning method to get UE-specific timing.
- New PRACH format
- Coexistence of UE with/without GNSS

# Positioning Enhancement



## NTN Positioning Enhancement

- In NTN, radio cells may be larger. This makes it difficult to determine reliably the UE location
- This may prevent NTN to support regulatory services
  - As part of Release 18, Some of the use cases and requirements are identified, and recommendations
- Further, in some other use cases like GNSS-free operation for power optimization and latency reduction, NTN-based positioning is necessary.
- During Rel. 18 SI, it is concluded that UE location with accuracy 5-10 Km should be reported to NW
- For the normative phase, the multi-RTT is supported assuming a single satellite is in view.
- Multiple satellites in view case is useful for better positioning accuracy
  - More techniques should be supported for positioning over NTN
    - DL-TDOA,
    - carrier phase based
  - Positioning should be optimized for GNSS free operation capability

## Proposal

- Extend support of DL-TDOA and carrier phase-based positioning
- Consider Multiple satellites in view case for positioning solution over NTN

# Carrier phase-based Positioning Enhancement

- Carrier phase is a useful scheme for mm level accuracy of positioning which is the requirement for the advanced use case
- Carrier phase-based positioning (CPP) for NR is extensively studied in Rel 18 SI
- Normative work is agreed upon with limited scope
- Left over should be considered in the Rel 19
- CPP is discussed for SL application but not consider in the scope of normative phase
- For NTN CPP methods should be extended

## Proposal

- CPP should be extended for Sidelink based positioning.
- The NTN positioning enhancement should include the CPP method.
- Left over items of CPP from Rel 18 should be considered in Rel 19

# Positioning Enhancement



## SL positioning enhancement

- Support of carrier phase positioning for SL will be necessary for ultra-high precision positioning
- In SL position SI, different methods for FR1 and FR2 are considered but FR 2 is precluded due to limited support of FR2 over sidelink
- FR2-related optimization for positioning is important for some of the use cases link IIoT, joint sensing & communication operation support
  - AOD method can be considered in Rel 19 for SL which will be useful for directional ranging

### Proposal

- Introduce the CPP method in sidelink for ultra-high precision positioning
- Extend the support of SL positioning to FR2 considering
  - Introducing AOD-based positioning method for ranging and positioning
  - Optimize SL-AOA, SL-RTT, and SL-TDOA methods for FR2
- Consider joint radar and communication use case for V2X use case under joint communication & sensing case

# Side link Enhancement

## Sidelink FR2 optimization

### Motivation

Some V2X and commercial use cases over sidelink require a high data rate (e.g., 1GBPS) which is not easily supported in FR1. Therefore, FR2 needs to be optimized for better operation over sidelink. Rel 18 has started the study and it will be completed in Rel 18, and outcome and recommendations should be considered for normative work in Rel 19.

### Proposal

- FR2 optimization with respect to sidelink beam management should be considered in Rel 19 as normative work
- Recommendation and outcome of the study should be considered for defining the normative work objectives.

## CA in Sidelink

### Motivation:

- Available spectrum for sidelink is limited and fragmented
- Aggregating these fragmented channels will result in effective sidelink operation covering many use-cases requirements. The goal of carrier aggregation is to enhance performance and ensure a high-quality user experience by enabling data rates
- In Rel 18, the CA objective is agreed but unfortunately, no work is started
- This work should be completed in Rel 19

### Proposal

- Specify mechanism to support NR sidelink CA operation based on LTE sidelink CA operation
- It should include SL carrier (re-)selection, synchronization of aggregated carriers, power control for simultaneous sidelink TX, packet duplication, etc.
- FR1 and FR2 licensed spectrum and ITS bands.

## Energy saving in Sidelink

### Motivation

Sidelink increases the processing at the UE resulting in abrupt increase in energy consumption

- Synchronization and beam management
- Reference signal transmission and feedback
- Beam pairing and beam failure recovery
- Sensing and allocation
- Two stage side control information (SCI) decoding

### Proposal

Study following objectives in Rel. 19

Evaluation methodology

- Reference configuration (e.g., BW, inter UE distance, etc.)
- Energy saving gain of the techniques in different scenarios (e.g., in-coverage/out of coverage)

Identification of techniques for SL energy saving

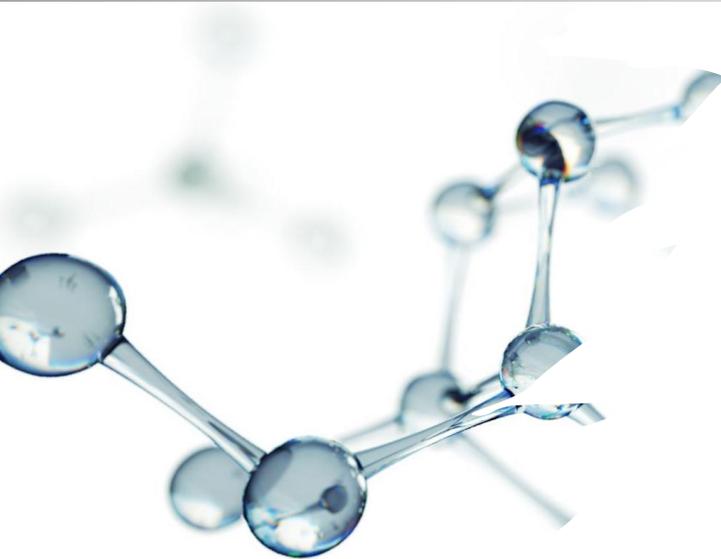
# Positioning Enhancement

## Requirement

- Positioning accuracy deteriorates when the model is trained with a different dataset than the actual deployment scenario.
- The prioritized scenario for the evaluation of AI/ML based is Indoor Factory (InF).
- For both the direct AI/ML based Positioning the model input agreed are PDP and CIR and the dimension of model input is Ntrp, Nport, Nt.

## Proposal

- Moving R18 study item to work item.
- For the Direct AI/ML positioning study the performance of Label free direct AI/ML method.



## L1/L2 Mobility Enhancement

### Objectives

- Inter-cell temporal beam prediction
- Enhanced handover for seamless mobility

### Proposal

- Study mobility enhancement based on temporal beam prediction using AI/ML

# AI/ML

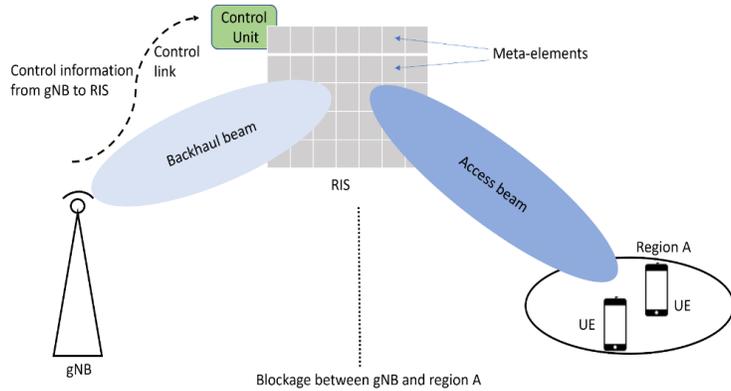
## CSI Enhancement

### Rel18

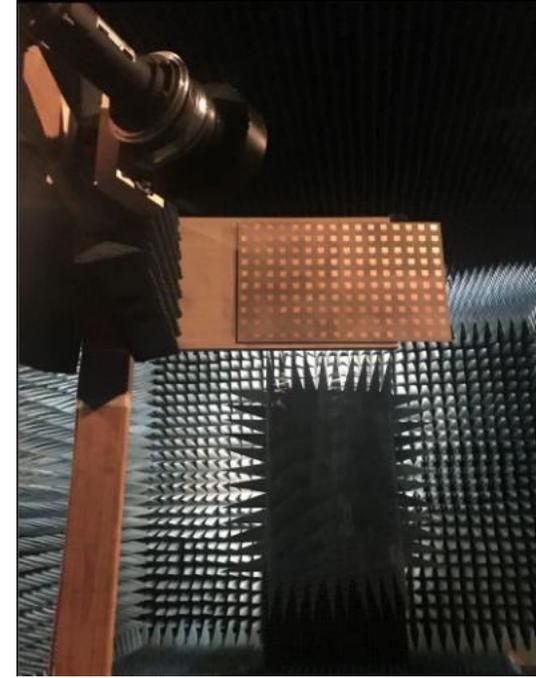
- Time domain CSI prediction using UE sided model is selected for CSI enhancement.
- Companies to report the model used, number of future prediction instances and other related KPI's.

### Proposal

- Moving R18 study on CSI prediction and compression to work item.
- Consider beam management using AI/ML for Work Item in Rel 19.



# Reflective Antenna Surfaces



Planar surface capable of performing passive beamforming

- Control unit:
  - Receives control information from the gNB and controls the beamforming and reflections at the meta-surface
- Meta-surface:
  - Comprising meta elements that can passively beamform in certain direction and reflect the RF signals incident on it
- Passive reflecting elements
- Low-cost solution for coverage extension
- Low energy consumption, ease of deployment, et

## Proposal

- Evaluation methodology
  - channel model (e.g., far/near field, indoor/outdoor)
  - performance gains in different scenarios (e.g., indoor/outdoor)
  - cost effectiveness and complexity
  - interference in multi-operator scenario
- Identification of RIS in a network
- Identification of control information required for RIS Configuration

# Study on Integrated sensing and communication

## Sensing aid communication

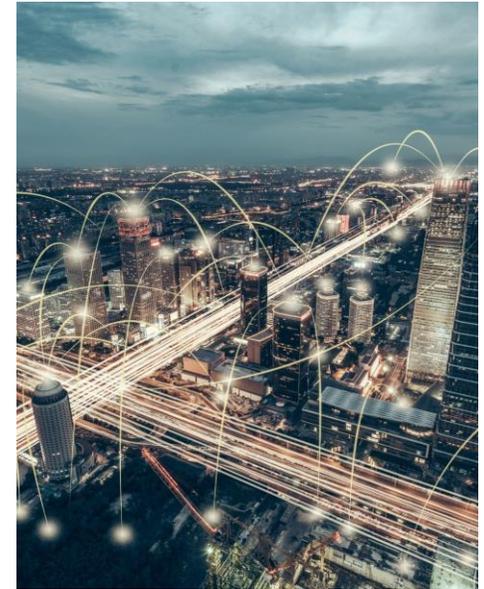
- Beam tracking, beam failure recovery and CSI tracking

## Communication aid sensing

- Moving to THz makes huge bandwidth available for sensing
- Presence of MIMO makes detection more accurate
- Passive sensors aid sensing even in absence of LOS path

## Potential use cases

- v2X, Smart city, Smart home, HAPS



## Proposal

- Study use cases and potential requirements to provide integrated communication and sensing services addressing different target verticals/applications
  - e.g. autonomous/assisted driving, V2X, aviation/UAVs, 3D map reconstruction, smart city/factories, public sectors, healthcare, smart home, maritime sector.
- Study channel model requirements to support ISAC
- Identify KPIs related to NR based sensing
  - Eg: Range, Motion, Velocity

# THANK YOU

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