

The vivo logo is displayed in white lowercase letters in the top left corner of the slide. The background of the entire slide is a dark blue, abstract, fiber-optic-like pattern with glowing points and lines.

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

**RWS-230059**

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

**Agenda Item: 5**

**Source: vivo**

**Title: Consideration on Rel-19 positioning evolution**

# Overall Rel-19 positioning summary

- **Positioning for XR use cases**

- High accuracy 6DoF tracking
- XR positioning over FR2-2 band
- XR positioning over unlicensed band
- XR positioning over sidelink
- ...

- **Rel-18 positioning continuation**

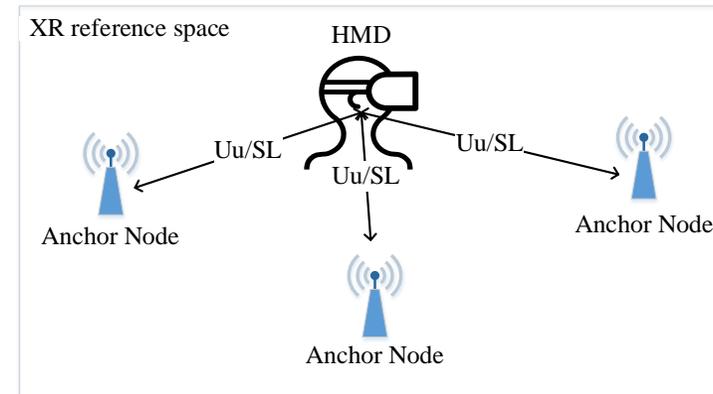
- Other sidelink positioning enhancement
- Power saving enhancement for LPHAP and RedCap positioning

# XR positioning

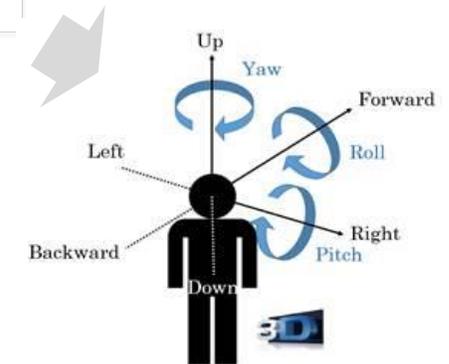
## Motivation

- An XR pose describes a position and orientation in space relative to an XR space. An essential element of XR is the spatial tracking of the viewer pose with the following technical requirement.

- Technical requirement of Tracking (SA4 TR26.928)
  - 6 degrees of freedom tracking (6DoF)
  - 360 degrees tracking
  - Sub-centimeter accuracy
  - Quarter-degree-accurate rotation tracking
  - Minimum update rates are 1000Hz (1ms) and beyond
    - May update to ~16.67ms to align with the frame rate of the rendered video (e.g., 60fps) according to TR 38.835
  - No jitter
  - Comfortable tracking volume



Positioning of the HMD



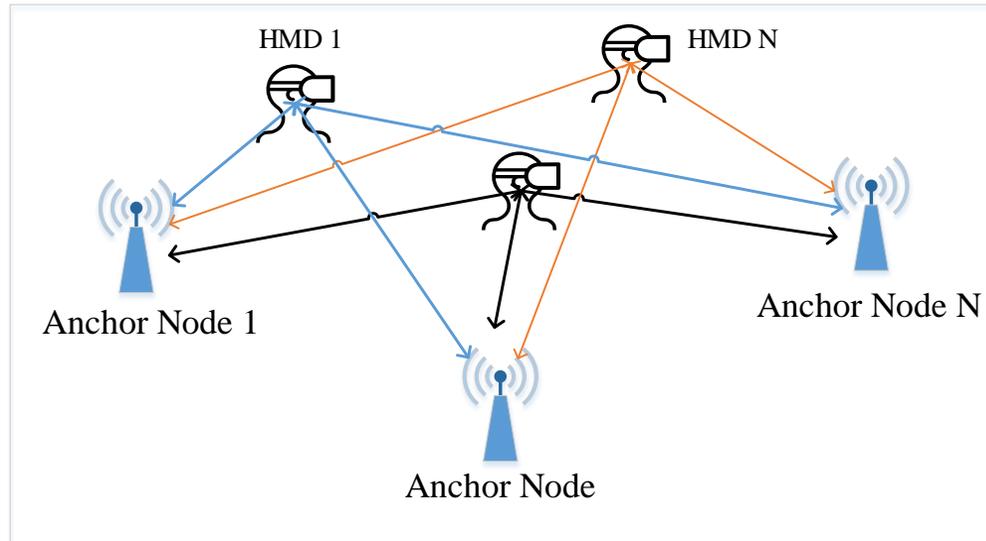
6DoF tracking

- High accuracy 6DoF XR viewer pose (position and orientation) tracking is the critical challenge for XR positioning.

# XR positioning

## Motivation

### ■ Example scenario for RAT-dependent XR positioning



Multi-user AR Service in public hotspot

AR and AI functionalities are provided for Image & Object Recognition, Navigation, Occlusion Avoidance, etc.



Airport



Stadium



Shopping mall

### Advantages over RAT-independent

- Dense deployment of BSs enables low-cost outside-in positioning with 5G large bandwidth
- Super coverage of BSs integrates the maximum amount of environmental/spatial map information into the Network, simplifies map construction/environmental awareness on XR devices
- NR RF signals are not affected by light and have stronger privacy protection, compared with traditional XR visual positioning
- Can serve as a supplement to RAT-independent positioning, for cumulative error calibration or tracking recovery

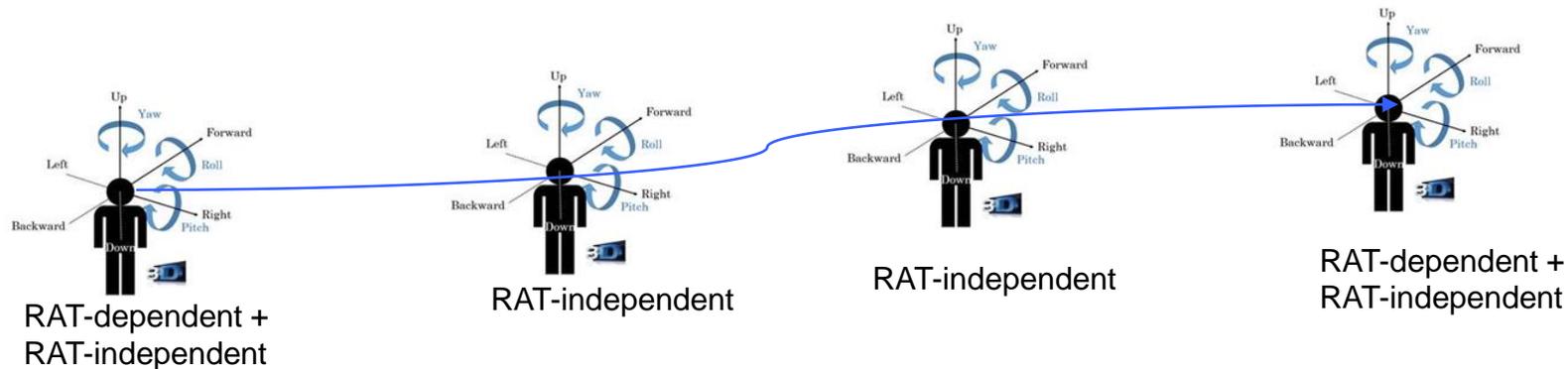


- Higher accuracy of tracking
- Lower processing complexity and power consumption; fewer sensors/cameras, lower cost and weight on XR devices
- Stronger privacy protection
- Stronger robustness for tracking

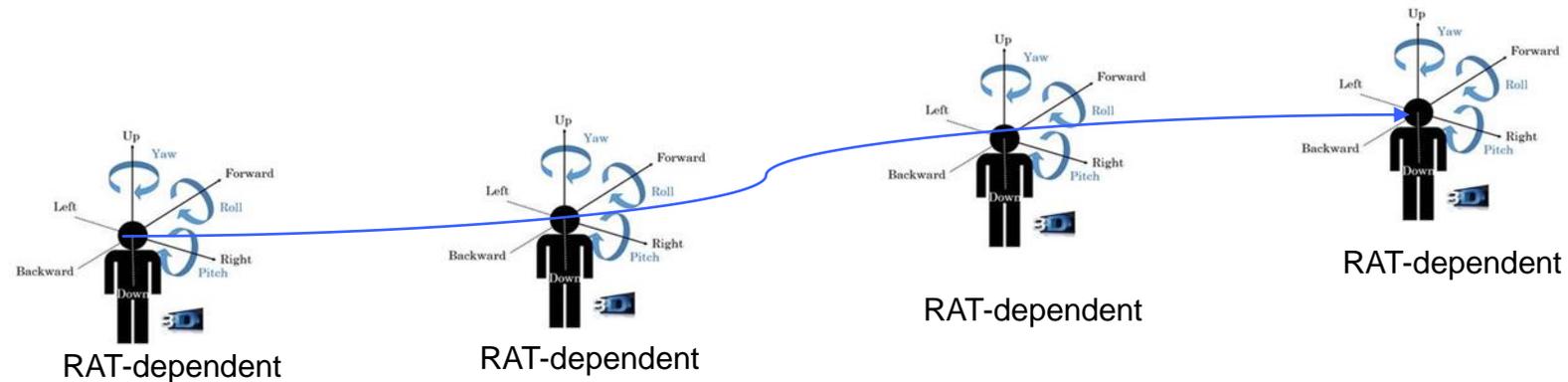
# XR positioning

## Application of RAT-dependent XR positioning

- For the application of RAT-dependent XR positioning, two alternatives can be considered:
  - Alt 1: RAT-dependent positioning serves as a supplement to RAT-independent positioning (i.e., sensor-based positioning)
    - To reduce the impact of error accumulation;
    - To relax strict latency requirement



- Alt 2: RAT-dependent positioning serves as standalone positioning



# XR positioning over FR2-2 band

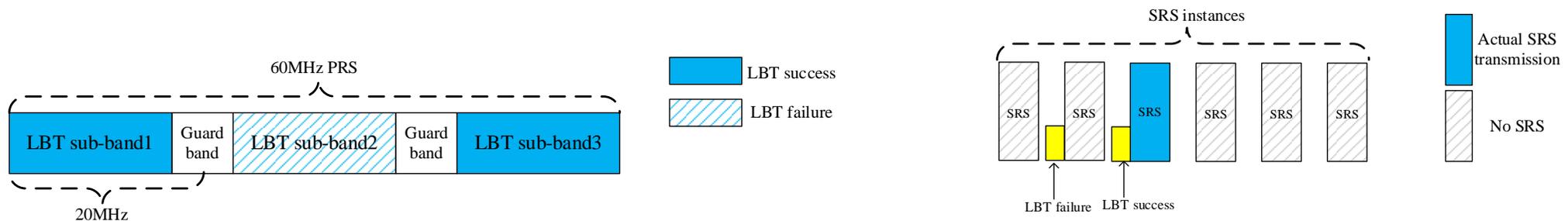
## Motivation and enhancement

- Rel-17 NR\_ext\_to\_71GHz WI extended NR operation up to frequency range 52.6-71GHz
  - New bandwidth: support 800MHz, 1600MHz and **2000MHz** as channel bandwidth
  - New SCS: support 480KHz and **960kHz** SCS for all DL and UL channels
- New bandwidth provides the possibility to meet the **accuracy** for XR positioning
- New SCS provides the possibility to minimize physical-layer latency for XR positioning
  
- Potential work for FR2-2 positioning
  - Support new bandwidth (800MHz, 1600MHz, 2000MHz) and new SCS (480kHz, 960kHz) for DL PRS and SRS for positioning, and study potential impact on positioning
  - Evaluate the achievable positioning accuracy for XR use cases based on characteristics from 52.6GHz to 71GHz
  - Define performance requirement by RAN4

# XR positioning over unlicensed band

## Motivation and enhancement

- Use **unlicensed band to provide larger bandwidth** for high-precision positioning for XR use cases
  - Use unlicensed band to provide larger bandwidth if licensed resources are limited
    - ✓ Provide positioning signaling/measurement interaction on licensed band; transmit PRS/SRS on unlicensed band
    - ✓ Provide angle positioning or rough positioning on licensed band; provide time-based positioning or high-precision positioning on unlicensed band
  - Support positioning function in scenarios without licensed deployment
  - Considering that the WIFI already supports positioning, NR-U supports positioning to better promote NR-U
- Potential enhancement
  - **Frequency domain:** study the impact of 20MHz LBT bandwidth granularity and the intra-cell guard band on wide-band PRS/SRS
    - ✓ Study how to deal with unsuccessful LBT sub-band for wide-band PRS/SRS transmission (e.g., left figure)
  - **Time domain:** study the impact of LBT on time domain PRS/SRS transmission
    - ✓ Study the type of PRS/SRS transmission (e.g., periodic, aperiodic)
    - ✓ Study how to increase the probability of successful PRS/SRS time domain transmission (e.g., right figure)

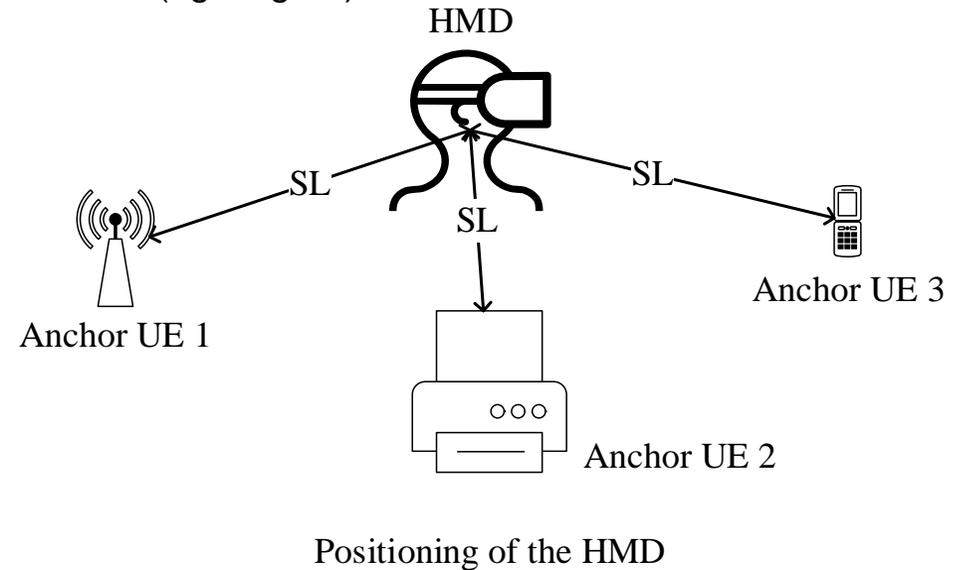
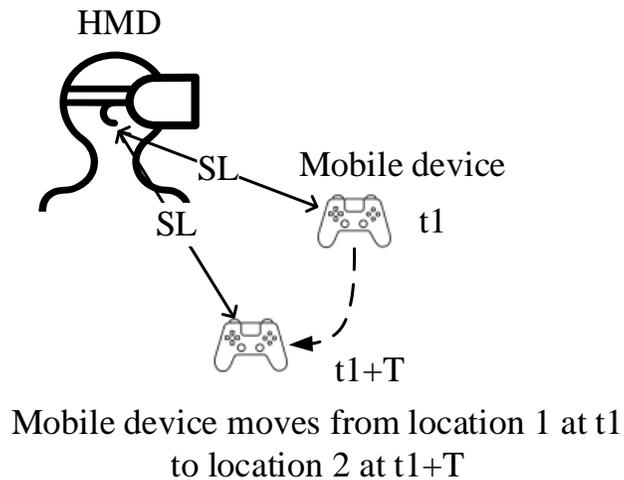


# XR positioning over sidelink

## Motivation and enhancement

- Scenarios of SL positioning in XR

- Sidelink-based XR positioning is an alternative to Uu-based XR positioning
- **Scenarios 1:** sidelink positioning between the mobile devices and head-mounted displays (HMD) (left figure).
  - FFS: whether the mobile device is regarded as a separate UE or as one UE together with the HMD.
- **Scenarios 2:** sidelink positioning of HMD according to the anchor UEs (right figure).



- Potential enhancement for higher accuracy

- SL FR2 positioning
- SL positioning over the unlicensed spectrum

## Summary

- **Study the following potential scenarios/solutions for XR positioning to enable high accuracy (e.g., sub-centimeter and quarter-degree rotation) 6DoF tracking**
  - Measurement and report enhancement for high accuracy 6DoF tracking
  - RAT-dependent positioning serves as a supplement or standalone method
  - Positioning over FR2-2 band
    - Support new bandwidth (800MHz, 1600MHz, 2000MHz) and new SCS (480kHz, 960kHz) for DL PRS and SRS for positioning, and study potential impact on positioning
    - Define performance requirement by RAN4
  - Positioning over unlicensed band
    - The impact of LBT on frequency domain wideband PRS/SRS
    - The impact of LBT on time domain PRS/SRS transmission
  - Positioning over sidelink
    - SL FR2 positioning
    - SL positioning over the unlicensed spectrum

# Rel-18 positioning continuation

## Motivation and enhancement

### Other SL Positioning enhancement

- Support SL positioning power saving for power limited UEs (PUE, commercial hand sets)
  - Partial sensing based resource allocation for SL PRS/SL measurement report
  - SL DRX based SL PRS reception/measurement
- Support Wi-Fi, sensor and GNSS measurement/report for SLPP
- Support integrity for sidelink positioning

### Power saving related enhancement

- LPHAP
  - Support SRS alignment with eDRX (especially for eDRX cycle > 10.24s) in RRC\_INACTIVE towards meeting the battery life requirement for LPHAP (if not supported in Rel-18)
- RedCap positioning
  - Support positioning impacted by CDRX in RRC\_CONNECTED

THANK YOU.

谢谢。