

# Meta's Views on XR Enhancements in Rel. 19 RAN

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# Outline

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- Metaverse and XR
- Further XR-Awareness Enhancement over NR
- XR Latency Reduction
- RAN-Aware Rate Adaptation
- Support of XR Type Devices



# Metaverse

- **What is Metaverse?**

- The metaverse is the next generation of the mobile internet; the metaverse will help you connect with people you aren't physically in the same place



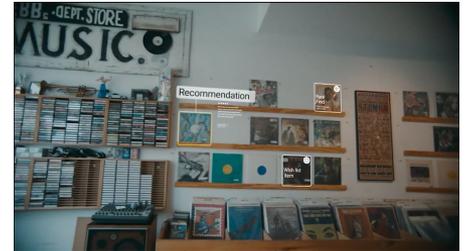
*Connect*



*Play*

*Work*

*Shop*

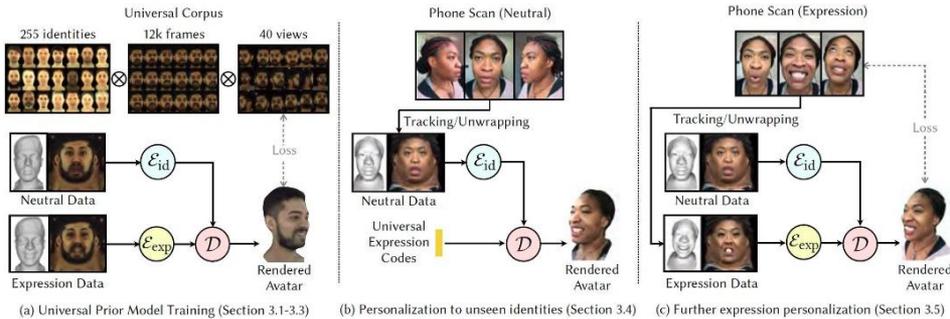


# XR and 5G

- XR Devices and Use Cases Enable Metaverse
  - Devices: AR, VR, and MR
  - Use cases: e.g., Codec Avatar, AI/ML based use cases



*E.g. Codec Avatar Generation and Communications [S4-230750]*



## RAN Challenges:

- QoS of Multi-modal XR traffic
- Power Saving and Capacity Enhancement
- Interactivity and Latency
- XR Device Requirements
- Different Connection Paradigms

**Collaboration between RAN and SA2/SA4 are needed for these features!**

***5G Connectivity is a Critical Enabler for Anywhere Anytime Metaverse Experiences!***



# Further XR-Awareness Enhancement over NR

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- Enhancement of PDU set Framework
  - Enhancement of PDU set discard
    - e.g., Threshold-based PDU Set Integrated Handling Information
  - Inter PDU set dependency and optimization
  - Map multi-modal PDUs into the same PDU set with similar application layer importance
    - e.g., Spatial audio with corresponding video rendering
  - Application level FEC awareness to enable adaptation and optimization in RAN
- Work with SA2/SA4 to further study XR traffic and use case characteristics and the need for further PDU set framework improvement
  - e.g., Codec avatar communications; immersive multi-modal XR traffic; AI/ML use cases



# XR Power Saving and Capacity Enhancement

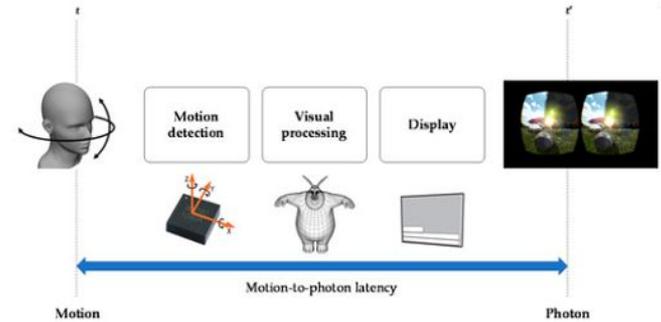
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- XR Power Saving
  - Multi-modal scenarios to be further studied
    - A single traffic flow with multiplexed traffic (3D mesh based video or AI/ML based codec avatar, audio or spatial audio, Contextual AI)
    - Multiple traffic flows of XR traffic
  - Further enhancement on CDRX based approaches for multi-modal XR traffic
  - Explore dynamic PDCCH monitoring based power saving approaches for XR traffic
  - PDU Set based discard or early termination
- XR Capacity Enhancement
  - Study UE support of delay sensitive scheduling
  - Enable adaptive selection of BSR tables



# XR Latency Enhancement (1)

- Latency is not a scalable KPI (either make it or not) and critical to XR applications
  - Stringent requirements based on human perception (e.g., Motion to photon latency)
  - Consider different architectures (cloud offload or local computing)
- PDB significantly impacts the overall system capacity



## TR 38.838 Rel. 17 Study on XR (Extended Reality)

### 7.3.1.2.2.3 AR (2 streams: pose/control-stream + scene/video/data/voice-stream)

Based on the evaluation results in Table 7.3.1.2-1, the following observations can be made.

- For FR1, Indoor Hotspot, UL, with 100MHz bandwidth for AR two-stream (Scene/video/data/audio-stream, 10Mbps, **30ms PDB**, 60FPS + Pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS), with SU-MIMO, it is observed from Source 16, Source 18 that the mean capacity performance is **8.41 UEs** per cell in a range of 4.1~12.71 UEs per cell.
- For FR1, Indoor Hotspot, UL, with 100MHz bandwidth for AR two-stream (Scene/video/data/audio-stream, 10Mbps, **10ms PDB**, 60FPS + Pose/control-stream, 0.2Mbps, 10ms PDB, 250 FPS), with SU-MIMO, it is observed from Source 15, that the mean capacity performance is **4.05 UEs** per cell

# XR Latency Enhancement (2)

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- Latency Reduction
  - Retransmission-less protocol design at higher layers
    - Adaptive application layer FEC for multi-modal XR traffic
    - Low-latency transport layer protocols over NR (e.g., QUIC)
  - Improvement of the reliability of retransmission-less lower layer protocols
    - Link layer: RLC UM vs RLC AM
    - PHY: HARQ vs Enhanced UE CSF feedback
  - Study E2E latency with different connection paradigms
    - e.g., tethering AR glasses with sidelink [3GPP TR 28.806]
- Enhancement of PDB and PSDB
  - Enhancement of XR-Awareness PDU set framework
  - Enhancement for multi-modal XR traffic (e.g., spatial audio + video rendering)
  - Device architecture aware delay requirements (tethered or direct connection)
  - Further explore jitter characteristics of XR traffic
  - Location based PDB/PSDB (Edge vs deep edge vs cloud)



# RAN-Aware Rate Adaptation

- Motivation
  - XR application based rate adaptation provides better QoS
  - Further improve the efficiency of XR traffic delivery: latency and data rates
  - Enable efficient application layer FEC
  - Enable the optimization of local compute and offloading
  - Enable the optimization of computation power vs transmission power
  - Further enhancement E2E QoE with XR-Aware RAN framework (e.g., PDU set and properties)
- Joint study with SA2/SA4 to explore the framework to enable RAN-aware rate adaptation

SA4 would like to point out, that due to its **heavy-compression and spatial-temporal prediction, any packet losses in video generally result in degradation of the user-perceived quality of experience**. Hence, **video applications generally (i) benefit, (ii) are more efficient and (iii) can be simplified, if the network minimizes video packet losses**. Nevertheless, a video decoder in particular in a low-latency application needs to include mechanisms to handle packet losses and delayed packets, such as frequent resynchronization and error concealment. In those cases, the operation of the receiver/network may vary. For example, the handling of dependent PDU Sets once a leading PDU Set is lost is not universally defined and depends on the operation of the application. However, **typically, video applications prefer reducing the encoding bitrate in order to minimize congestion-related packet losses**. If the application and the 5GS have agreed to a QoS flow establishment, then the network is obviously expected to support the delivery of PDUs according to the QoS requirements of the application

[S2-2208157/S4-221174/S4-220505](#) Reply LS to Follow-up LS on QoS support with Media Unit granularity

# Support of XR Device Type

- Motivation
  - Define the requirements for XR wearables considering the following characteristics, e.g.,
    - 2Rx due to form factor limitations
    - BW and CA requirements considering demanding XR use cases
  - Further enhancement based on the Rel. 18 progresses



Form Factor Constraint:  
Weight, Size, Sleekness

Light, comfortable and natural to wear



Battery Operation Lifetime

Augmented Call: minutes to hours  
Daily companion: Last one day or longer

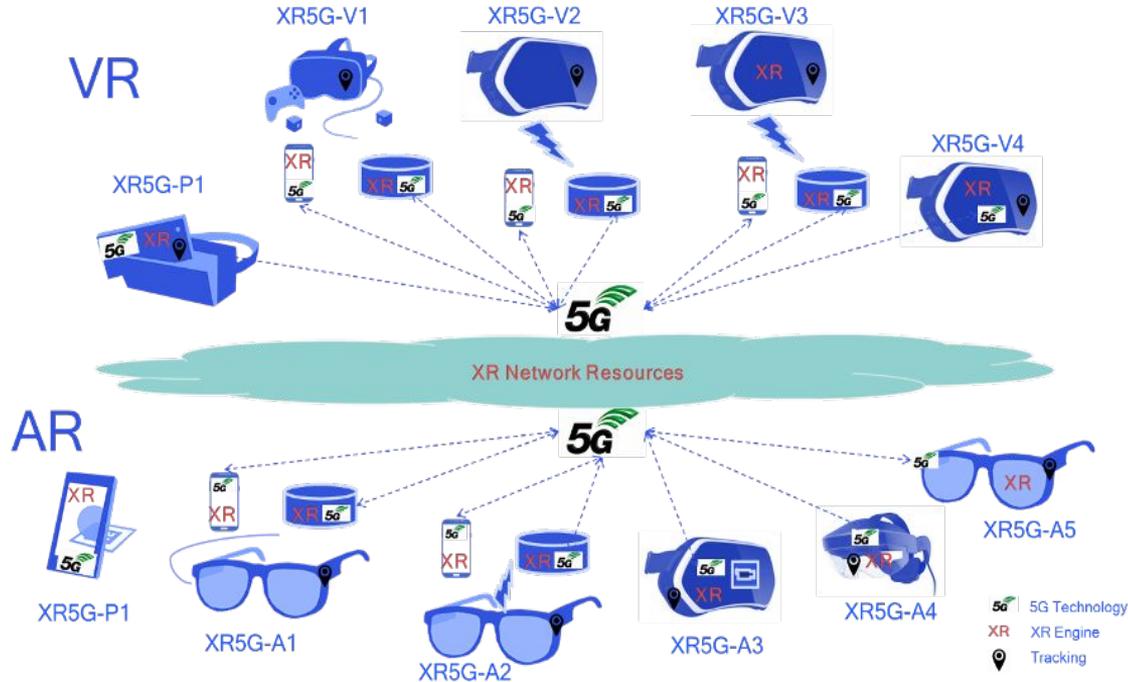


Thermal Limit

IEC defines the damage threshold (for skin) as 43 degrees Specific Absorption Rate (SAR) limit in US: 1.6 watts/kg

- *For example, AR use cases require cameras (e.g., eye tracking, SLAM), sensors (e.g., IMU), processing units (e.g, rendering, AI), display and wireless connectivity, etc.*
- *On the other hand, XR wearables have very limited spaces ...*

# Examples of XR Types Form Factors



- XR5G-P1* : Smart phone device for VR/AR
- XR5G-V1* - Simple VR Display wired:
- XR5G-V2* - Simple VR Display wireless:
- XR5G-V3* - Smart VR Viewer wireless tethering:
- XR5G-V4* - VR HMD standalone:
- XR5G-A1* - Simple AR Wearable Glass wired:
- XR5G-A2* - Simple AR Wearable Glass wireless:
- XR5G-A3* - Smart AR HMD video see-through:
- XR5G-A4* - AR Wearable Glass standalone:
- XR5G-A5* - Smart AR Wearable Glass wireless:

TR 26.928, section 4.8 Devices and Form Factors



