

Metaverse Related Projects (SID/WID) in 3GPP SA1 & SA2

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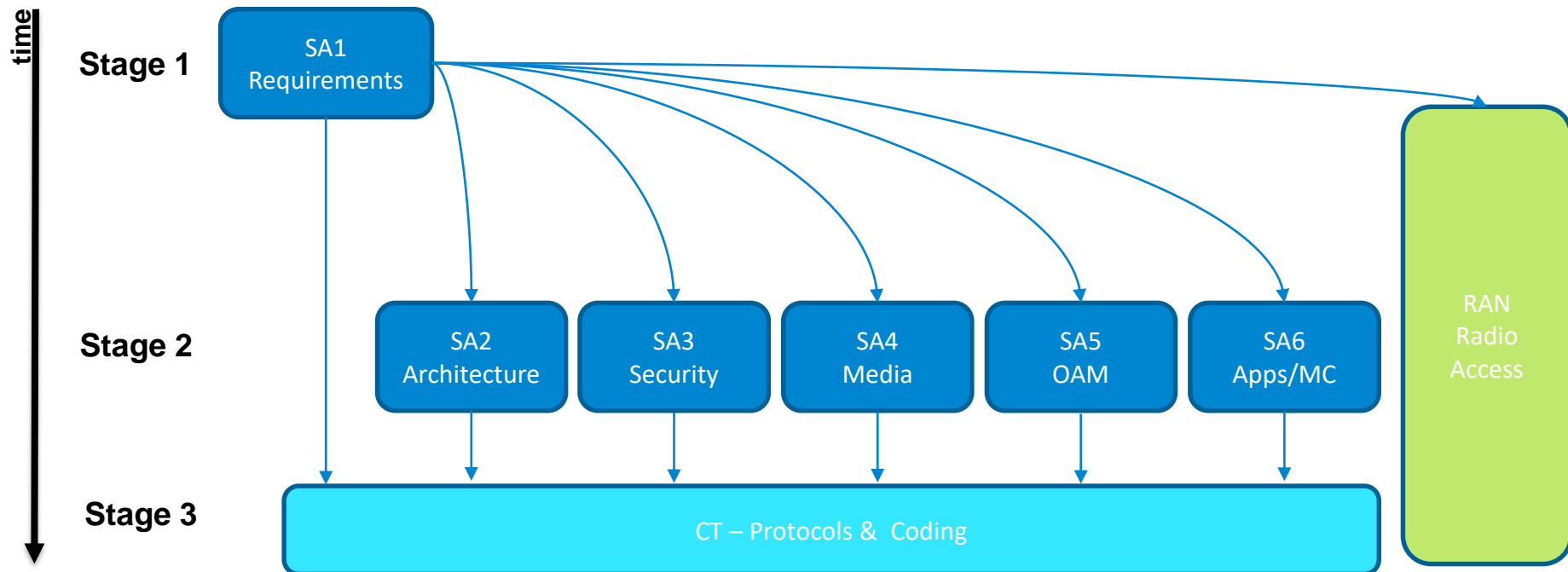
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- 3GPP 5G work: Stage -1, -2 & -3
- 3GPP 5G Rel-18 (subset of Metaverse):
 - SA1 TACMM (Tactile & Multi-Modality Communication Services)
 - SA2 XRM (eXtended Reality & Multi-Modality Media Services)
- 3GPP 5G Rel-19
 - SA1 Metaverse (Study the Localized Mobile Metaverse Services)

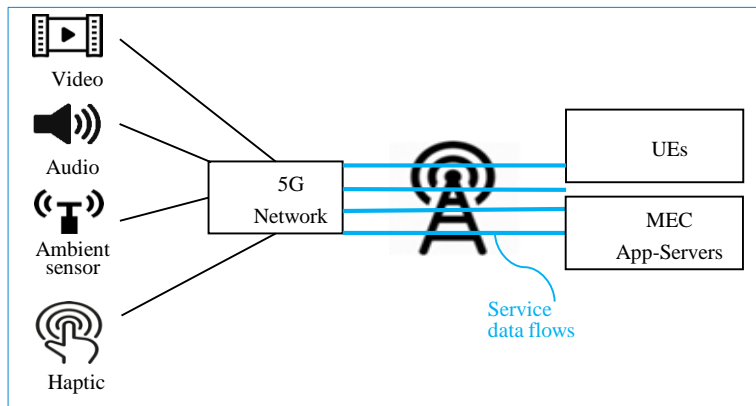
Background: 3GPP Stage 1/2/3 (A very brief SA view)

3GPP - the 3rd Generation Partnership Project:

- A global standards organization for mobile communication;
- 3 TSGs: SA, CT & RAN



- **TACMM**: Considered as a subset of the more-general ‘Metaverse’ application
- A type of 5G advanced service that enables multi-modality interactions, combining ultra-low latency with extremely high availability, reliability and security.
 - Normally 4 categories (or modalities): **video**, **audio**, **ambient-sensor** (e.g., brightness, temperature, humidity), and **haptic data** (e.g., the feeling of touch like the pressure, texture, vibration of medias, and the kinaesthetic senses, like the gravity, pull forces, position awareness)
 - Typical use cases with immersive real-time experience (AR, VR, XR)



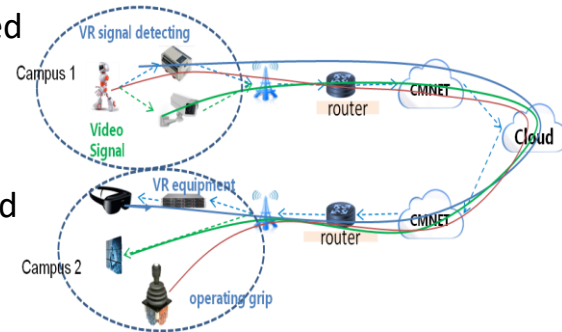
- Some Req. challenges across different types of media steams (i.e., multi-modality) with coordinated throughput, latency and reliability
 1. Data characteristics
 2. Accurate synchronization across & within modalities
 3. QoS differentiation
 4. large volume of small packets & packet-size variation

1. Characteristics of generated data across modalities: high frequency and low latency to achieve 'acceptable' quality across a large area
 - E.g.: haptic-data may generate a traffic stream with 1000 PPS; video @ 50-60 FPS, etc.
2. Accurate synchronization across & within modalities
 - Multiple data inputs across modalities with high accuracy (~sub-1ms of time-sync), large scalability (involving a large number of wireless devices possibly over a relatively large area); e.g., visual-haptic feedback process
3. QoS differentiation (across modalities):
 - E.g. communication latency, data reliability, average data rate across modalities
4. large volume of small packets & packet-size variation
 - E.g., Haptic Packet-size related to the capacity of DoF; data-size/DoF: 2-8 Byte; a haptic device might support 6+ DoFs; high traffic volume

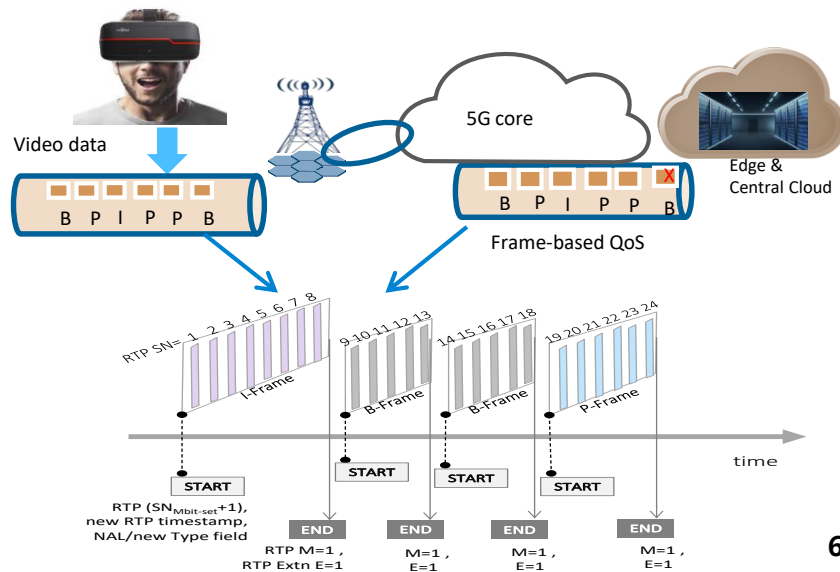
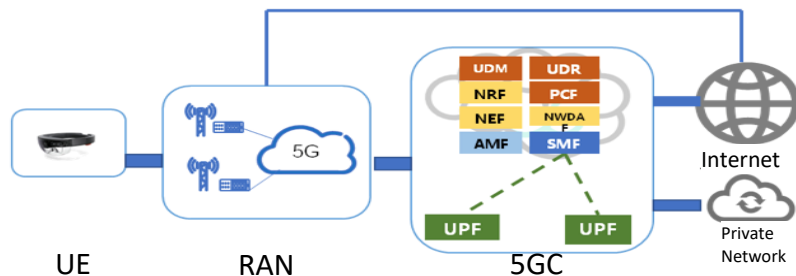
Potentially addressed via IETF related technologies:

1. Sub-1ms sync accuracy: e.g., IETF DetNet WG: layer-3, and IEEE802.1 TSN: layer-2.
2. Inter-modality time-sync: IETF has a draft by introducing a reference stream for clock synchronization.
3. Prioritized processing with a modality: E.g., video data transmission thru RTP by utilizing the different level of criticalness of MPEG image frames : I, P and B, etc.
4. Small-size packets with large volume: E.g., IETF QUIC: providing zero RTT connection establishment and transmission - could potentially benefit the haptic data transmission.

- **XRM:** Considered as a subset of the more-general ‘Metaverse’ application; related to the Rel-18 stage-1 work SA1 TACMM (study of use-cases and KPIs)
- A type of 5G advanced service to provide immersive real-time experience (XR); characterized by the Reqs. of high data rate and low latency, including multi-modality transmission, congestion control of media streams, PDU/PDU-set -based QoS handling, uplink-downlink transmission coordination, Packet Delay jitter handling, and etc.



- Various networking related issues to address:
 - Network information exposure & congestion control of media streams: L4S with ECN/AQM (3 RFCs in 5G Spec. already), etc.
 - QoS handling: (PDU/PDU-set –based, RTP w/ extension): PSDB/PDB, PSER/PER; GBR/Non-GBR w/ feedback control, etc.
 - Delay/Jitter (UL/DL): provisioning, measurement, guarantee, etc.



- **Metaverse:** A type of 5G advanced service that investigates specific use cases and service requirements for 5GS support of enhanced XR-based services to offer shared and interactive user experience of local content and services, accessed either by users in the proximity or remotely.
- Support of interactive XR media shared among multiple users in a single location
 - ❖ Perf KPIs, e.g. latency, throughput, connection density, scalability
 - ❖ Identification and digital representations of entities (e.g., users, devices)
 - ❖ Acquisition, utilization & exposure of local info (physical & digital): e.g., local spatial/environmental, users' positioning/viewing/directional/haptic, etc.
- Compared to (SA2) XRM: Metaverse involves coordination of input data from different devices/sensors from different users and coordination of output data to different devices at different destinations to support the same task or application.

28 Use Cases have been proposed (select.)

1. Localized Mobile Metaverse Service
2. Mobile Metaverse for 5G Traffic Flow Simulation & Situational Awareness
3. Concurrent & Collaborative Engineering Design via Metaverse services.
4. Immersive Gaming & Live Shows
5. Multi-service Coordination in Metaverse
6. Critical HealthCare Services via Metaverse
7. Interconnection of Mobile Metaverse Services)
8. ...

- 3GPP TR 22.856: Feasibility Study on Localized Mobile Metaverse Services (Stage 1, Rel-19)

Requirements: User Experience/ Performance	<ul style="list-style-type: none"> Multi-user audio & video stream synchronization under the strict RTT latency req. (~20ms) Distribution, provisioning & execution of digital representation prediction model Session creation between digital avatars
	<ul style="list-style-type: none"> End-to-end latency: 5-20ms Bandwidth: 200-2000Mbps Positioning precision: <1m Delay jitter: 2ms(haptic); 50ms(audio/video) Area capacity: 39.6Tbps/km² Reliability: 99.9999%
Spatial reconstruction	<ul style="list-style-type: none"> Mgmt. of spatial anchor; Generation of spatial mapping & positioning info.

Thank you!