SA WG2 Meeting #157
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Discussion on Architecture enhancement for 5G Mobile Metaverse services

Samsung

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Overview

- **SA1 has studied the feasibility of localized mobile metavers services in FS_Metaverse Rel-19.**
  - Feasibility Study on Localized Mobile Metaverse Services, TR 22.856

- **In SA2 perspective, the following topics can be studied to support Mobile Metaverse services in 5GS:**
  - Enhancements for supporting avatar communications
  - Enhancements for supporting Digital Identity Authentication
  - Enhancements for supporting End-to-End QoS Control for Mobile Metaverse services

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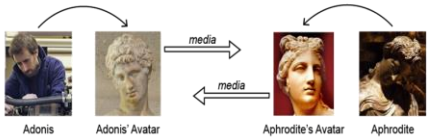
Enhancements for Mobile Metaverse

[General Description]

Motivation/Scenarios

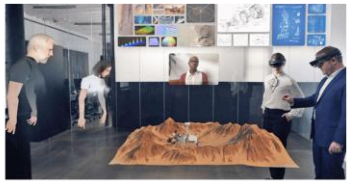
- Metaverse comprises of both real and digital worlds, and both worlds interact with each other.
- 3GPP SA1 is studying Localized Mobile Metaverse Services in Rel-19.
- System architecture enhancement and Application enablement for various use-cases are required.
- Example use-cases:



Avatar Communications

Localized Mobile Metaverse Service

Spatial Mapping and Localization Service Enabler



Metaverse Conference with user identity

[Potential Scope]

Mechanisms to support Avatar Communications

- Architecture enhancement for IMS based avatar communication
- Transition between video and avatar media considering UE capability, network condition, and user preference
- QoS management for interactive avatar communication in both IMS/non-IMS

Mechanisms to support Digital Identity Authentication

- User authentication(e.g. biometric authentication) using UE
- Exposure digital identity service to AF for 3rd party services

Mechanisms to support E2E QoS Control

- End-to-End QoS and congestion control and enforcement
- UE App(e.g. traffic category) triggered dynamic QoS Flow control
- Traffic handling/monitoring/analytics enhancements for metaverse

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Objective#1: Enhancements for supporting avatar communications

Justification

- The NG-RTC (Rel-18) is an IMS architecture enhancement for supporting Data Channel. However, it may not be sufficient for fulfill the SA1 requirements and various use-cases, and the emergeing media, i.e. avatar, to be defined in Rel-19 SA4.
- Avatar Communication Models need to be considered for representing user's avatar in the network:
  - Transmission of facial expression between the UEs after pre-downloading avatar model
  - Transmission of 3D avatar timed media between the UEs after pre-downloading avatar model
  - Transmission of augmented avatar in addition to audio/video
  - (avatar model: e.g. configured animated avatar, user created animated avatar, and photo-realistic avatar)
- Based on the different UE capabilities, various network entity deployments, network conditions, and based on the user's preferences, the avatar call may be dynamically converted to the video call, or more over normal voice call

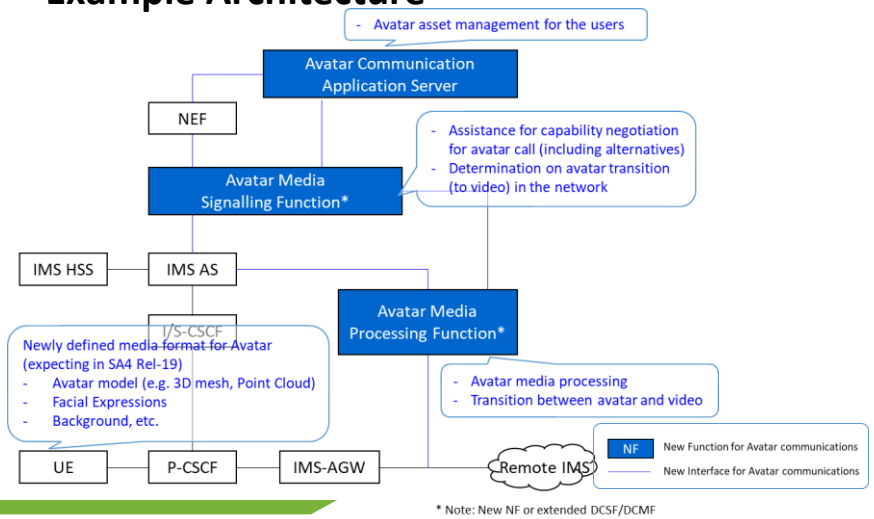
SA1 Requirements

- See TR 22.856 clause 5.11, 5.26

Objectives

- Study how to further enhance IMS procedures with new NFs and/or new services of the NFs to support network rendering and processing for avatar communications.
- Study how to support interworking between avatar communication and traditional video communication while considering UE capabilities.
- Study how to support dynamic transition between avatar communication and traditional video communication based on the user request.
- Study how to manage and ensure QoS for interactive avatar communications.

Example Architecture



Objective #2.1: Digital ID Authentication and its exposure

Justification

- 1billion people have no formal proof of identity
- Source: GSMA Digital Identity Initiative
- https://www.gsma.com/mobilefordevelopment/digital-identity/
- Digital Identity Authentication as a new service of Mobile operators
- EU Digital Identity Wallet Initiative
- (See SA1 TR 22.856 Annex B)
- At the metaverse meeting, due to the strict security requirements, typically participants need to be authenticated using bio information (e.g. finger print, facial image) at the terminal side. The result (not the original bio information) of the terminal side authentication can be forwarded to the corresponding application server of the enterprise. (in TR 22.856)

SA1 Requirements

- Subject to regulatory requirements, operator policies and user consent, the 5G system shall be able to support mechanisms to expose to a trusted third party (e.g. the conference focus) the result of authenticating a user identity to a UE.
- TR 22.856 clause 5.3.6

Objectives

- Study how to authenticate digital identity of the user (e.g. digital representations including avatar) with user information (e.g. user's bio information including finger prints, facial image) in the UE and how to forward the result of the user authentication to the 5GC.
- Study whether and how to expose a digital identity service to AF for 3rd party services

Potential Impacts

- Impacted NFs: UE, AMF, UAF(User Authentication Function, New NF), NEF, AF
- Example Procedures:
  - Provisioning Digital ID authenticator's credential (in UE)
  - AF triggers the User Authentication Procedure
  - UAF initiates the user authentication
  - Authenticator in UE perform biometric authentication (bio information is not exposure outside of the UE
  - The UE sends the result of user authentication result to the UAF (over NAS)
  - UAF informs the result of the authentication result to the NAF via NEF

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Objective #2.2: Binding external user authentication to 3GPP subscription

Justification

- Identification of users and other digital representations of entities interacting within the metaverse service is required
- 3rd party user authentication (using external user identity provider) can be used for authenticating the user using the metaverse service
- Binding the authenticated user to the 3GPP subscription is useful for various use cases

SA1 Requirements

- [PR 5.3.6.2-2] Subject to regulatory requirements, operator policies and user consent, the 5G system shall be able to support mechanisms to expose to a trusted third party (e.g. the conference focus) the result of authenticating a user identity to a UE.
- NOTE: Authenticating a user identity to a UE at the terminal side is out of 3GPP scope.

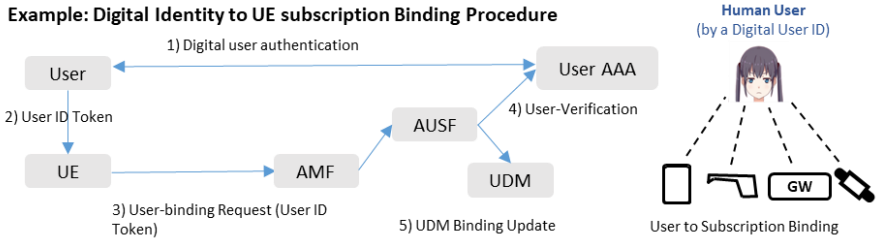
Objectives

- Study whether and how to bind the external user authentication with the 3GPP subscription
- Study whether and how to verify multiple user devices belonging to the same user. (Secondary device mapping to the primary device after authenticating the primary device and its exposure)

Potential Impacts

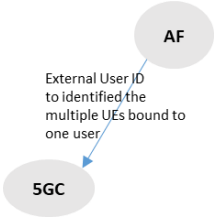
- Impacted NFs: UE, AUSF, UDM, User-AAA

Example: Digital Identity to UE subscription Binding Procedure



3GPP 5GC extends UDM to support the external User Identification

Existing UDM records		Extension to the UDM records	
SUPI	Subscription Data	Digital User ID	External ID Provider
SUPI 1	DNN, S-NSSAI, etc	Digital User ID 1	External ID Provider 1
SUPI 2	DNN, S-NSSAI	Digital User ID 1	External ID Provider 1
SUPI 3	DNN, S-NSSAI	Digital User ID 2	External ID Provider 2
SUPI 4	DNN, S-NSSAI	Digital User ID 3	External ID Provider 3



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Objective #3.1: Enable QoS control in total end-to-end range

Justification

- To provide end-to-end QoS support for metaverse services, it is required to integrate non-3GPP network's QoS
- L4S is the simplified, and promising end to end congestion control mechanism. It can be easily extended to the non-3GPP part (i.e. the non-3GPP network behind the UE towards to the wearable devices, as well as N6 part between the UPF towards to the Application Server)
- To maintain consistent QoS across wired and Wi-Fi networks the RFC 8325 defines a mapping between DSCP and IEEE 802.11's user priority (UP), which is then mapped to Wi-Fi CERTIFIED Multimedia™ (WMM®) access categories.

SA1 Requirements

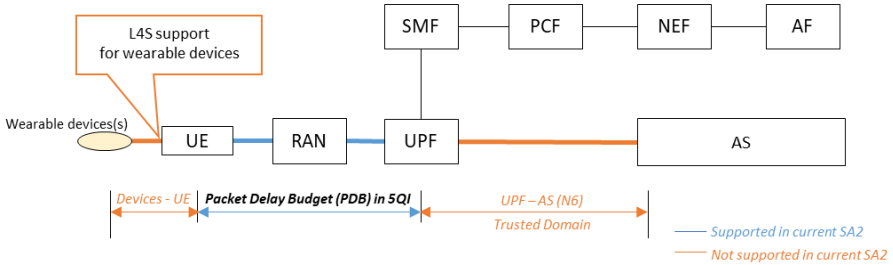
- WiFi alliance suggests DSCP mapping can also act as QoS bridge between WiFi QoS and 5G QoS Flow
- Reference: "Analyzing operator QoS deployment scenarios between Wi-Fi® and 5G (2022)"

Objectives

- Study whether and how to enable QoS control (including congestion control) and enforcement in total end-to-end range which includes the range between the UE and the tethered wearable devices for mobile metaverse services behind the UE, and the range between the UPF and the Application Server (e.g. N6 part), including but not limited to:
  - L4S support in the gateway UE of the tethered wearable device
  - QoS mapping between 5G QoS Flow and Non-3GPP QoS (e.g. by use of DSCP code);
  - QoS statistics monitoring and analytics for N6 part

Potential Impacts

- Impacted NFs: Gateway UE, SMF, PCF, (RAN, UPF), NEF, AF, NWDAF



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Objective #3.2: UE Application triggered dynamic QoS Flow control

Justification

- The mobile metaverse services support applications that including multiple data flows (e.g. video data flow, audio data flow, haptic data flow). And the differences between the required QoS of each data flow are significant.
- If 5GS is possible to manage in per-QoS Flow basis within a PDU Session dynamically, the operators can manage their network resource efficiently for the massive users.
- The UE Application is the one that knows exactly when and what kind of application traffic is required by the Application in the UE.
- In this way, the operator can determine the PCC rules flexibly based on the operator policy or application service requirements. Also, the UE can trigger the network procedure in UE OS independent way.

SA1 Requirements

- [TS 22.261, clause 6.43.2] The 5G system shall support a means to apply 3rd party provided policy(ies) for flows associated with an application. The policy may contain e.g. the set of UEs and data flows, the expected QoS handling and associated triggering events, other coordination information.
  - NOTE: The policy can be used by a 3rd party application for coordination of the transmission of multiple UEs' flows (e.g., haptic, audio and video) of a multi-modal communication session.

Objectives

- Study how to support dynamic QoS Flow control by the trigger from UE Application traffics for a single PDU Session, including but not limited to:
  - By using existing UE reporting to network procedure (e.g. Traffic Category);
  - By using NEF API from UE Application

Potential Impacts

- Impacted NFs: UE, PCF, SMF, UPF

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