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Abstract: This TD contains the initial text of draft new Recommendation F.CAR-reqs "Requirements and framework of cloud-based augmented reality systems".

This document contains the initial text for this new work item, based on the discussions of the following contribution.

Document	Source	Title	Agreements
SG16-C329-R2	China Telecom, ZTE, Huawei Technologies, China Mobile	New: F.CAR-reqs: Proposed new work item on "Requirements for cloud augmented reality systems"	Proposal for new WI agreed.

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Draft new Recommendation ITU-T F.CAR-reqs

Requirements and framework of cloud-based augmented reality systemsRequirements for cloud augmented reality systems

Summary

WithBased on the cloud computing capabilities and massive data collaborative processing, the cloud-based augmented reality cloud AR systems can effectively support large-scale physical scene recognition and digital processing, provide more flexible virtual scene integration, and support multi-person interactive scenarios. This Recommendation doesn''t change the cloud computing's functions, presents basic concept of cloud-based augmented realityc,loud AR and specifies requirements and framework of cloud-based augmented reality systemsfor cloud augmented reality systems.

[TBD]

Keywords

cloud-based augmented reality systems, augmented reality, requirements, framework

1 Scope

This Recommendation specifies requirements and framework of cloud-based for cloud augmented reality systems. The scope of this Recommendation includes:

– Overview

– Hierarchy fFramework of cloud-based augmented reality systems

– Requirements of cloud-based augmented reality systems

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T J.301] Recommendation ITU-T J.301 (10/2014) *Requirements for augmented reality smart television systems.*

[ITU-T F.740.2] Recommendation ITU-T F.740.2 (07/2022) *Requirements and reference framework for digital representation of cultural relics and artworks using augmented reality.*

[ITU-T J.302] Recommendation ITU-T J.302 (10/2016) *System specifications of augmented reality smart television service.*

[ITU-T G.1036] Recommendation ITU-T G.1036 (07/2022) *Quality of experience influencing factors for augmented reality services.*

[TBD]

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 augmented reality [ITU-T J.301]: A type of mixed reality where graphical elements are integrated into the real world in order to enhance user experience and enrich information.

3.1.2 augmented content [ITU-T J.301]: A binary object, such as 2D images, 3D animated models or audio/video streaming files, to be augmented into a predefined augmentation region.

3.1.3 application [**b-ITU-T Y.101**]: A structured set of capabilities, which provide value-added functionality supported by one or more services.

[TBD]

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

[TBD]

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AR Augmented Reality

[TBD]

5 Conventions

In this Recommendation:

– The keywords "**is required**" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this Recommendation is to be claimed.

– The keywords "**is recommended**" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement needs not be present to claim conformance.

– The keywords "**can optionally**" indicate an optional requirement which is permissible, without implying any sense of being recommended. These terms are not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

6 Overview

Cloud-based AR, based on the super computing power of the cloud, completes complex real scene understanding, 3D modelling, multi-terminal data sharing, cloud edge collaboration and other processing, builds a continuous combination of point cloud map and real world coordinates, realizes real-time and updated 3D digital world model for real world scanning, and provides the terminal with the ability to index and integrate virtual information.

Cloud-based AR requires the collaborative provision of services based on various systems, collectively referred to as cloud-based AR systems.~~Cloud AR~~ Cloud-based AR systems ~~-~~require~~s~~ the real-time collection of multi-terminal collaboration, the low latency transmission of network uplink, the capabilities of cloud-edge collaboration, the integration of various multimedia

processing capabilities, the efficient distribution of services/content, and the control and coordination of various capabilities.

Compared with the AR terminal local operation mode, the cloud-based AR systems~~-~~ ~~has~~ have the characteristics of low terminal capacity requirements, multi-person interactive sharing, and integrated AI processing capabilities.

– The low terminal capacity requirements are mainly manifested in the completion of scene understanding, three-dimensional modelling and other processing through the cloud, and the use of multimedia streaming delivery and other modes, which can reduce the processing pressure of the terminal on logic operations and graphics rendering, thereby reducing the intensity of terminal operations and extending the battery life of terminals.

– The multi-person interactive sharing is mainly manifested in the digital processing of super-large scenes and multi-person data sharing. For the processing of ultra-large scenarios, based on the cloud-edge collaborative processing mechanism, the multi-terminal crowdsourcing collection mode is adopted to obtain a wide range of map information, and realize the digital processing of ultra-large outdoor scenes through intelligent understanding, resource aggregation, and repositioning in the cloud. For multi-person data sharing, based on the cloud-unified large-scale real-world digital processing results and super virtual world construction capabilities, it provides high-end AR multi-person interactive services for terminals with basic functions such as display.

– The integrated AI processing capabilities, first of all, AI model training needs the super-scale computing power support of cloud response, and accurate recognition of real scenes also needs cloud capabilities. Therefore, the cloud-based AR can effectively integrate AI and other capabilities, and improve the quality of AR user experience.

7 ~~Hierarchy f~~Framework of cloud-based augmented reality systems

In the ITU-T G.1036, the reference framework for digital representation of cultural relics and artworks using augmented reality, includes AR cloud creator, AR cloud management platform, mobile device.

The digital representation of cultural relics and artworks using augmented reality, is mainly to establish a digital communication mechanism between visitors and physical cultural relics/artworks, and there is no cross-regional large-scale multi-person interaction, more complex cloud processing and multiple edge computing collaboration, such as multi-person cross-regional cloud-based AR navigation, cloud-based AR tourism, etc.

In order to widely adapt to cloud-based AR service scenarios, we need to refine the end-to-end cloud-based AR system~~s~~ composition. We believe that the cloud-based AR systems consist of content layer, control layer, resource layer, network layer, terminal layer, security and cloud-based AR OA&M, etc.

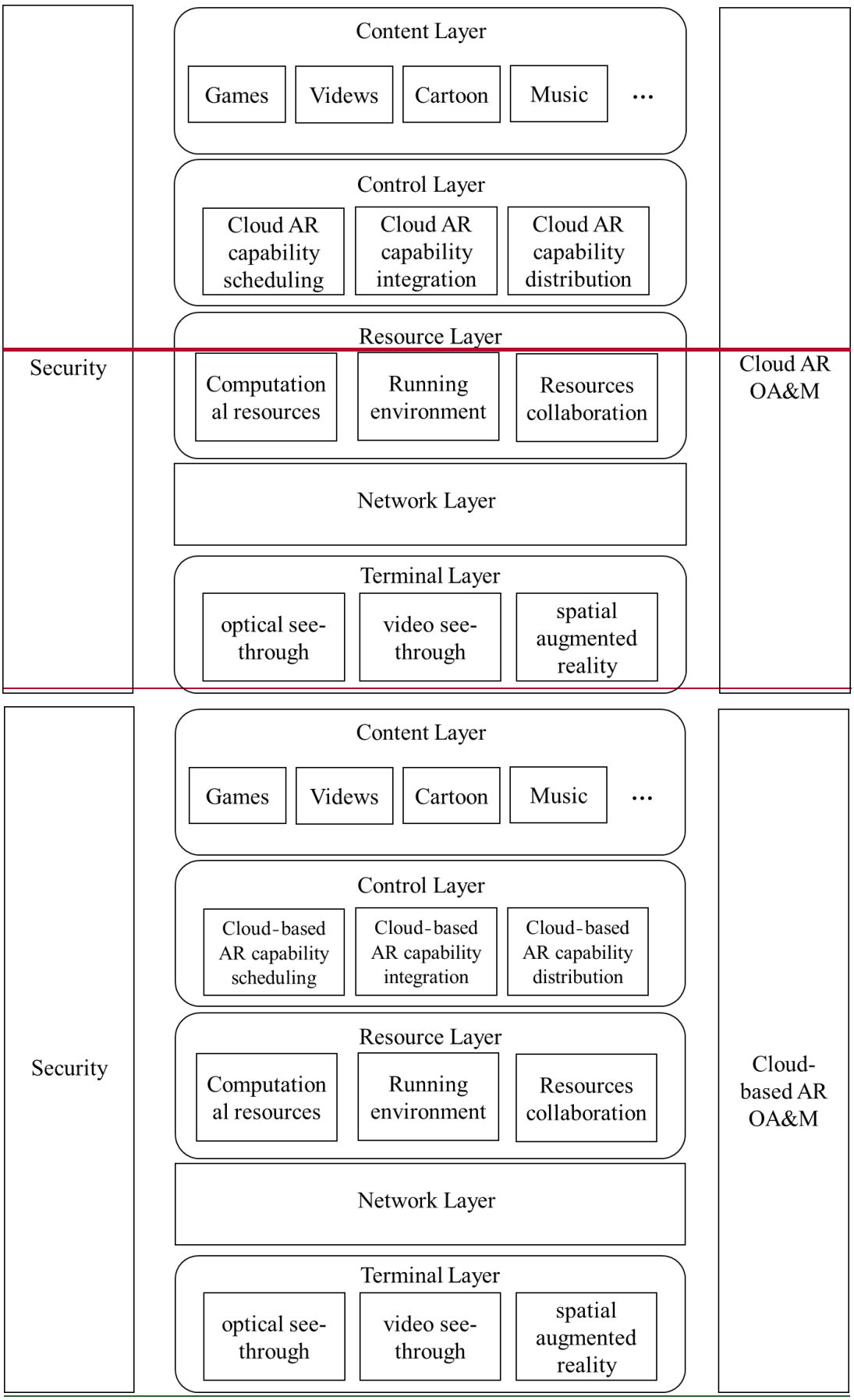

Figure 7-1 – ~~Hierarchy f~~Framework for cloud-based AR systems

The content layer mainly provides a variety of cloud-based AR application content; Based on the application presentation mode ~~From the application presentation form~~, it can be divided into cloud-based AR games, cloud-based AR videos, cloud-based AR cartoons, cloud-based AR music, etc. Based on ~~From~~ the perspective of industry application, cloud-based AR content can be divided into cloud-based AR education, cloud-based AR social networking, cloud-based AR entertainment, cloud-based AR tourism, cloud-based AR industrial manufacturing, etc.

The control layer mainly provides cloud-based AR capability scheduling, cloud-based AR capability integration, cloud-based AR capability distribution, etc.

– Cloud-based AR capability scheduling: provide various Cloud-based AR capability docking, coordination and other functions, including channel docking, resource scheduling, service allocation, operation mapping, location collaboration, etc.

– Cloud-based AR capability integration: provide integrated services of various technical capabilities related to cloud-based AR, including real scene understanding, 3D modelling, point cloud map, manipulation conversion, location service, AI processing, multi-terminal data sharing, etc.

– Cloud-based AR capability distribution: provide cloud-based AR capability distribution from resource pool to cloud-based AR users or terminals

The resource layer mainly provides computational resources, running environment and resources collaboration.

The network layer provides the communication capabilities for Cloud-based AR, such as QoS service, uplink services, network optimization, etc.

The terminal layer, provides the cloud-based AR built-in services based on different types of terminals, including cloud-based AR services clients/ APPs, pug-ins/SDK, etc. It also provides service presentation on the terminals and collects manipulations of the terminals to return the control layer. It also provides the function of crowdsourcing collection about the real world.

The OA&M provides centralized operating, management and maintenance functions of Cloud-based AR, such as the managements of content, user, technology integration, operation, resource, network capability docking and terminal.

The security of cloud-based AR provides multi-dimensional security mechanisms, such as the securities of content, service, data, cloud resource pool, network and user experience.

8 Requirements of cloud-based augmented reality systems

8.1 General requirements

[TBD]

8.2 Content layer

[TBD]

8.3 Control layer

[TBD]

8.4 Resource layer

[TBD]

8.5 Terminal layer

[TBD]

8.6 Network layer

[TBD]

8.7 Operation, administration and management

[TBD]

8.8 Security

[TBD]

Appendix I
~~TBD~~ Use cases

(This appendix does not form an integral part of this Recommendation)

[TBD]

Bibliography

[b-ITU-T Y.101] ITU-T Y.101 (03/2000), *Global Information Infrastructure terminology: Terms and definitions*.

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