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Abstract: This TD contains the initial text of draft new Recommendation ITU-T H.ILE-AR "Requirements and framework of augmented reality for immersive live experience (ILE) services", discussed at the Q8/16 sessions of this SG16 meeting, Rennes, from 15-26 April 2024.

This initial draft new Recommendation is based on the discussion of contribution SG16-C587-R1 at this SG16 meeting, Rennes, from 15-26 April 2024.

Document	Source	Title	Agreements
SG16-C587-R1	China Telecom, China Unicom, ICT-CAS (China)	New: F.ARSArch: Proposed new work item on requirements and framework of augmented reality for immersive live experience (ILE) services	Proposals accepted.

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Draft New Recommendation ITU-T H.ILE-AR

Requirements and framework of augmented reality for immersive live experience (ILE) services

Summary

This draft Recommendation identifies the requirements and framework of AR targeting application scenarios for Immersive Live Experience (ILE). It aims to define the functional framework of AR for ILE, and outline the technical requirements of AR for ILE on the device layer, network layer, service support and application support layer, and application layer. In light of increasing user demands of mobility, collaboration, and interactivity for ILE services, AR technology can be employed to address these needs. The objective is to enhance above-mentioned needs through AR in ILE services such as telepresence scenarios, remote operation scenarios and remote assistance scenarios, ultimately increasing efficiency, improving usability and potentially reducing costs.

Keywords

TBD

1 Scope

This draft Recommendation is to defines the requirements and framework of augmented reality for Immersive Live Experience(ILE) services such as telepresence scenarios, remote operation scenarios, and remote assistance scenarios, in order to satisfy further technical requirements in terms of mobility, collaboration and interactivity. In particular, the scope of this draft Recommendation includes:

– Scenarios of augmented reality for ILE services

– Framework of augmented reality for ILE services

– Requirements of augmented reality for ILE services.

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; all 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.

[ITU-T H.430.1] Recommendation ITU-T H.430.1 (2018), *Requirements for immersive live experience (ILE) services*.

[ITU-T H.430.3 (V2)] Recommendation ITU-T H.430.3 (202x), *Service scenario of immersive live experience (ILE)*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 Immersive Live Experience (ILE) [ITU-T H.430.1]: A shared viewing experience that stimulates emotions within audiences at both the event site and the remote sites, as if the audience at the remote sites had wandered into substantial event venue and had actually watched the events taking place in front of them. This impression is due to high-realistic sensations provided by a

combination of multimedia technologies such as sensorial information acquisition, media processing, media transport, media synchronization and media presentation.

TBD

3.2 Terms defined within this document

This Recommendation defines the following terms:

TBD

4 Abbreviations and acronyms

[Editor notes: The followings include abbreviations. for all content of this contribution.]

AGPS	Assisted global position system
AI	Artificial intelligence
AMOLED	Active matrix/organic light emitting diode
AR	Augmented reality
CPE	Customer premise equipment
CPU	Central processing unit
DC	Data center[TSB1]
DCC	Digital content creation
DOF	Degree-of-freedom
GPS	Global position system
GPU	Graphics processing unit
HMD	Helmet-mounted display
ILE	Immersive Live Experience
MEC	Mobile edge computing
OCR	Optical character recognition
OST	Optical see-through
QoE	Quality of experience
RTT	Round trip time
VR	Virtual reality
VST	Video see-through
XR	Extended reality

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document 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" and "may" 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.

TBD.

6 Introduction

This work item studies the requirements and framework of augmented reality for Immersive Live Experience(ILE) services in device layer, network layer, service support and application support layer, and application layer:

The application layer plays an important role in selecting and providing flexible applications based on actual scenarios while ensuring stable and available services in line with production logic;

The service support and application support layer includes essential functionalities, such as application management, algorithm/model management, data management, computing management, configuration management, and security management;

The network layer includes networking & transport, such as wireless network access, wired access, and MEC networks;

The device layer includes multimedia service devices, on-site computing devices, and edge side application-aware devices.

7 Scenarios of augmented reality for ILE services

7.1 AR assisted healthcare

AR assisted healthcare is highly related to remote operation scenario which is one of ILE services in H.430.3 (V2). AR technology is the key to realizing this scenario and the introduction of AR technology enables interactivity and mobility for this scenario.

Specifically, AR technology can superimpose real-time information (such as pulse counts, blood pressure measurements, and CT images) onto the patient’s image. The image is transmitted to the remote doctor over extremely low latency and high bandwidth networks in real time. The remote doctor can perform a series of operations on the patient by interacting with the image. And the information about operations is captured and converted into control signals, transmitted to local auxiliary facilities (such as mechanical arms) through extremely low latency and reliable networks. Then local auxiliary facilities perform represented operations on the local patient based on the received control signals, and the feedback interactive information is reflected on the remote doctor's AR device in real time. The remote doctor can judge the result and continue to the next.

In rehabilitation training, AR technology can superimpose virtual training devices (such as wrist rehabilitation trainers, and dumbbells) anywhere in the real world. Patients who need to restore their motor functions can interact with the training devices to conduct targeted rehabilitation training anytime and anywhere. The built-in sensors and algorithms of AR devices can monitor the patient's motor performance (such as joint angle, muscle activity, and balance status) in real time, and instantly correct the incorrect postures through visual cues such as colour changes and arrows, to ensure the accuracy of the rehabilitation training.

7.2 AR education

AR education is highly related to telepresence scenario which is one of ILE services in H.430.3 (V2).[TSB2] AR technology is the key to realizing this scenario and the introduction of AR

technology enables interactivity and collaboration for this scenario, which can improve the fun of the teaching process, and better enhance the learning effect of students.

Taking the subject of History and Archaeology as an example, by capturing students on camera, AR technology can superimpose all students in class on a virtual historical scene, and various special effects like animation or information in many formats can be projected on the field of view. Students can "travel" to ancient cities, battlefields or historical events, interacting with the scene and experiencing the historical situation first-hand, which improves their learning interest and memory.

In early childhood teaching, AR technology can superimpose game props on virtual environments to create learning apps, such as AR puzzles, role-playing, and treasure hunts, to guide students to complete learning tasks. And in some tasks that require cooperation, multiple students can work together to complete a task. A highly realistic image of each student's action is distributed to all others in real time.

7.3 Equipment Maintenance

Equipment maintenance is highly related to remote operation scenario which is one of ILE services in H.430.3 (V2). AR technology is the key to realizing this scenario and the introduction of AR technology enables interactivity and collaboration for this scenario.

A high-resolution image of faulty equipment, with the help of capture device, is generated by a combination of AR, holographic 3D image, surrounding audio, haptic information and other multimedia technologies. And using AR technology, 3D models, maintenance manuals and real-time operational data of faulty equipment are superimposed on the image.

The image is transmitted to remote experts over extremely low latency and high bandwidth networks in real time. Experts can perform a series of operations on remote faulty equipment by interacting with this image. Information about operations on the image is captured and converted into control signals, transmitted to local auxiliary facilities through extremely low latency and reliable networks. The facilities perform operations on remote faulty equipment in accordance with the control signals received. Feedback information about remote faulty equipment is reflected in the image in real time.

When experts are located at different sites, they can synchronously view the image of faulty equipment on AR display devices from different angles, and manipulate the faulty equipment via peripheral devices (e.g., camera, data glove). During the collaboration, experts can see a virtual scene of the event site and all real-time changes in the faulty equipment, and communicate and collaborate with each expert at the event and other remote sites as if they work in the same place.

7.4 Patrol and remote assistance

Patrol and remote assistance is related to remote operation scenario which is one of ILE services in H.430.3 (V2). AR technology is the key to realizing this scenario and the introduction of AR technology enables interactivity and collaboration for this scenario.

AR for ILE is able to enhance the usability and efficiency of services for the scenario of patrol and remote assistance.

To be more specific, on-site technicians can wear AR glasses or use mobile AR devices during inspections to see virtual information superimposed on the physical object while viewing the equipment. For example, key parts of the equipment will be highlighted, and information such as important parameters, maintenance history, and operating instructions will be presented directly in the field of view, making the inspection work more targeted.

When encountering complex or difficult problems, on-site inspectors can use AR devices to send first-view video streams in real time to a team of remote experts. Experts are able to add

annotations, arrows or other markup to the AR interface, and even perform remote operation demonstrations, enabling remote collaboration and guidance as if they were there.

8 Framework of augmented reality for ILE services

The augmented reality for immersive live experience (ILE) services provides a variety of capabilities such as connecting, diverse computing, multimedia application awareness, on-demand fine diversion, and AR applications that can be tailored to different scenarios. Figure 1 shows the framework of the service, which is divided into four layers: device layer, network layer, service support and application support layer, and application layer.

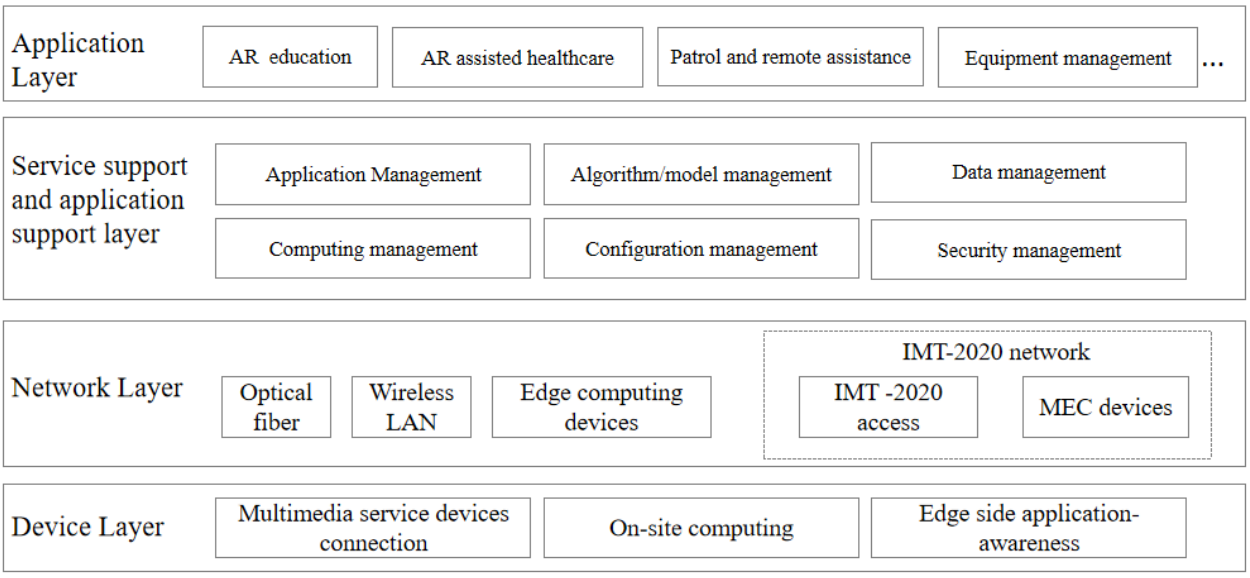

Figure 1 – The framework of augmented reality for ILE services

[Editor's Note: According to the comments that we received during the discussion, it was confirmed in the meeting that Figure 1-The framework of augmented reality for ILE services will be modified to align with the ILE system architecture in the future contributions.]

The application layer plays an important role in selecting and providing flexible applications based on actual scenarios while ensuring stable and available services in line with production logic. Common scenarios of AR services include AR education, equipment management, AR assisted healthcare, patrol and remote assistance, and so on.

The service support and application support layer includes essential functionalities such as application management, algorithm/model management, data management, computing management, configuration management, and security management. Application management includes various functions for different scenarios. Algorithm/model management encompasses algorithm training, general algorithms, and AR algorithms. Data management involves functions such as data collection, processing, and unified storage. Computing management includes collaborative management functions for central cloud, MEC edge cloud, and on-site computing devices, while configuration management involves device, user, system, algorithm, and application configuration.

The network layer includes networking & transport, wireless network access (such as IMT-2020 access and wireless LAN), wired access (e.g., fibre-optic), and edge computing devices and IMT-2020 MEC devices deployed at the network edge.

The device layer includes multimedia service devices, on-site computing devices, and edge side application-aware devices. Multimedia service devices such as AR glasses, smart helmets, AR

headbands, smartphones, tablets, high-precision cameras are used for real-time data collection and multi-device collaborative interaction. On-site computing devices such as computing gateways and computing power base stations provide functions such as heterogeneous multimedia device access, on-site computing scheduling and arrangement, local data unloading and processing, and more. Edge side application-aware devices enable multimedia application-aware identification configuration, multimedia application flow control strategy execution, and multimedia application-aware identification resolving.

9 Requirements of augmented reality for ILE services

9.1 Requirements of Device Layer

AR is mainly composed of several parts: operating system, processor, optical components, camera and sensors, and memory. AR presentation methods include handheld terminal and wearable type.

– Handheld terminal i.e., using the camera of cell phone or any mobile terminal to acquire real-world images and superimpose virtual information on the real-world pictures and videos in the mobile terminal.

– Wearable type can be subdivided into video type and optical type.

– RTT latency requirements for AR: RTT of handheld end: 80-100ms; RTT of AR glasses: 20-50ms;

9.2 Requirements of Network Layer

Requirements of Network Layer should include the following:

a) Should support wearable AR devices should support 5G network transmission to ensure smooth operation of AR devices, and ensure that text, sound and image provide perfect operation instructions and guidance.

b) Should support AR glasses to achieve OCR or shape recognition of labels or parts, etc.

c) 5G network gateway, CPE, etc., support production equipment to access wireless network and realize real-time collection, upload and analysis processing of operation status data.

d) The MEC architecture provides low latency guarantee for AR applications. MEC is deployed at the edge DC location, and the latency can be controlled to 10ms; part of the computing and storage functions are deployed to the MEC server, taking advantage of MEC traffic offload, low latency and high bandwidth of 5G to enhance the performance of AR applications.

e) Performance requirements: end-to-end time delay ≦ 50ms, reliability ≧ 99.9%;

9.3 Requirements of the service support and application support layer

Requirements of The service support and application support layer should include the following service functions:

a) Requirements for Application Management

b) Requirements for Algorithm/Model Management

c) Requirements for Data Management

d) Requirements for Computing Management

e) Requirements for Configuration Management

f) Requirements for Security Management

9.4 Requirements of application Layer

AR application service platform provides the basic tools and service capabilities required for AR application development on smartphones or smart terminals such as AR glasses. AR at the platform layer should support:

a) Basic capabilities: provide environment understanding capabilities and 3D engine capabilities that the upper layer platform tools rely on; environment understanding capabilities include spatial perception capabilities and object perception capabilities; 3D engines include rendering engines, animation engines and physics engines, etc;

b) Platform tools: including AR content creation tools and AR visualization tools, which involve cross-platform technologies;

c) AR content creation tool: for the material exported by DCC (Digital Content Creation) tool, users create AR scenarios according to their needs through AR content creation tool and publish the digital content to the cloud;

d) AR visualization tools: Based on the ability of environment understanding, virtual contents are made like real objects through rendering and multimedia, and can interact with real-world objects to achieve the integration of reality and imagination.

e) AR content cloud service: effectively organize and store perceptual content and AR content, and provide support for AR content distribution, perceptual recognition of terminals and content application.

f) Content cloud has the functions of storage and distribution of AR content;

g) Perception Cloud provides perception capabilities such as image retrieval and gesture recognition using image recognition and artificial intelligence technologies.

Appendix I
Configuration on test systems

TBD

Bibliography

TBD