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Recommendation

ITU-T H.430.7 (09/2023)

SERIES H: Audiovisual and multimedia systems

Infrastructure of audiovisual services – Telepresence, immersive environments, virtual and extended reality

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Requirements of interactive immersive services

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Recommendation ITU-T H.430.7

Requirements of interactive immersive services

Summary

Recommendation ITU-T H.430.7 provides the definition and requirements of interactive immersive services (IIS). Based on the overview of IIS, the requirements which include interactive capabilities, synchronous transmission of concurrent streams, intelligent distribution of massive multimedia data, media processing for immersive interactive information, and network status awareness with quality of experience (QoE) scheduling, are specified in this Recommendation.

History *

Edition	Recommendation	Approval	Study Group	Unique ID
1.0	ITU-T H.430.7	2023-09-13	16	11.1002/1000/15630

Keywords

Conceptual framework, IIS, ILE, requirements.

* To access the Recommendation, type the URL https://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID.

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The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

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1 Scope

This Recommendation provides the requirements of interactive immersive services (IIS) as part of an immersive live experience (ILE).

The scope of this Recommendation includes:

– Definition of IIS;

– High-level requirements of IIS.

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

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

[ITU-T H.430.3] Recommendation ITU-T H.430.3 (V2) (2023), *Service scenario of immersive live experience (ILE)*.

[ITU-T P.1320] Recommendation ITU-T P.1320 (2022), *Quality of experience assessment of extended reality meetings*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 haptics [b-ISO 9241-910]: Haptics consists of touch (tactile/cutaneous) and kinaesthesis (kinaesthetic), which are sensory and/or motor activity based in the skin, muscles, joints and tendons.

3.1.2 immersive live experience (ILE) [ITU-T H.430.1]: A shared viewing experience that stimulates emotions within audiences at both the event sites and the remote sites, as if the audience at the remote sites had wandered into a 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.

3.1.3 quality of experience (QoE) [b-ITU-T P.915]: The degree of satisfaction of the user of an application or service. It results from the fulfilment of their expectations with respect to the utility or enjoyment of the application or service in the light of the user's personality and current state.

3.1.4 vibrotactile [b-ISO 9241-910]: Vibration-based stimulation of the skin.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 interactive immersive information: The information is delivered two ways among users and/or objects at the event site(s) and the remote site(s) during immersive interaction, which includes audio, video, text, haptics, etc.

3.2.2 interactive immersive services (IIS): Services which involve in collection, processing and transmission of immersive interactive information to support real-time interactions among immersive service users and/or objects.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3D Three Dimensional

CODEC Coder-Decoder

E2E End-to-End

IIS Interactive Immersive Services

ILE Immersive Live Experience

QoE Quality of Experience

QoS Quality of Service

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 Recommendation is to be claimed.

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

– The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is 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 this Recommendation.

6 Overview

Immersive live experience (ILE) services provide immersive sensations to users by creating high-realistic environments which involve simulating visual, auditory, haptic, and other sensory information. The provision of interactive immersive services (IIS) may involve an interaction of extended reality (XR), three dimensional (3D) images including hologram, haptic communication, digital twin and other multimedia technologies.

IIS requires the collection, processing and transmission of interactive immersive information (including video, audio, haptic, etc.) to support real-time interactions among users and/or objects. The IIS scenarios may be categorically divided into point-to-point use cases (e.g., telemedicine, prototype experiment, automobile maintenance, remote shopping assistance), and point-to-multipoint use cases (e.g., immersive conference, immersive education, multi-user collaborative design).

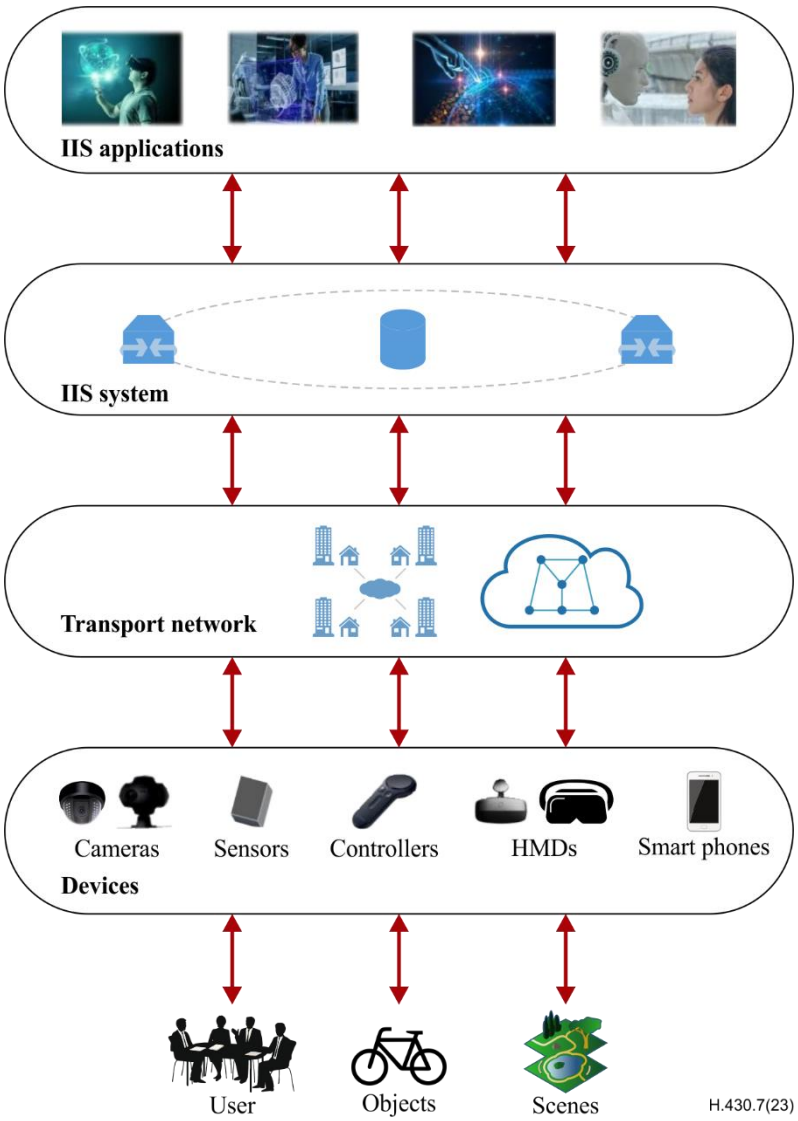

Figure 1 – Conceptual framework of interactive immersive services

The conceptual framework of IIS is illustrated in Figure 1. The devices (e.g., cameras, sensors, controllers, head mounted devices, smartphones, etc.) capture or represent the interactive immersive information from/to users, objects and scenes. The transport network is responsible for the transmission of media from devices to the IIS system and vice versa. The IIS system provides functional capabilities such as coder-decoder (CODEC), rendering, reconstruction, media synchronization, intelligent distribution, media processing, network status awareness and quality of experience (QoE) scheduling. The IIS applications invoke the capabilities of the IIS system to provide various applications such as holographic communication, haptic communication, intelligent interaction, etc.

7 High-level requirements of IIS

The general and high-level requirements of ILE have been addressed in [ITU-T H.430.1]. Regarding the IIS related scenarios in [ITU-T H.430.3], the requirements of IIS are presented as follows.

The high-level requirements of IIS in addition to high-level requirements of ILE, include:

– Support for interactive capabilities.

– Support for synchronous transmission of concurrent streams.

– Distribution of massive multimedia data.

– Media processing for immersive interactive information.
– Network status awareness and QoE scheduling.

7.1 Support for interactive capabilities

(1) Information input and output

The interactive immersive information contains many forms of multimedia such as movement, expression, audio, video, text, haptic and operation. IIS are required to handle a wide variety of data types corresponding to the interactive immersive information, for example, volumetric visual data, audible data, textual data, and haptic data.

There are several kinds of capture devices and equipment which include cameras, positioners, sensors, controllers, etc. These devices and equipment should support capturing immersive interactive information. These collected data might be processed for information output, and then the processed data would be output at the other end.

High-level requirement 1-1: IIS requires the devices and equipment to support capturing interactive immersive information including audio, video, text, haptics, and other sensed data.

High-level requirement 1-2: IIS are required to reproduce processed volumetric visual data, audible data, textual data, haptic data, and control signal.

High-level requirement 1-3: When multi-user interacts with virtual objects, IIS are required to time align attribute information of physical users and virtual objects (e.g., status, position and colour) with interactive immersive information (e.g., volumetric visual media, textual, etc.).

(2) Haptic interaction

Some interactive immersive services such as immersive remote surgery, use haptic information in addition to video and audio information.

High-level requirement 1-4: IIS can optionally use haptic or vibrotactile information in addition to video and audio to increase immersiveness.

High-level requirement 1-5: IIS using haptic or vibrotactile information are recommended to have the functionality of suppressing howling, which is similar to acoustic feedbacks.

High-level requirement 1-6: IIS using haptic or vibrotactile information can optionally have the functionality of storing haptic or vibrotactile information.

(3) Transport network capability

Bandwidth requirements for IIS depend on immersive scenarios such as true hologram transmission at normal human size. Extremely low end-to-end (E2E) latency is crucial for truly immersive scenarios to avoid motion sickness. For example, haptic applications impose stringent latency requirements. Moreover, deterministic delay and high reliability should be guaranteed for teleoperations like remote surgery.

High-level requirement 1-7: The transport network of IIS is recommended to transmit true hologram transmission at normal human size.

High-level requirement 1-8: The transport network of IIS is recommended to guarantee deterministic delay and high reliability for teleoperation.

High-level requirement 1-9: The transport network of IIS is recommended to manage transmitting data accurately.

7.2 Support for synchronous transmission of concurrent streams

IIS involves multiple channels of interactive immersive information in various media. Each channel may map to a separate stream with stringent in-time requirements to ensure an internal consistency. Synchronous transmission of concurrent streams is required to guarantee the QoE of IIS.

High-level requirement 2-1: IIS system is required to support multiple concurrent streams transmitted through multiple channels from multiple terminals or devices. These concurrent streams are required to be synchronized appropriately with limited arrival time differences.

High-level requirement 2-2: When realizing haptic communication, an IIS system is recommended to transmit interactive haptic or vibrotactile information captured by several sensors synchronously with video and audio signals.

High-level requirement 2-3: When realizing real-time multi-user collaboration, an IIS system is required to support synchronous data transmission (e.g., processed media, concurrent stream, control signal) for multiple users, which implements synchronous media representation for multiple users.

7.3 Distribution of massive multimedia data

In order to provide IIS, massive multimedia data needs processing (rendering and modelling) and transmitting through networks. Edge computing might be used for processing due to its lower E2E latency, especially for holographic representation.

High-level requirement 3-1: IIS system is required to support the distributing policies based on data type and priority.

7.4 Media processing for immersive interactive information

Due to the different applications and service scenarios, it is required to support media processing (extract, render, reconstruct, etc.) for interactive immersive information in the IIS system. IIS system provides computation and storage resources. Edge computing might be beneficial for providing low latency services by accessing the proximity of the end-users.

High-level requirement 4-1: IIS system is required to process several media interactively that are involved in the ILE requirements such as audio, video streams, lighting, and spatial information defined in [ITU-T H.430.1]. In addition, the support of haptics and control signals are required for the IIS system in order to represent a remote site.

High-level requirement 4-2: IIS system can optionally support the central cloud and edge computing and provide the allocation and schedule of computing resources based on the service requirements.

High-level requirement 4-3: IIS system is required to support real-time media processing so that users may not be aware of any delays in the immersive interactive experience.

High-level requirement 4-4: IIS system is required to support multiple rendering functions to ensure immersive interaction such as multi-channel rendering, distribution rendering, viewport-based rendering, 3D scene or objects rendering, and holographic rendering, which are selected according to the interactive immersive information and service requirements.

High-level requirement 4-5: IIS system is required to support interaction and control processing which combines the different kinds of collection information (e.g., motion information, spatial information) and media content (e.g., virtual object).

High-level requirement 4-6: IIS system is required to support low delay media coding techniques for processed media data (e.g., rendered volumetric visual data) to achieve real-time interaction.

High-level requirement 4-7: IIS can optionally support the CODEC of volumetric visual data, audible data, textual data, and haptic data. The CODEC may include lossless coding such as MPEG-4 audio lossless coding (ALS) for audio and haptic data.

High-level requirement 4-8: Considering personal information protection, an IIS system is required to support the capability of media processing including biometric special handling (e.g., mosaicking), anonymization (e.g., user identity, location, etc.), and other processing (e.g., virtual backgrounds and video filters processing).

7.5 Network status awareness and QoE scheduling

QoE of IIS refers to the degree of satisfaction of the user of an interactive immersive service. The degree of QoE can be referenced from the influenced factors defined in [ITU-T P.1320] and [ITU-T G.1036].

Network status awareness is the capability to collect quality of service (QoS) and network resource information. QoS scheduling is the capability to update policies based on the collected information. Networks and terminals/devices can make adjustments based on policies.

High-level requirement 5-1: IIS system is required to support collecting QoS and network resource information, and then updating the degree of QoE accordingly.

Bibliography

[b-ITU-T P.915] Recommendation ITU-T P.915 (2016), *Subjective assessment methods for 3D video quality*.

[b-ISO 9241-910] ISO 9241-910:2011, *Ergonomics of human-system interaction – Part 910: Framework for tactile and haptic interaction*. <https://www.iso.org/standard/51097.html#:~:text=ISO%209241%2D910%3A2011%20provides,ISO%209241%20%22900%22%20subseries.>

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