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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

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

Reference models for immersive live experience (ILE) presentation environments

Recommendation ITU-T H.430.5



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Recommendation ITU-T H.430.5

Reference models for immersive live experience (ILE) presentation environments

Summary

In order to reproduce a highly realistic experience and sense of immersiveness for audiences at a viewing site on par with the experience of audiences at the event site at the same time, and also to reduce the design and setup times of immersive live experience (ILE) viewing sites, Recommendation ITU-T H.430.5 specifies reference models for the immersive live experience (ILE) presentation environments. There are three basic types of ILE presentation environment: a proscenium style that has a one-sided stage or screens, an open style that has island stages or runways from a single-sided stage, and an arena style presentation environment that has one island stage. This Recommendation provides one reference model each for the proscenium, open, and arena style presentation environments. This Recommendation also provides functional blocks and implementation guidelines for ILE viewing sites as informative information.

History

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Functional blocks, ILE, implementation guidelines for ILE viewing sites, presentation environment, reference model.

* To access the Recommendation, type the URL <http://handle.itu.int/> in the address field of your web browser, followed by the Recommendation's unique ID. For example, <http://handle.itu.int/11.1002/1000/11830-en>.

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Introduction

The most significant feature of the immersive live experience (ILE) is that audiences at viewing sites can enjoy a highly realistic experience and sense of immersiveness on par with the experience of audiences at the event site. To enable this feature, it is necessary to set up the viewing sites with elements such as projection mapping, audio systems suitable for each viewing site to achieve auditory lateralization, and other stage effects such as lighting, vibration, and smoke for reproducing the event in a way that stimulates the five senses. However, viewing sites generally consist of halls that are of completely different sizes (e.g., height and width) and shapes (e.g., rectangular or circular), that have a different numbers of seats, and have different stage types (e.g., theatre and island types). Therefore, a highly realistic atmosphere at the viewing sites needs to be reproduced by considering the unique features of the individual sites. The presentation environments for ILE services are currently constructed site by site. This takes a very long time and comes at huge labour and financial costs.

Implementation guidelines for the ILE presentation environment based on a reference model of the viewing site with related parameters may help to reduce the time and costs. Such guidelines would greatly help with the efficient implementation of the presentation environment.

This Recommendation provides three reference models for the ILE presentation environment. The functional blocks and implementation guidelines are attached in the appendices.

Recommendation ITU-T H.430.5

Reference models for immersive live experience (ILE) presentation environments

1 Scope

In order to reproduce highly realistic sensations or immersiveness on par with the experience of the audience at the event site, and to reduce the design and set-up time of immersive live experience (ILE) viewing sites, this Recommendation provides three reference models for the ILE presentation environment. This Recommendation supports the ILE services as described in the ITU-T H.430-series Recommendations. It also introduces an example of functional blocks for the presentation environment as well as implementation guidelines based on the reference models.

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 H.430.1] Recommendation ITU-T H.430.1 (2018), *Requirements for immersive live experience (ILE) services*.
- [ITU-T H.430.2] Recommendation ITU-T H.430.2 (2018), *Architectural framework for immersive live experience (ILE) services*.
- [ITU-T H.430.3] Recommendation ITU-T H.430.3 (2018), *Service scenario of immersive live experience (ILE)*.
- [ITU-T H.430.4] Recommendation ITU-T H.430.4 (2019), *Service configuration, media transport protocols, signalling information of MPEG media transport for immersive live experience (ILE) systems*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following term 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 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.

3.2 Terms defined in this Recommendation

None.

4 Abbreviations and acronyms

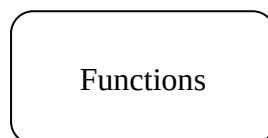
This Recommendation uses the following abbreviations and acronyms:

HDMI	High-Definition Multimedia Interface
ILE	Immersive Live Experience
LCD	Liquid Crystal Display
MMT	MPEG Media Transport
USB	Universal Serial Bus
WFS	Wave Field Synthesis

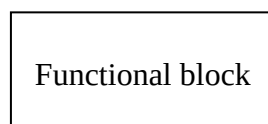
5 Conventions

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 that 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.
- The keyword "functions" are defined as a collection of functionalities. It is represented by the following symbol in this Recommendation:



- The keyword "functional block" is defined as a group of functionalities that has not been further subdivided at the level of detail described in this Recommendation. It is represented by the following symbol in this Recommendation:



NOTE – In the future, other groups or other Recommendations may possibly further subdivide these functional blocks.

Frame borders of "functions" and "functional blocks", and relational lines among "functions" and "functional blocks" are drawn with solid lines or dashed lines. The solid lines mean required functionalities or relations. On the other hand, the dashed lines mean optional functionalities or relations.

6 Overview of ILE viewing sites

6.1 Types of presentation environments

As defined in [ITU-T H.430.2], there are several types of presentation environments, such as proscenium style, open style, and amphitheatre (arena style). These types are illustrated in Figure 6-1.

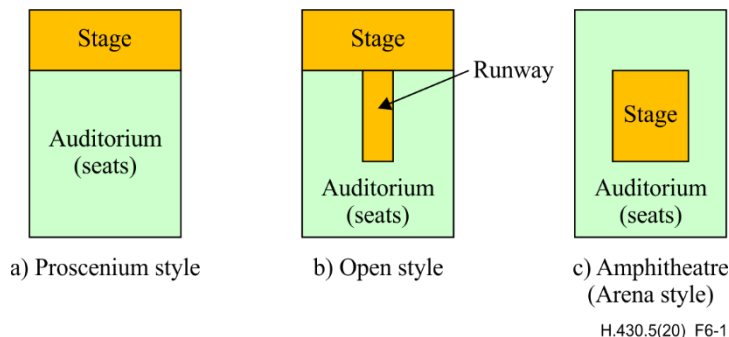


Figure 6-1 – Types of presentation environments

Figure adapted from [ITU-T H.430.2]

a) Proscenium style

In most theatres, audiences view a stage or screens in front of them. As shown in Figure 6-1(a), the stage is located at one end of theatre, and the seats for the audience, called the auditorium, are located at the other end. This type of theatre is called proscenium style. The details are discussed in [ITU-T H.430.2].

b) Open style

Most concert halls have one or more stages and/or runways, as shown in Figure 6-1(b), so that audiences can view the performance from different angles. This type of theatre is called open style. The open style has many variations, such as a theatre that has a stage with one or more runways, or a theatre that has a stage with one or more island type stages. The details are discussed in [ITU-T H.430.2].

c) Amphitheatre (Arena style)

Amphitheatres (arena style), as shown in Figure 6-1(c), have one field or one stage at the centre of the theatre, and audiences may be seated around the stage, which means they can watch performances from a 360-degree angle. The details are discussed in [ITU-T H.430.2].

6.2 Proscenium style presentation environment

In the proscenium style, the entire audience is seated in one direction facing the stage. In order to reconstruct this environment at viewing sites, one or more display(s) are placed on a single side. One example is a synchronous live talk show or a lecture presentation, where the feed is transmitted by live streaming from the event site to one or more viewing sites.

There are three required functionalities at the viewing site side: controlling, receiving, and displaying. For providing ILE services in the proscenium style presentation environment, the following functions are required.

- Controlling functionality:
 - Controlling:
Hardware and the operating system (OS) are the controlling functions.

- Resident:

The resident function provides a user interface such as a menu screen that enables content selection. It might have a function for the setup screen of display devices. The resident function calls a renderer in order to play content.
- Input interface:

The input interface connects the input devices to allow users to control or operate the receiving functionality. A universal serial bus (USB) might be used for this interface.
- Input devices:

The input devices are usually keyboards and pointing devices.
- Receiving functionality:
 - Communication interface:

Communication interfaces are used to handle data of user interfaces, coded content data, and other controlling information. For example, HTTP, HTTPS, and MPEG media transport (MMT) can be used as the communication interfaces.
 - Receiving function for streaming content:

The receiving function for streaming content can receive content sent from the event site via the communication interface and immediately transfer the received streaming content to the displaying functionality.
 - Receiving function for downloaded content:

The receiving function for downloaded content can receive content sent from the event site via the communication interface and then store the content before later transferring it to the displaying functionality.
 - Communication devices:

The communication devices are used for connecting networks through the communication interface. Network interface cards can be used as the communication device.
- Displaying functionality:
 - Displaying function:

The displaying function is a set of core technologies consisting of displaying user interfaces and a renderer for displaying content. This function treats not only video and audio but also various signals for stage effects such as lighting information.
 - Renderer:

This function decodes various types of video and audio content into video and audio signals. It may also decode other information such as lighting information.
 - Displaying interface:

The displaying interface is an interface for video content between the receiving function and the display devices. High-definition multimedia interface (HDMI) might be used for this interface.
 - Display devices:

The display devices output video content. Liquid crystal displays (LCDs), plasma displays, and projectors are generally used.

6.3 Open style presentation environment

The open style presentation environment is similar to the proscenium style but has stages at the centre and/or (both) sides of the viewing site. Some ILE services, such as those used for Kabuki¹ plays and musical concerts, can be considered to use the open style presentation environment by combining real persons (actors or players) with pseudo-3D images (objects) displayed on screens. There are several styles, such as one centre stage, two side stages, and front and rear stages. On the stages, real persons may perform simultaneously with images displayed on movable screens.

The required functionalities of the open style presentation environment are the functions for combining real persons and images in addition to all functionalities of the proscenium style presentation.

6.4 Arena style presentation environment

In the arena style presentation environment, the audience is seated in a circle around the stage, that is, to the left, right, front, and back of the stage. In order to reconstruct this environment at the viewing sites, at least four displays are required. As an example, a four-surface display device is shown in Figure 6-2. In this device, the events are reproduced at the viewing site at a fraction of the actual size at the event venue. Four half-mirrors (marked 1 to 4 in the figure) are combined in a four-sided pyramid shape, and each half-mirror displays a virtual image by reflecting the images of the flat display device located above the half-mirror. Each half-mirror is installed at a 45-degree tilt to display virtual images in a vertical fashion, and a floor (or stage) is installed inside the half-mirrors to function as the floor of the virtual images.

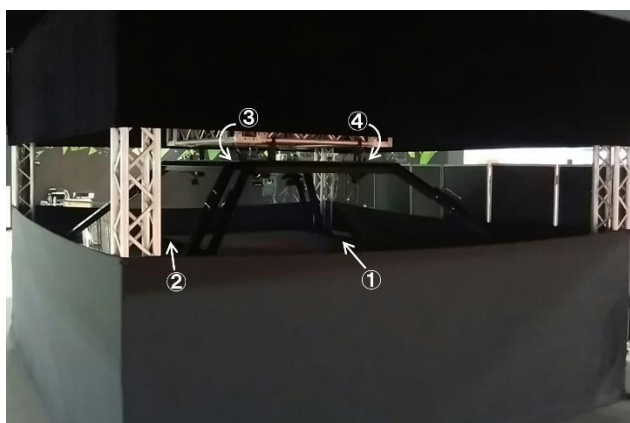


Figure 6-2 – An example of an arena style presentation environment

Each of the images displayed on the half-mirrors looks as if it is floating in the empty space above the stage inside the pyramid-shaped display device.

By crossing the virtual image planes of the four half-mirrors, and by adjusting the distance between the half-mirrors and the related display devices, the virtual images reflected by the half-mirrors can be located at the centre of the stage. It is required to display images synchronously on the four display devices. This technique enables virtual images to be displayed at the centre of the stage when viewed from any of the four directions around the arena style presentation environment.

Several functions are required in order to arouse the sense of depth by the virtual images displayed on the four-surface display device. A depth expression function, which performs the image processing to add depth expression to the images, is required. In addition, a position measurement

¹ Kabuki is a traditional Japanese popular dance-drama with roots tracing back to the 17th century. It is a UNESCO Intangible Cultural Heritage.