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SERIES F: NON-TELEPHONE TELECOMMUNICATION SERVICES

Audiovisual services

Definitions, requirements and use cases for telepresence systems

Recommendation ITU-T F.734

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Recommendation ITU-T F.734

Definitions, requirements and use cases for telepresence systems

Summary

Recommendation ITU-T F.734 provides definitions, use cases and functional requirements for telepresence systems. Telepresence is an interactive audio-visual communications experience between remote locations, where the users enjoy a strong sense of realism and presence between participants by optimizing a variety of attributes. A telepresence system is a set of functions, devices and network elements which are able to capture, deliver, manage and render multiple high quality interactive audio and video signals in a telepresence conference to deliver a telepresence experience.

History

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* 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.

FOREWORD

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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.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure, e.g., interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at http://www.itu.int/ITU-T/ipr/.

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Definitions, requirements and use cases for Telepresence Systems

1   Scope

This Recommendation provides definitions, use cases and functional requirements for telepresence systems. A telepresence system is a set of functions, devices and network elements which are able to capture, deliver, manage and render multiple high quality interactive audio and video signals in a telepresence conference. An appropriate number of devices (e.g., cameras, screens, loudspeakers, microphones, codecs, multipoint control units (MCUs), PCs) and environmental characteristics are used to establish telepresence. Specific requirements include those for:

–   User experience

–   Control, including:

•   Call control functions

•   Media control functions

•   Conference control functions

•   Collaboration functions

–   Inter-operability

–   Network

–   Security

The requirements in this Recommendation relate to functions that a telepresence system is required to support. That is, a telepresence system should be able to provide the functions in its design or by utilizing existing mechanisms. Recommended requirements do not mandate the implementation or the deployment of a particular function. For example: Whilst a telepresence system should support mechanisms for assured QoS, it may be deployed in a network where QoS is not assured.

Unless the requirement mentions a specific function or device, the requirements listed in this Recommendation apply to a telepresence system as a whole. The inclusion of a requirement does not necessarily mean that new protocols need to be developed to meet it. For example whilst there may be a requirement to support QoS for telepresence, ultimately existing QoS mechanisms may be utilized for this.

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.243]   Recommendation ITU-T H.243 (2005), *Procedures for establishing communication between three or more audiovisual terminals using digital channels up to 1920 kbit/s*.

[ITU-T H.323]   Recommendation ITU-T H.323 (2009), *Packet-based multimedia communications systems*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 **actual size**: A rendered figure in a display is the same size as if the person is in the room.

3.2.2 **capture**: Media acquired from a capture device such as a camera or microphone or constructed from other media (for example combining the signals from several microphones).

3.2.3 **endpoint**: For the purposes of this Recommendation an endpoint is a device representing the logical point of final termination through receiving, decoding and rendering, and/or the point of origination through capturing, encoding, and sending of media streams, e.g., an H.323 terminal.

3.2.4 **gaze awareness**: Awareness of gaze direction of persons by watching their eyes, head and body position. There is awareness of both direct gaze and averted gaze. Direct gaze is the perception of persons looking at each other directly and simultaneously. Averted gaze is the perception that other persons are looking at someone/something else in the environment.

3.2.5 **gaze direction**: The vector positioned along the visual axis, pointing from the fovea of the looker through the centre of the pupil to the looked at spot.

3.2.6 **eye contact**: Mutual direct-gaze between two persons communicating.

3.2.7 **natural response**: Interaction between local and remote participants that is not impeded by the delay introduced by the telepresence system.

3.2.8 **telepresence**: An interactive audio-visual communications experience between remote locations, where the users enjoy a strong sense of realism and presence between participants by optimizing a variety of attributes such as audio and video quality, eye contact, gaze awareness, body language, spatial audio, coordinated environments and natural image size.

3.2.9 **telepresence-enabled audio endpoint**: An audio-only endpoint that supports telepresence endpoint functions/signalling and delivers a strong sense of presence and realism through the use of technologies such as wider bandwidth speech and spatial audio (e.g., stereo telephony).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

3D	Three Dimensional
FECC	Far End Camera Control
HDTV	High Definition Television
IP	Internet Protocol
IPv4	Internet Protocol Version 4
IPv6	Internet Protocol Version 6
MCU	Multipoint Control Unit
NAT	Network Address Translation
PC	Personal Computer
QoE	Quality of Experience

| QoS | Quality of Service |
| SIP | Session Initiation Protocol |

5 Conventions

In this Recommendation, the following conventions apply.

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 the specification.

6 Scenarios and use cases

The use cases in this clause illustrate various telepresence configurations for the purposes of identification of requirements. These configurations apply to scenarios where telepresence is in use and do not include legacy systems (i.e., non-telepresence systems) unless specifically indicated in the use case. They do not imply the need for mandatory support of any particular configurations.

For simplicity, the use cases below assume that each camera and microphone produces a single capture, and that each display renders a single capture. In actual implementations, the relationship between captures and transducers can be more complex. For example, a pair of microphones may be mixed to monophonic sound (creating one capture from two transducers). Alternatively, the same microphone arrangement can produce three captures (left, right, and centre), creating three captures from the same two transducers.

6.1 Use case 1: Symmetric point-to-point meeting

In this case, the two sites have an identical number of screens, with cameras having fixed fields of view, and one camera for each screen. The number of screens or cameras is not relevant so long as both sites have the same number. The sound type is the same at each end. Figure 1 illustrates the use case.
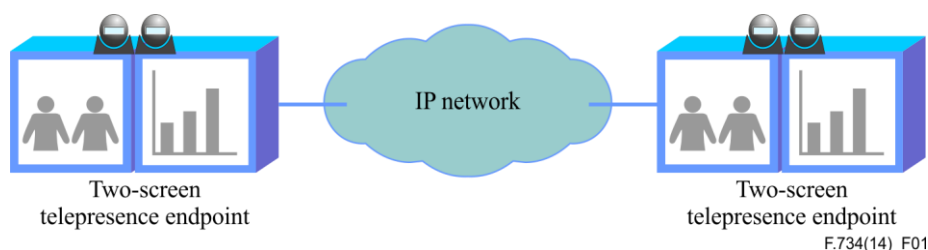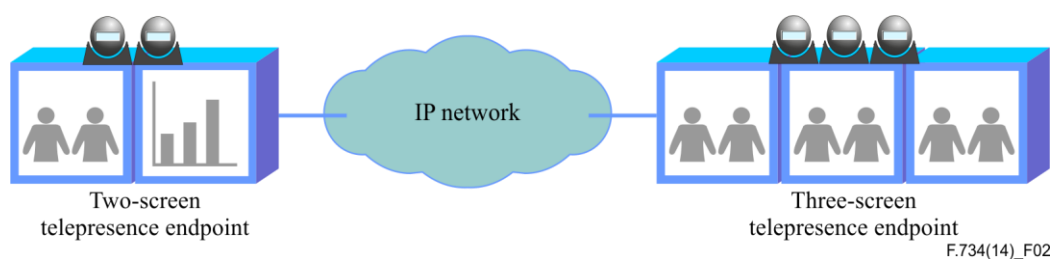

Figure 1 – Use case 1: Symmetric point-topoint meeting

For further information see clause 3.1 of [b-IETF RFC 7205].

6.2 Use case 2: Asymmetric point-to-point meeting

In this case, each site has a different number of screens and cameras. The number of screens or cameras is not relevant so long as both sites have a different number. Figure 2 illustrates the use case.

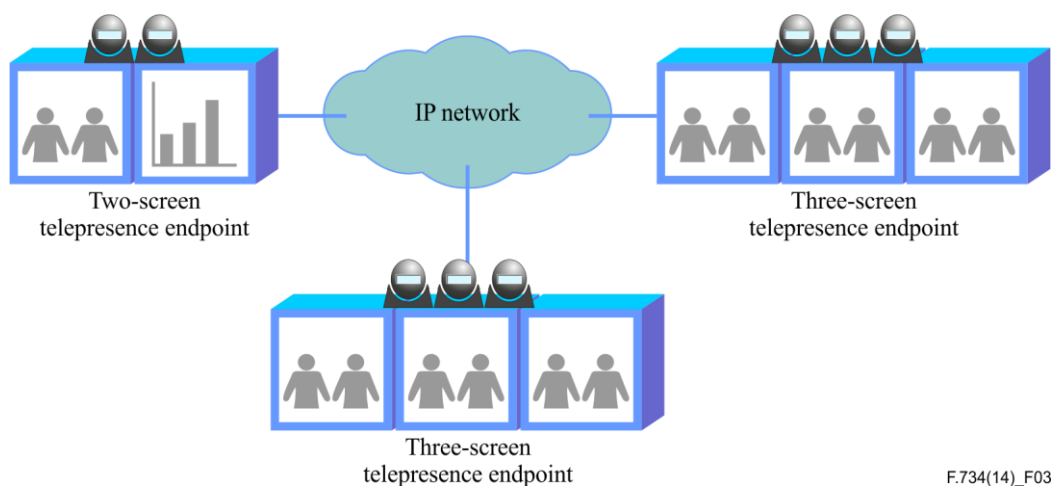For further information see clause 3.2 of [b-IETF RFC 7205].

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Figure 2 – Use case 2: Asymmetric point-to-point meeting

6.3 Use case 3: Multipoint meeting

In this use case of a multipoint telepresence conference, there are more than two sites participating. Figure 3 illustrates the use case.

For further information see clause 3.3 of [b-IETF RFC 7205].

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Figure 3 – Use case 3: Multipoint meeting

6.4 Use case 4: Presentation

This use case builds on the previous use cases. In addition to the video and audio streams showing the participants, additional streams are used for presentations. For example, the additional stream may be for content sources such as: document cameras, electronic whiteboards, computer (e.g., a laptop computer) or instant messaging. Figure 4 illustrates the use case.

The presentation viewgraphs can be distributed to remote endpoints either by adding new streams or by embedding (or switching) viewgraphs into an existing video stream.

For further information see clause 3.4 of [b-IETF RFC 7205].
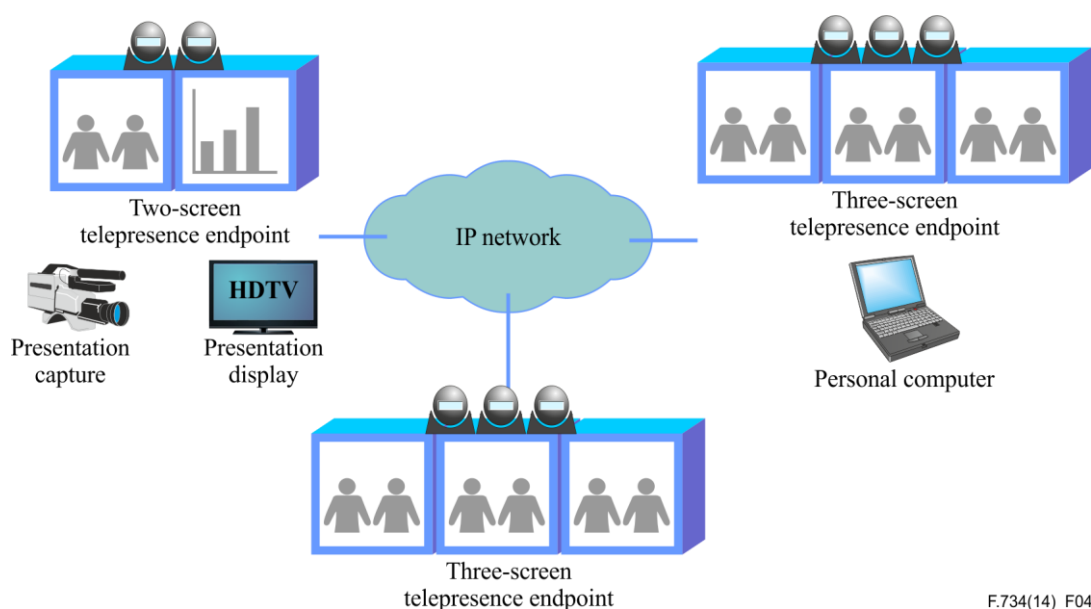
Figure 4 – Use case 4: Presentation

6.5   Use case 5: Heterogeneous systems

This use case illustrates the common meeting scenario for people to join the conference from a variety of environments using different types of endpoint devices. A multi-screen immersive telepresence conference may include someone using a PC-based video conferencing system, a telepresence-enabled audio endpoint, or a handheld device.

This use case assumes that all the endpoint devices are able to handle signalling related to telepresence systems. The underlying technology does not determine whether a device is "legacy" or not, the deciding factor is whether it supports telepresence related protocols (or protocol extensions). Legacy systems that do not support telepresence related protocols (or protocol extensions) are not in scope of this use case. Figure 5 illustrates the use case.

For further information see clause 3.5 of [b-IETF RFC 7205].
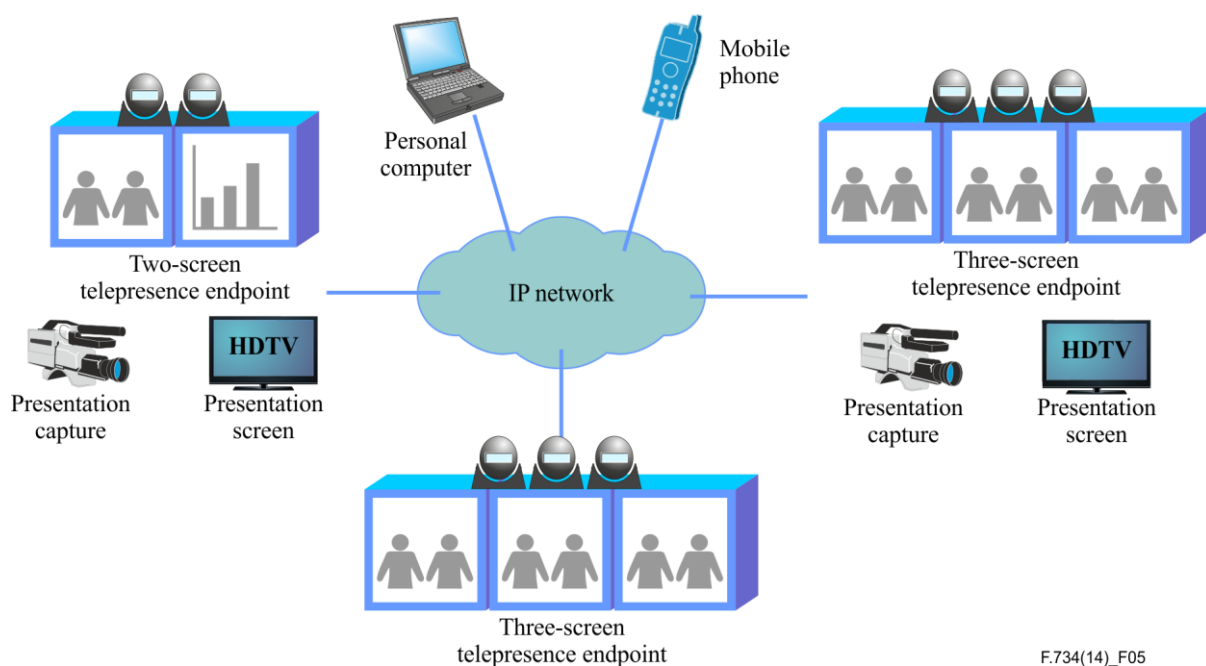
Figure 5 – Use case 5: Heterogeneous systems

6.6 Use case 6: Multipoint education usage

This use case deviates from other use cases in that multiple video streams are not used to create an immersive conferencing experience with panoramic views at all sites. Instead the multiple streams are dynamically used to enable full participation of remote students in a university class. In some instances the same video stream is displayed on multiple screens in the room, in other instances an available stream is not displayed at all. Figure 6 illustrates the use case.

For further information see clause 3.6 of [b-IETF RFC 7205].
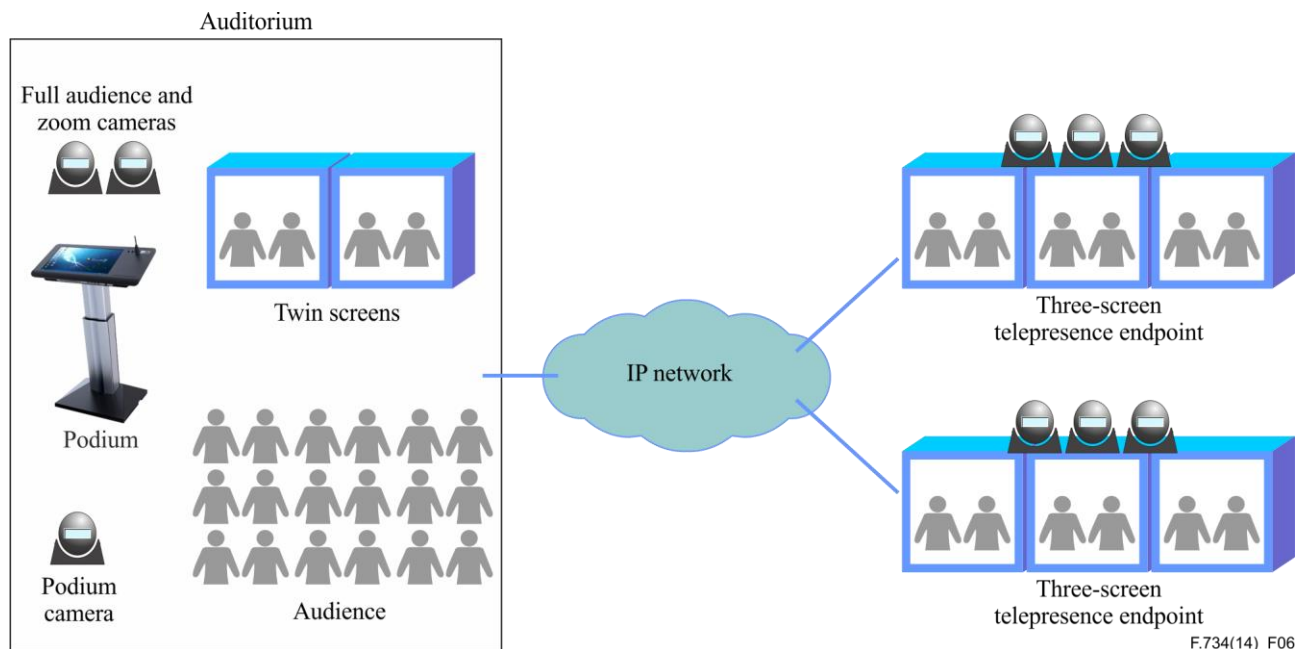
Figure 6 – Use case 6: Multipoint education usage

6.7 Use case 7: Multipoint multiview (virtual space)

This use case describes a virtual space multipoint meeting with good eye contact and spatial layout of participants. Virtual space multipoint, as defined here, assumes endpoints with multiple cameras and displays. Usually there are the same number of cameras and displays at a given endpoint. A camera is positioned above each display. A key aspect of virtual space multipoint is the details of how the cameras are aimed. The cameras are each aimed on the same area of view of the participants at the site. Thus each camera takes a picture of the same set of people but from a different angle. Figure 7 illustrates the use case.

For further information, see clause 3.7 of [b-IETF RFC 7205].

NOTE – This use case is not for 3D stereoscopic view.
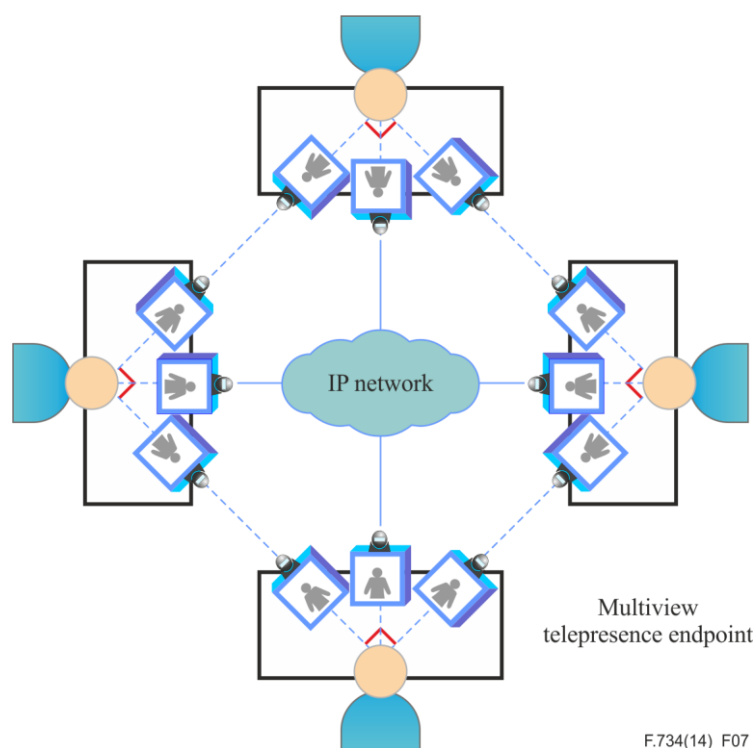
Figure 7 – Use case 7: Multipoint multiview (virtual space)

6.8   Use case 8: Legacy interworking

This use case describes a case where a legacy videoconferencing endpoint (or other heterogeneous device such as voice only endpoint) is involved in the telepresence session. The legacy endpoint does not support telepresence related protocols, and interworking is required to communicate between the telepresence and legacy endpoints. Figure 8 illustrates the use case.

This use case may also utilise other legacy equipment such as a legacy H.323 MCU in order to participate in a conference.
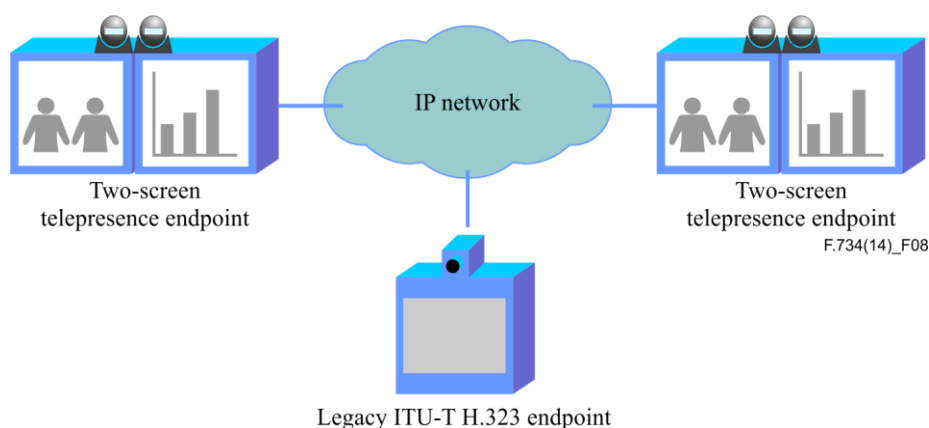
Figure 8 – Use case 8: Legacy interworking

6.9   Use case 9: Telemedical use case

This use case describes a typical application of telepresence systems for medical usage. Multiple presentation streams are used dynamically to satisfy the need for presenting multiple videos and still images, etc. simultaneously. In this use case the endpoints are able to both receive and send multiple presentations. In some instances multiple presentation screens are used to enhance visibility.

Figure 9 illustrates the use case.

For further information see clause 3.8 of [b-IETF RFC 7205].
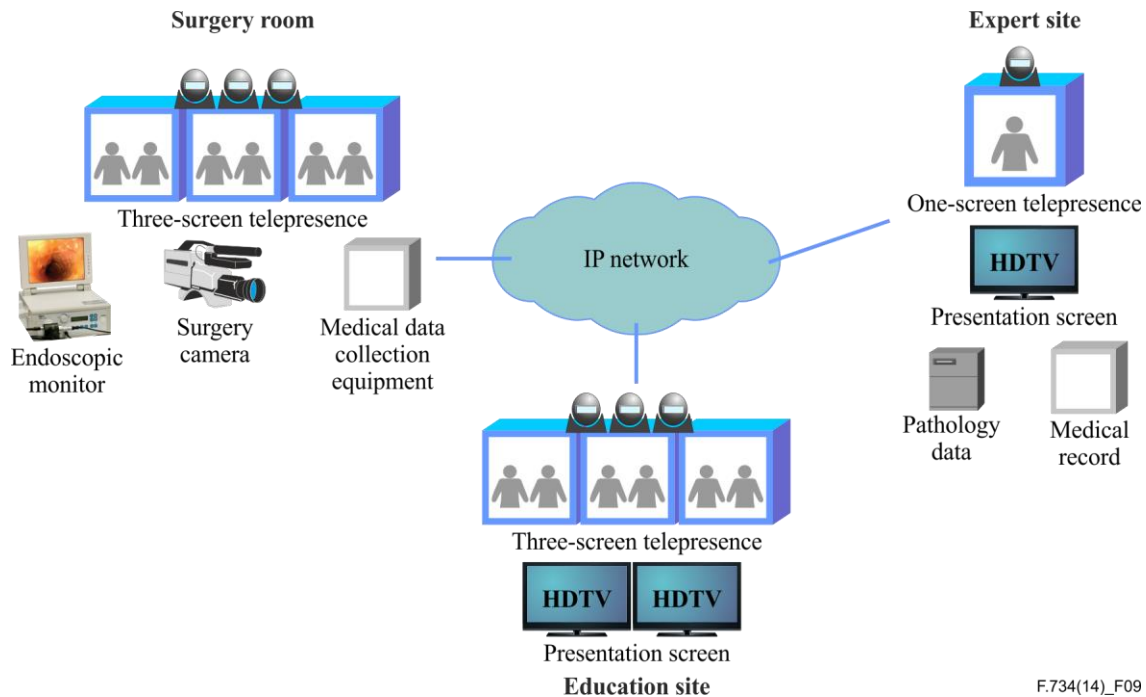
Figure 9 – Use case 9: Telemedical

7 User experience requirements

This clause addresses user experience requirements of a telepresence system on an end-to-end system basis, primarily in terms of functional requirements rather than detailed performance requirements.

User01: It is recommended that a telepresence system support actual size high definition imaging of videoconferencing participants at the remote end. The support of actual size is considered an advanced telepresence feature.

User02: It is recommended that a telepresence system provide an experience where there is awareness of both direct gaze and averted gaze, with the video images of the remote participants being rendered within a tolerable angle in both horizontal and vertical axes from the gaze direction between the two communicating participants.

NOTE 1 – The visual clues for determining the gaze direction may include the orientation of the looker's eyes with respect to their head and the orientation of the looker's head with respect to the environment. Some research suggests that tolerable angles are 3-5 degrees horizontal and up to 12 degrees upward and 8 degrees downward.

User03: It is recommended that a telepresence system support a means of locating the speaker in a remote meeting room so that local participants can readily identify the position of different remote speakers.

User04: It is required that a telepresence system enable synchronization of audio and video from the remote location. Synchronization includes "lip-sync" and the sequencing of multiple media streams.

User05: It is recommended that a telepresence system provide a control function to allow a user to perform an operation with a minimum of input thus enabling convenient centralized management and one-touch smart control capabilities.

User06: It is recommended that a telepresence system provide harmonized environment for assuring immersive presences of remote users. Typically, in order to provide immersive and realistic experiences to users, some environmental factors are aligned between local and remote locations.
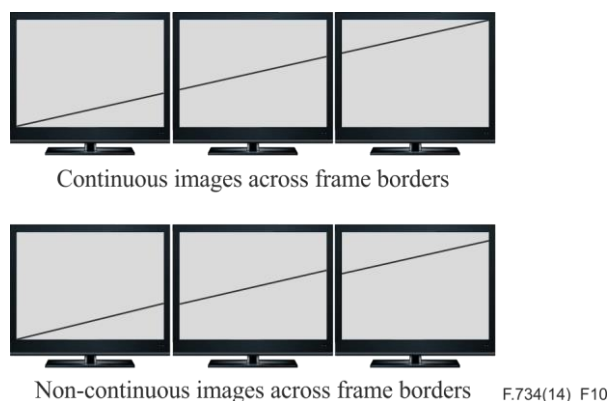
These environmental factors include: interior design aspects such as the desk shape, wall colour, illumination, or lighting position, etc.

User07: It is recommended that a telepresence system support multiple video sources in each meeting room. It is recommended that these video sources provide a seamless view of the conference participants.
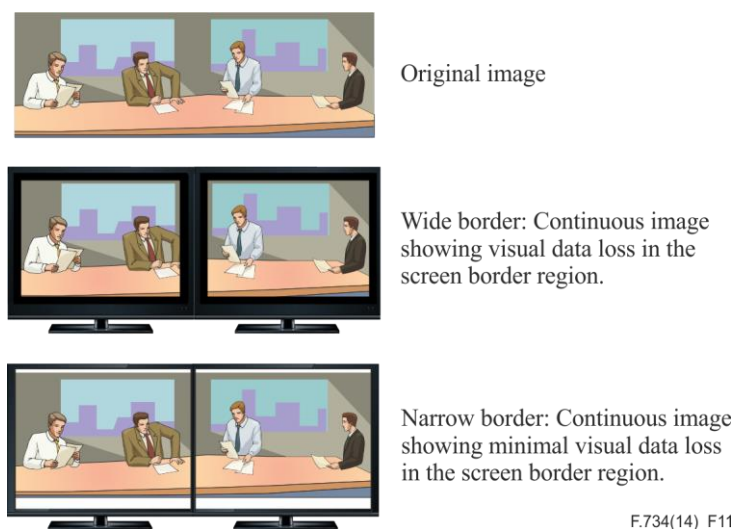
User08: It is recommended that a telepresence system support multiple screens in each meeting room. It is recommended that the gap width between neighbouring displays be minimized. Furthermore it is recommended that the output images on neighbouring displays be continuous across the display frame borders (either physical or virtual), if they exist.

Figure 10 illustrates the continuity requirement.

Figure 11 shows the effects of gap width on the display of images.

Continuous images across frame borders

Non-continuous images across frame borders   F.734(14)_F10

Figure 10 – User experience: image continuity

Original image

Wide border: Continuous image showing visual data loss in the screen border region.

Narrow border: Continuous image showing minimal visual data loss in the screen border region.

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Figure 11 – User experience: gap minimization

NOTE 2 – In some cases, the images from the received video captures overlap and in other cases they are separated. In all of these cases, the displays may not be able to provide a continuous view of the conference participants without processing the images (e.g., introducing a virtual border, shifting, scaling and cropping, or other methods). It may also not be possible to provide image continuity when physically different screens,in terms of their own characteristics and/or their spatial placement, are used to display the image.

User09: It is required that a telepresence system provide natural response for facial expression and conversational voice.

User10: It is recommended that a telepresence system allow the receiver to switch captures between displays and assign desirable display positions for them (either automatically or via user input).

User11: It is recommended that a telepresence system indicate detailed information associated with a composed capture including the list of originating sources and the policy of the composition.

User12: A telepresence system can optionally provide each participant with an experience of being present in the same virtual room, maintaining consistent spatial relationships among all the participants.

8   Control Functional requirements

This clause specifies a number of functional requirements of the telepresence system in different categories of control functions including call control functions, media control functions, conference control functions, collaboration functions, and other functions.

Call control functions are those functions used to establish, modify and release a session in a telepresence system. Media control functions are those functions used to support different media streams including the description and negotiation of distinct capabilities of media, a method for describing the spatial arrangement of media streams, and addition/deletion of media streams. Conference control functions are those functions used to manage the display mode of screens, control cameras, support add/delete participants, switch views, switch meeting room (endpoint), or request information about the conference. Finally, collaboration functions are those functions used to provide additional applications for collaborating with other endpoints.

8.1   Call control functions

Call01: It is required that a telepresence system support a method for negotiating, establishing, modifying and releasing a telepresence session between two or more endpoints/MCUs. Thus a mechanism for determining whether or not an endpoint or MCU is capable of telepresence is required.

8.2   Media control functions

Med01: It is required that a telepresence system support the use of video with different aspect ratios between endpoints.

Med02: It is required that a telepresence system support a method for describing the spatial arrangement of audio and video streams in a manner which enables a satisfactory reproduction at the receiver in a spatially correct manner. Furthermore it is required to support a method to enable a satisfactory spatial matching between audio and video streams coming from the same endpoints.

This requirement encompasses the requirements REQMT-1, REQMT-2 and REQMT-3 as defined in [b-IETF RFC 7262].

Med03: It is recommended that a telepresence system support a method to indicate that the spatial information regarding a capture is dynamic (i.e., may change during the session) and/or a method of updating the spatial information.

Med04: It is recommended that a telepresence system support the ability for endpoints to send and receive multiple presentation streams.

Med05: It is recommended that a telepresence system support multiple simultaneous presentation streams from different endpoints.

Med06: It is required that a telepresence system provide interoperability between endpoints which send and receive different numbers of media streams. This requirement encompasses requirement REQMT-9 as defined in [b-IETF RFC 7262].

Med07: It is recommended that a telepresence system be able to add additional media streams, and remove existing media streams during the telepresence session.

Med08: It is recommended that a telepresence system provide a suitable range of video frame rates, resolutions, and bit rates for media streams as well as the shared data.

Med09: A non-mixing mode of operation for MCUs connecting telepresence endpoints is recommended.

Med10: It is recommended that a telepresence system advertise a set of media characteristics suitable for use by various types of devices.

Med11: It is recommended that a telepresence system limit its advertised set of media characteristics to ensure a suitable user experience for the application (for instance ensuring high quality video for telemedicine)

Med12: It is required that a telepresence system support interoperability with other devices that send or receive a different number of media streams.

Med13: It is required that a telepresence system support the description, identification and negotiation of appropriate information to enable spatially coordinated rendering of audio and video streams.

8.3 Conference control functions

The requirements in this clause relate to conference control functions that are stimulated either through direct user interaction or through policies with prior user input. These conference control functions are grouped into several areas: chair control, media rendering, meeting arrangement and endpoint control.

The requirements below indicate requirements for a user. These also apply to a user when the user is designated as the conference chair. In some use cases the requirements may be limited to users who are designated as conference chair.

8.3.1 Chair control

Chair control requirements relate to the management of a "chair" function that provide a mechanism to control how resources are used in a conference.

Con01: It is recommended that a telepresence system support a mechanism for floor control. It should be possible for a user to:

–   **Con01a**: apply to be floor chair,

–   **Con01b**: apply to the floor chair for permission to speak,

–   **Con01c**: release the chairmanship to allow another to user to take the chair,

–   **Con01d**: receive the list of endpoints/persons applying to speak, and

–   **Con01e**: remove floor control from the conference.

8.3.2 Media rendering

Media rendering requirements are those related to the control of the content and the description of media streams within a conference and how these media streams are rendered.

Con02: It is recommended that a telepresence system enable a user to:

–   **Con02a**: Set information regarding the content of media captures and which captures are advertised.

–   **Con02b**: Select which captures are consumed by the local endpoint. This may be through user interaction or automatically as the result of policy.

–   **Con02c**: Select a particular local rendering layout/policy. For example: control what is displayed when multiple endpoints/captures are in a conference. This may be all the remote participants (including non-telepresence participants) or a subset.

–   **Con02d**: Set which endpoints and their captures may be distributed in the conference.

–   **Con02e**: Set a particular endpoint as an endpoint from which all other endpoints in the conference receive media from.

- **Con02f**: Set the switching policy for media distributed in the conference. Example policies include voice controlled switching with a voice activity threshold to control which media is distributed, or whether all or a subset of endpoints/captures are switched.
- **Con02g**: Set a composition policy to control how media is combined from two or more streams into a single stream.
- **Con02h**: Set a policy to control autonomous operation of the telepresence system with respect to switching and composition.
- **Con02i**: Indicate whether a particular stream is related to a presentation and to control which endpoints can send presentation streams.

8.3.3 Meeting arrangement

Meeting arrangement requirements are those related to the initiation, maintenance and ending of the overall conference session.

Con03: It is recommended that a telepresence system enable a user to:
- **Con03a**: Schedule a conference, provide meeting information and invite participants.
- **Con03b**: Start a conference, to enable users/endpoints to join a conference.
- **Con03c**: Lock a conference to ensure extra users/endpoints cannot join an active conference.
- **Con03d**: Extend a conference past its scheduled time.
- **Con03e**: End a conference, which results in the release of resources associated with the conference.
- **Con03f**: Receive details regarding the conference, including the conference name and list of the participants and who is conference chair.

8.3.4 Endpoint control

Endpoint control requirements are those related to managing the connection of endpoints to a conference and the control of endpoint resources.

Con04: It is recommended that a telepresence system enable a user to:
- **Con04a**: Connect one or more endpoints to a conference by calling the endpoint.
- **Con04b**: Disconnect an endpoint that is currently connected to a conference. For example, the procedures described by [ITU-T H.243].
- **Con04c**: Add an endpoint to the conference list.
- **Con4d**: Mute/unmute endpoints at the local and/or remote endpoint(s).
- **Con04e**: Control a remote camera (FECC) and its capture area.

8.4 Collaboration functions

Collaboration functions are those functions used to provide additional facilities for collaborating with other endpoints.

Col01: A telepresence system can optionally provide one or more means of collaboration such as remote presentation, instant messaging, online documentation, whiteboard and file transfer based on existing protocols.

Col02: A telepresence system can optionally support a captioning function.

8.5 Other functions

This clause contains requirements that are not related to the other clauses in clause 8.

Other01: It is required that a telepresence management system be able to provide various statistical information about a telepresence conference session, both during and at the end of the conference, which includes, but is not limited to: the media type(s) used, the numbers of endpoints, the session duration and the data volume of each media type. Depending on the information required, the telepresence management system may collect the information from multiple different telepresence system entities (e.g., call resource controller, MCU and endpoints).

NOTE – There may be other requirements for the generation of local statistics, e.g., for the consumption of local users and/or local endpoint management systems. As these statistics are local in scope they are not detailed by this Recommendation.

Other02: It is recommended that a telepresence system provide QoS/QoE information, including media network utilization, network delay, loss rate and jitter.

9   Interoperability requirements

9.1   Interoperation with traditional systems

This clause presents requirements for interoperation with legacy devices or systems. When used in a conference with telepresence system these legacy devices might not provide a telepresence experience.

Int01: It is required that a telepresence system supports the participation in the same conference of both traditional videoconferencing endpoints and telepresence endpoints.

Int02: It is recommended that a telepresence system support connection to a traditional videoconferencing system in a cascaded conference mode.

Int03: It is recommended that a telepresence system allow audio only legacy devices to participate in a conference.

9.2   Interoperation between telepresence systems

This clause presents requirements for interoperation with devices or systems that have been enhanced for telepresence.

Int04: It is required that a telepresence system enable audio and video terminals based on different open standards, different software and/or hardware architectures to participate in the same conference.

Int05: It is required that a telepresence system provide a telepresence experience between telepresence endpoints and devices based on different open standards when participating in the same conference. For example: A telepresence enhanced SIP endpoint and a telepresence enhanced H.323 endpoint via control signalling gateway.

Int06: It is required that a telepresence system allow telepresence endpoints and devices residing in different networks to participate in the same conference. This includes cases of intra and inter operator networks, and also between an operator network and an enterprise network.

Int07: It is recommended that a telepresence systems support interoperability between endpoints with screens of different resolutions.

10   Network requirements

Net01: It is recommended that a telepresence system enable reservation of network resources for assuring QoS for the telepresence session.

Net02: It is recommended that a telepresence system enable adaptation of the quality of media based on the network status. For example, under a best-effort network such as the Internet, which cannot

provide strictly guaranteed network QoS, the telepresence system may need to manipulate its video quality based on network status.

Net03: It is recommended that a telepresence system provide a means for endpoints to participate in telepresence conferences when some of telepresence system components are located in one or more private networks.

NOTE – Signalling and media may be subject of NAT or firewall traversal techniques to assure connectivity of telepresence services. Such techniques should be applied automatically with minimal user operation.

Net04: It is required that a telepresence system not preclude support for both IPv4 and IPv6.

11   Security requirements

Sec01: A telepresence system can optionally support a security mechanism for securing sessions.

Sec02: A telepresence system can optionally support a negotiation mechanism for negotiating the characteristics of the secured session.

Sec03: A telepresence system can optionally support both signal security and media security.

Sec04: A telepresence system can optionally support authentication of the endpoints.

Bibliography

[b-IETF RFC 7205] IETF RFC 7205 (04/2014), *Use Cases for Telepresence Multistreams*.

[b-IETF RFC 7262] IETF RFC 7262 (06/2014), *Requirements for Telepresence Multistreams*.

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