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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
  - 1 presented to TSG for information;
  - 2 presented to TSG for approval;
  - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document contains the study on Telepresence using IP Multimedia (IM) Core Network (CN) subsystem based on the Session Initiation Protocol (SIP), Session Description Protocol (SDP) and other protocols of controlling multiple streams for Telepresence based on service requirements.

The study aims, within the defined CT1 work areas, at:

- analysing IMS session procedures and signalling between the UE and core network for Telepresence creation, establishment with media negotiation and configuration, session modification and termination, with the incorporation of new protocol (i.e. CLUE as under developing in IETF);
- investigating impacts for presentation in Telepresence and floor control in IMS;
- analysing similar impacts to allow legacy devices interworked with Telepresence using IMS; and
- studying potential enhancements and extensions to facilitate these procedures.

This study will identify specification areas, if any, that lie within the scope of other 3GPP working groups, and seek input from those 3GPP working groups to define that related specification work.

Editor's note: This TR holds the agreed material for an interim period of time. It has the advantage that avoiding duplicate work with IETF and progress the stage 3 solutions from IMS perspective.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 24.147: "Conferencing using the IP Multimedia (IM) Core Network (CN) subsystem; Stage 3".

[3] 3GPP TS 24.229: "Internet Protocol (IP) multimedia call control protocol based on Session Initiation Protocol (SIP) and Session Description Protocol (SDP); Stage 3".

[4] 3GPP TS 23.228: "Technical Specification Group Services and System Aspects; IP Multimedia Subsystem (IMS); Stage 2".

[5] IETF RFC 3261 (June 2002): "SIP: Session Initiation Protocol".

[6] IETF RFC 4566 (July 2006): "SDP: Session Description Protocol".

[7] IETF RFC 4582 (November 2006): "The Binary Floor Control Protocol (BFCP)".

[8] IETF RFC 4583 (November 2006): "Session Description Protocol (SDP) Format for Binary Floor Control Protocol (BFCP) Streams".

[9] draft-ietf-clue-framework-10 (May 2013): "Framework for Telepresence Multi-Stream".

Editor's note: The above document cannot be formally referenced until it is published as an RFC.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Telepresence: A conference with interactive audio-visual communications experience between remote locations, where the users enjoy a strong sense of realism and presence between all participants by optimizing a variety of attributes such as audio and video quality, eye contact, body language, spatial audio, coordinated environments and natural image size.

CLUE channel: A reliable, bidirectional, transport mechanism used to convey CLUE messages. A CLUE channel consists of one SCTP stream in each direction over a DTLS/SCTP session.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Symbol format (EW)

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

BFCP	Binary Floor Control Protocol
CLUE	ControLling mUltiple streams for tElepresence
DTLS	Datagram Transport Layer Security
IMS	IP Multimedia CN subsystem
SCTP	Stream Control Transmission Protocol
SDP	Session Description Protocol
SIP	Session Initiation Protocol
TCP	Transmission Control Protocol
TP	TelePresence
UDP	User Datagram Protocol

4 Overview of telepresence using IMS

4.1 General

As an architectural framework for provision of IP multimedia services, IMS is capable of delivering various service functionalities and easing to integrate with new kinds of application, such as telepresence. Compared to traditional video conference, telepresence is a conferencing system with multiple cameras, microphones and screens that has the characteristics of gaze direction, eye contact, spatial audio and scaling images to true size, which in all to achieve the immersive "being there" experience for participants.

IMS is using the IETF defined session control mechanism with the inherited capability to negotiate multiple multimedia streams in one single session, which could be applied as a basis for supporting telepresence in IMS that always has the necessity of producing and rendering various media streams with high qualities among the involved parties, even in the point to point case.

Based on the existing procedures as specified for IMS conferencing in 3GPP TS 24.147 [2], this technical report introduces updates and enhancements for IMS by incorporating the new tools as defined by IETF CLUE WG (see more

from: https://datatracker.ietf.org/wg/clue/charter/) that achieves media advertisement and configuration to facilitate controlling multiple spatially related media streams in an IMS conference supporting telepresence. The main foreseeable challenges are capability negotiation for new tools, interactions of the adopted protocols, and interoperability and interconnection with the traditional IMS conferencing users.

This technical report provides the procedures to satisfy the above requirements by evaluating the impacts and additions to support telepresence using IMS.

4.2 Telepresence enhanced IMS characteristics

4.2.1 General

In order to provide a "being there" experience for conversational audio and video conferencing between remote locations, where the users enjoy a strong sense of realism and presence between participants a variety of information needs to be co-ordinated between local and remote participants such as:

- audio and video spatial information;
- information to enable eye contact, gaze awareness, body language and natural image size; and
- information to coordinate the environments;

This section discusses the information that may be provided by one to another to achieve a telepresence experience.

4.2.2 Spatial information

A spatial relationship is representative of the arrangement in space of two or more objects in the same room, in contrast to retain in time or other relationships. It involves mainly both video and audio sources in telepresence conferencing system.

If so, a spatial description of source video images sent in video streams helps to enable a reproduction of the original scene at the receiver side, and a spatial description of source audio sent in audio streams helps also to enable a reproduction at the receiver side in a spatially correct manner. Furthermore, the spatial description of source video images includes the order of images in the actual captured scene and may be in two or three dimensions. The spatial description of source audio includes the spatial position of audio in the captured scene. It may be transmitted as single or multi-channel audio. Maybe there is a spatial matching between audio and video streams coming from the same endpoints.

The descriptions as above apply to each scene in a point to point or a multipoint meeting and refer to the spatial ordering within a scene, not to the ordering of images and the spatial position of audio between scenes.

4.2.3 Media information

Information regarding media traditionally describes its encoding. This information is enhanced in an IM session supporting telepresence by information regarding the source components of the media capture, i.e. the origin of captures may be the original media captures (e.g. from a camera) or a composed media captures indicating a mix of audio streams, a composition video streams or switched media captures indicating the dynamic or most appropriate subset of a "whole".

This enhanced description of captures helps a sender to describe which sources are included and helps a receiver to choose which sources to receive from a list of sources.

Further enhanced media information may indicate simultaneity constraints. For example, a room camera have two options which are zoomed-in view and zoomed-out view, but there is no way for it to do both simultaneously.

4.2.4 Meeting description

Meeting description includes place information, participant information and language information. This information helps receivers to choose between different captures and may also be rendered by receivers.

Place information indicates a physical region captured, which is further refined to "room", "table", "individual", "lectern", "audience" and others. Language information is mainly used in case of multi-lingual and/or accessible conferences. Participant information indicates the attributes of people participating within a multi-media conference. This may include information such as "meeting roles", "meeting specific roles", "conference system control roles", "institution type", "personal information", and others.

In addition, there may be some descriptive information which indicates a relative priority between different captures, or indicates a capture provides embedded textual information, or indicates the capture contains additional complementary information related to another capture, and so on.

4.2.5 Presentation

Presentation indicates that a capture originates from a presentation device, that is one that provides supplementary information to a conference through slides, video, data and so on. Furthermore, presentations can have unfixed sources, can be varied in placement and can be seen by all participants in the conference.

4.2.6 Conference control

Conference control is used to for the chairman of a conference or the participants granted appropriate permissions to manage and control participation in a conference, such as forbidding other users joining a conference when the number of participants reaches the certain number, or muting a conference participant/endpoint when the conference site has too much noise.

4.2.7 Information usage

The information detailed above may be used to obtain a better experience during an IM session where interoperability is needed between endpoints of different capabilities, such as between endpoints that have a different number of devices which are similar or different, or different picture aspect ratios, or send and receive different numbers of media streams, and so on. In fact, the minimum requirement is guaranteed to voice conference if there are some mismatches between devices.

Accordingly, protocols adopted for IM session supporting telepresence which exchanges above information from participating sites enables interoperability by handling multiple streams in standardized way.

5 Alternative procedures for telepresence using IMS

5.1 Brief introduction of protocols used in IM session supporting telepresence

5.1.1 Session Initiation Protocol (SIP)

SIP, as defined in IETF RFC 3261 [5] and adopted by 3GPP TS 24.229 [3] and 3GPP TS 24.147 [2], is used as the basic session control protocol to create an IMS session supporting telepresence.

There is no special enhancement to SIP in order to support an IM session supporting telepresence.

5.1.2 Session Description Protocol (SDP)

SDP, as defined in IETF RFC 4566 [6] and adopted by 3GPP TS 24.229 [3] and 3GPP TS 24.147 [2], is used to establish multimedia streams in an IM session supporting telepresence.

In an IMS session supporting telepresence, each party in the session usually sends and receives multiple multimedia streams, the number of streams may not be symmetric due to their different capabilities for media production and rendering. This is different from the typical communication model for SDP offer/answer and its usage in normal IM sessions, which is more often a bidirectional agreement on media parameter values. The usage and potential enhancements for SDP should be addressed.

5.1.3 ControLling mUltiple streams for tElepresence (CLUE)

CLUE, under development in IETF, is used to advertise and configure audio and video components comprising the media flows in an IM session supporting telepresence. The introduction for such a new protocol can be found in subclause 1 of draft-ietf-clue-framework [9].

A data channel for CLUE message is negotiated via the first INVITE message when creating an IM session supporting telepresence. With the establishment of that channel, the participants have consented to use the CLUE protocol mechanisms to determine the capabilities of the each of the endpoints with respect to multiple streams support. The following exchange of CLUE messages of each participant's "advertisement" and "configure" is to achieve a common view of media components sent and received in the IM session supporting telepresence. A corresponding SDP offer/answer may be needed to establish the media streams based on the user's choice in CLUE messages.

5.1.4 Binary Floor Control Protocol (BFCP)

BFCP, as defined in IETF RFC 4582 [7] and IETF RFC 4583 [8] and adopted by 3GPP TS 24.147 [2], is used to offer floor control of shared resources in an IM session supporting telepresence.

There is no special enhancement to BFCP in order to support an IM session supporting telepresence.

Editor's note: Documentation of BFCP usage outside of 3GPP TS 24.147 [2] is for further study in CT1.

5.2 General procedures for IM session supporting telepresence

An IM session includes point to point call and multipoint conference scenarios. The endpoints participating in an IM session supporting telepresence shall support the procedures specified in 3GPP TS 24.229 [3] and 3GPP TS 24.147 [2].

Based on the comparison with a normal IM session as defined in 3GPP TS 24.229 [3] and 3GPP TS 24.147 [2], the following clauses focus on the general procedures to deal with multiple spatially related media streams to support telepresence and to interwork with IM session as below:

1) Initiation of telepresence using IMS, which includes an initial offer/answer exchange establishes a basic media session and a CLUE channel, CLUE exchanges to "advertisement" and "configure" media components used in the session, then followed by an SDP offer/answer in ReINVITE request to complete the session establishment (see more for the general idea in draft-ietf-clue-framework [9]);

2) Release or leaving of an IM session supporting telepresence, which needs remove the corresponding CLUE channel;

3) Update of an ongoing IM session supporting telepresence, triggered by CLUE exchanges modifying existing CLUE information. For example: a new participant at an endpoint may require the establishment of a specific media stream;

4) Presentation during an IM session supporting telepresence, which may also be initiated by the exchange of CLUE messages and possibly need an updated SDP offer/answer and activation of BFCP for floor control; and

5) Interworking with normal IM session, this is to let the normal IMS users be able to join telepresence using IMS.

5.3 Initiation procedures for IM session supporting telepresence

5.3.1 Introduction

Compared with a normal IM session, this subclause describes the necessary enhancements regarding initiation procedures for an IM session supporting telepresence.

5.3.2 Origination Procedures

To initiate an IM session supporting telepresence, the TP UE shall:

1) generate an SDP offer in the SIP request, containing basic media streams and an establishment request for a CLUE channel. The initial SDP offer message negotiates the port and transport information for setting up the CLUE channel, via a separate SDP m= line indicating "application" for CLUE that details the necessary information.

Editor's note: The details for using SDP to establish the underlying SCTP connection for CLUE channel is still for further definition. According to the current understanding, the CLUE channel is established by using SCTP, on top of the DTLS protocol, as negotiated in SDP for transporting non-media data between the communicating parties. An "m" line in SDP offer message that specifies "DTLS/SCTP" shall further qualify the application layer protocol "CLUE" using an fmt identifier, which is followed by media attributes specifying the SCTP association.

2) set up the CLUE channel between the remote party, after receiving the SDP answer with information for CLUE channel establishment (e.g. via an SDP m= line indicating "application" for CLUE).

NOTE 1: If the TP UE receives the SDP answer without the support information for CLUE channel establishment (e.g. by setting the port number to zero in the m= line for the CLUE channel), which means the remote party does not support telepresence, the session shall fall back to a normal IM session.

NOTE 2: In the point to point cases, the TP UE can initiate CLUE negotiation via the first SDP offer/answer when establishing an IM session or via the update SDP offer/answer during an ongoing IM session depending on local configuration.

In the conference case, when the TP UE acting as a conference participant joins in the conference, the conference focus shall follow the above steps to establish an IM session supporting telepresence among the conference participants based on the procedures as described in subclause 5.3.1 of 3GPP TS 24.147 [2]. If a participant that does not support telepresence requests to join in an existing IM session supporting telepresence, the participant can successfully join however the session between the participant and the conference focus is a normal IM session.

Conversely, when the TP enabled conference focus invites some specific users to join in the conference, the TP UE shall follow the above steps to establish an IM session supporting telepresence based on the procedures as described in subclause 5.3.2.5 of 3GPP TS 24.147 [2].

NOTE 3: In the conference cases, both the TP UE acting as a conference participant joining in the conference and the TP enabled conference focus inviting some specific users to join in the conference follow this approach regarding CLUE negotiation described as above in the point to point cases.

5.3.3 Termination Procedures

When receiving a SIP request to initiate an IM session supporting telepresence, the TP UE shall:

1) send an SDP answer with information for CLUE channel establishment (e.g. via the SDP m= line indicating "application" for CLUE), if telepresence is supported for the session.

NOTE: If the receiving UE does not support telepresence for the request, it shall reject the request for CLUE channel establishment (e.g. by setting the port number to zero in the m= line for the CLUE channel), and it is proceeded as a normal IM session.

In the conference case, when the TP UE acting as a conference participant responds to a request to join in the conference, the conference focus shall follow the above steps to complete an IM session supporting telepresence among the conference participants based on the procedures as described in subclause 5.3.2.3 of 3GPP TS 24.147 [2].

5.4 End of IM session supporting telepresence

This clause describes the end of an IM session supporting telepresence, which was established between the involved parties via an intermediate IM CN network.

To release an existing IM session supporting telepresence, the TP UE shall:

1) generate a BYE request for the session in accordance to the procedures described in 3GPP TS 24.229 [3]; and

2) remove the CLUE channel between the TP UE and the remote party.

To cancel an IM session supporting telepresence currently being established, the TP UE shall send a CANCEL request instead to end the session and remove the CLUE channel if it is established.

In the conference case, both of the TP UE acting as a conference participant and the conference focus can use the above procedures to end up an IM session supporting telepresence between them. The conference focus may trigger the procedures upon receiving a REFER request to remove a conference participant from the ongoing IM conference supporting telepresence.

When the conference focus supporting telepresence is aware that a conference participant has left an IM conference supporting telepresence, the conference focus shall terminate the session between the leaving participant according to the above procedure, and then:

1) initiate update procedures to those participants who has configured media information from the leaving participant; and

2) send the CLUE "advertisement" message to notify the latest available media captures to the remaining participants.

5.5 Update of media captures for IM session supporting telepresence

5.5.1 Introduction

An ongoing IM session supporting telepresence can be updated due to a number of potential reasons, for example the changes of media capture attributes, and addition or deletion of media captures if a camera in the room is turning on or off. Update of SDP offer/answer in IMS may be triggered based on the above modifications.

5.5.2 Originating an update procedure

When the TP UE determines to initiate an update to the ongoing IM session supporting telepresence, the TP UE shall:

1) trigger an update exchange of CLUE messages to negotiate with the other party about the status change of the ongoing call, complete the media capture configuration if needed;

2) if the CLUE messages have changes that result in needs to modify the media stream(s) (e.g. a change to encoding), the TP UE sends a new updated SDP offer/answer to apply the necessary media stream modifications, based on the exchange of CLUE messages. Other changes in CLUE information not having impacts on the media stream(s), e.g. update on spatial relationship, do not require an updated SDP offer/answer.

Editor's note: The details on how to make a decision whether update of SDP offer/answer are essential after the exchange of CLUE messages in an ongoing IM session supporting telepresence will be further discussed and implemented.

In an ongoing IM conference supporting telepresence, there are more possibilities than point to point case that will trigger an update of the session, for example a user joins or leaves the conference in result the available media captures have to be modified. Both of the TP UE acting as a conference participant and the conference focus can use the above procedures to update an IM session supporting telepresence between them.

5.5.3 Terminating an update procedure

When the TP UE or the conference focus in case of conference receives an update message to the ongoing IM session supporting telepresence, it shall:

1) finalize the CLUE exchange with the participant if needed, for example it may choose to make a new configuration on the available media captures;

2) may send a new update of SDP offer/answer to apply the necessary media stream modifications, based on the exchange of CLUE messages;

In case of conference, the conference focus shall further:

3) determine whether session update is needed between the conference focus and other participants in the same conference supporting telepresence, if so, the conference focus shall initiate the update procedures accordingly.

The update of an ongoing IM session supporting telepresence may result in a session fallback to a normal IM session without CLUE usage. There are two different fallback scenarios as specified below (which can also apply to the origination procedures):

1) If one or more media captures are removed via the exchanges of CLUE messages and cause the remaining stream to be audio only, the ongoing session may fallback to a normal IM session, i.e. the call keeps on with the only media but the CLUE channel is removed via updated SDP offer/answer;

2) If the CLUE channel is removed, due to local configuration of the TP UE or underlying SCTP/IP connection accident, there are two possible ways to handle the ongoing IM session:

   a) re-establish the CLUE channel;

   b) fallback the session to a normal IM session.

Editor's note: The indepth details regarding to how to identify fallback of an ongoing IM session supporting telepresence to a normal IM session are left for further completion. The fallback procedures are still under discussion in IETF.

5.6 Presentation during an IM session supporting telepresence

During an IM session supporting telepresence, a user may want to create presentations with other participants for a set of shared resources, such as slide sharing or playing a specific stored video piece, for which the procedure is described in this sub-clause.

As an option, floor control is achieved by using BFCP to offer control of shared presentation resources for an IM session supporting telepresence. Depends on the different scenarios in the session, functional entities including TP UE and MRFP shall support the roles for floor control (e.g. floor participant, floor chair, floor control server) and their general operations as specified in 3GPP TS 24.147 [2].

When a TP UE needs to start presentations during an ongoing IM session supporting telepresence, the TP UE shall:

1) construct media capture(s) for presentation in a CLUE message, and proceed the exchange for its advertisement and configuration between the other party, i.e. remoting TP UE for point to point session and conference focus for multipoint session, the CLUE messages of which can be combined with the initiation or update procedures;

2) once the media capture for presentation is configured, the TP UE creates an update of SDP offer/answer to establish media stream for the presentation flow, and an application channel for BFCP if floor control is supported, according to the procedures specified in IETF RFC 4583 [8]; and

3) determine the role of floor control and get the floor via the BFCP connection before starting media transmission of the presentation.

A TP UE or a conference focus, that receiving a presentation request in an IM session supporting telepresence, shall perform the procedures accordingly, i.e. configure the media capture for presentation via CLUE, update the SDP offer/answer message and do floor control via BFCP.

It is possible to have multiple presentation streams in a single IM session, where a TP UE or an MRFP may choose to exchange more than one media captures for presentation and act as different roles of floor control in the BFCP connection.

The mapping of the media components, including capture in CLUE, floor in BFCP and media stream in SDP, is achieved by correlating the identifiers used in these protocols.

5.7 Interworking with IM session supporting telepresence

When an IM session supporting telepresence is initiated, there's no CLUE channel can be created via SDP offer/answer if either of the involved parties does not support telepresence, and then it is established as a normal IM session that not support telepresence.

In the conference case, a UE not support telepresence can only establish a normal IM session between the conference focus, even in an IM conference supporting telepresence. A conference focus not supporting telepresence can only establish a normal conference with different kinds of UEs. Even when the conference focus acting as a conference participant joins an ongoing IM conference supporting telepresence, the session is established in the normal way as the conference focus is not able to establish a CLUE channel for telepresence.

When the conference focus supports telepresence, it can establish an IM conference supporting telepresence among different participants. In this case, the conference focus can still establish a normal IM session with those kinds of UE that not support telepresence, but no telepresence experience can be achieved between them. If the conference focus wants to join an ongoing conference, it can further establish a data channel with the conference focus in the other side to create an IM session that supporting telepresence.

Editor's note: It is for further study how to handle multiple media streams for the conference focus with both TP UE and normal IMS UE in the same conference supporting telepresence.

5.8 Open issues and alternative options

5.8.1 RTP stream creation before completion of CLUE negotiation

To maintain backward compatibility when initiating an IM session supporting telepresence, a set of RTP streams, for example one for audio and one for video, are created in the first SDP Offer/Answer messages. This initial SDP offer/answer also contains a request to setup a CLUE channel. If the CLUE channel is not supported, the session will fall back to a normal IM session, and there's no difference for the usage of the RTP streams. However, if the CLUE channel is established, the parties involved in the session will advertise and configure the media characteristics they want to exchange, and then use the created RTP streams or update them to adapt these characteristics.

The role of the RTP sessions established at this stage is unclear. It is intended that what is offered be acceptable to the traditional IMS devices, both for audio and video. What is unclear is whether these sessions will play any role once CLUE is negotiated? At that point both CLUE messages and SDP O/A can be used to transport encoding information and the relationship between captures, encodings and RTP streams.

5.8.1.1 Alternative 1: No media exchanged until completion of CLUE negotiation

CLUE negotiation is to achieve an agreement for the media contents (also called as Media Captures in CLUE) that will be exchanged between the involved parties; so if CLUE is used in the session, the first alternative way is to hold the basic RTP streams until the completion of CLUE negotiation. Once the CLUE negotiation is completed, SDP may or may not be updated to adapt the transport of CLUE encodings.

Pros:

1. Keep compatibility with traditional IMS mechanisms, and avoid potential bad user experience if there video or audio changes.

Cons:

1. RTP resources is reserved and not used until completion of CLUE negotiation.

5.8.1.2 Alternative 2: Transfer simple media contents

The SDP O/A is negotiated with the basic RTP streams, which are configured based on a simple one-screen/one-speaker view of the room. The RTP streams are flowing on after they are established, even though the CLUE negotiation is still in processing. Once the CLUE negotiation is completed, SDP may or may not be updated to adapt the transport of CLUE encodings.

It is good if those simple audio/video sessions could become encodings that are used for clue capture-encodings, so that no redundant RTP sessions are established and torn down.

Pros:

1. No RTP resources are wasted.

Cons:

1. It is probably possible that those simple audio/video sessions do not obey the result of CLUE negotiation, then SDP is updated and the RTP streams may be modified or torn down.

2. In that case, those simple audio/video streams need not be what the users want to receive, although transported.

5.8.1.3 Alternative 3: Other usages like announcement

The basic RTP sessions can have other usages, for example for some sort of announcement. Once the CLUE negotiation is completed, SDP may or may not be updated to adapt the transport of CLUE encodings.

Pros:

1. No RTP resources are wasted.

Cons:

1. The basic RTP sessions created in the first SDP O/A are not configured for the usage encodings.

5.8.2 Telepresence CLUE handling in a MRF

Editor's note: CT4, with the ownership of Mp interface, should be involved when making a decision on this issue.

CLUE, as a new mechanism defined by IETF, is designated to advertise and configure the multiple media contents and their spatial relationships (and other chracteristics) among different capturing and rendering entities in a telepresence session. Due to the potentially large number of media flows, CLUE is used to facilitate the session negotiation in IMS.

The CLUE messages are exchanged in a specific data channel initiated via SDP between two endpoints, for example UE and UE in the point to point case, UE and MCU in the multipoint case. When it is supported in IMS, the question is whether MRFC or MRFP is the point generating CLUE messages?

5.8.2.1 Alternative 1: MRFC generates CLUE message

With the nature of CLUE, which is more of an application type protocol, one way is to make the MRFC to generate the CLUE "advertisement" and "configure" messages.

The MRFC inserts its own address in the SDP O/A to setup a CLUE channel with the UE during the session establishment procedure, and exchanges CLUE messages in it.

Editor's note: There may still be a need for the MRFC to provide some information to the MRFP to facilitate operation of CLUE. E.g. any RTP level information related to the CLUE application. The need for this information is still being discussed in the IETF.

Pros:

1. It is straightforward for MRFC to deal with both CLUE and SDP O/A messages together.

Cons:

1. Resource issue for data channel connected between UE and MRFC, an extra port would be needed in the MRFC.

5.8.2.2 Alternative 2: MRFP generates CLUE message

Using the traditional SDP O/A procedure, the MRFC requests the MRFP to allocate bearer address for a CLUE channel in the session. In this case, it is MRFP exchanging CLUE messages with UE directly via the channel.

Enhancements on Mp interface for MRFC and MRFP interaction are needed, to handle CLUE messages and complete the SIP/SDP negotiation based on them.

Pros:

1. Bearer level data channel is followed.

Cons:

1. Enhancements on Mp interface are needed.

5.8.3 Sequence of SDP and CLUE during updating

To establish an IM session supporting telepresence, a CLUE channel needs to be created between two parties in this session, for example TP UE and TP UE in the point to point case, TP UE and MRF in the multipoint conference case. The CLUE channel may be created when establishing an IM session, or during an existing IM session. However, once the CLUE channel has been successfully established, update procedures may trigger both SDP offer/answer and CLUE exchanges during the IM session supporting telepresence.

For example, when adding a camera the parties involved in the session need to make a decision whether to first have "advertisement" and "configure" the media characteristics to be exchanged via CLUE, or initiate a ReINVITE request to renegotiate media flow information via SDP ahead of CLUE. Accordingly, the sending sequence between SDP and CLUE messages is unclear when there are changes of telepresence settings which cause to need to update them during an IM session supporting telepresence.

SDP and CLUE proceed independently via different routings and entities in IMS network, i.e. CLUE is exchanged directly between the involved parties via the specific data channel, and SDP offer/answer is negotiated among the IMS control plane entities and its containing media streams are connected by the controlled media plane entities. When the changes happen, two basic options to trigger the message exchange:

1) To first initiate an exchange of CLUE messages: after one of the parties involved in this session sends a new "advertisement" message, SDP may be updated to adapt the transport of CLUE encodings. If the new "advertisement" message references an Encoding that isn't defined in the current SDP, SDP needs to be updated to adapt the transport of CLUE encodings.

   In some cases, for example shutdown of a specific camera in a TP UE, closure of the corresponding media stream via SDP is needed, or errors may happen since there's no data transmission in the bearer connection if waiting for the completion of CLUE exchanges. The controlling of IMS media plane should consider such scenarios when choosing the way to handle the updates.

2) To send a ReINVITE request to first update media information: after one of the parties involved in this session sends a ReINVITE message because of the changes of media contents (e.g. to add or delete an Encoding), CLUE needs to be updated to describe the media information of SDP encoding. The other party may accept the request, but won't know what purpose the new Encoding serves or whether it will be useful. And then the prior party will send a subsequent "advertisement" message that references the new Encoding in the recent SDP. When the other party receives the "advertisement" message and is aware that the new Encoding will finally be clear what it is for. At that point a "configure" messages can be sent to use that new Encoding, and then media can flow.

   Or, the other party may refuse the request because there is no current need for the new Encoding. And then the prior party will send a subsequent "advertisement" message that references the new Encoding in the recent SDP. When the other party receives the "advertisement" message and is aware that the new Encoding will be desired to use. At that point a "configure" messages can be sent to use it. However, media can't flow yet because the SDP m-line was refused. Then a new offer can be sent to enable that encoding. Once the answer accepts it, media can flow. So this case there needs to be two SDP update procedures.

   More rounds of SDP offer/answer may be needed in this option, and the other impacts on IMS media processing may also be introduced due to the different modes like media aware or media agnostic on the media plane entities.

5.8.4 Media flows treatment after CLUE's removal

A CLUE channel for an IM session supporting telepresence may be removed due to some potential reasons, for example the SCTP association is disconnected due to some bearer/IP connection error, and then this CLUE session may downgrade to a non-CLUE session however the media flows from capture devices still exist. Then the question is whether the media flows that are previously configured by CLUE should continue or be stopped after a CLUE channel has been removed. There are two options to meet the above issue.

1) To keep the media flows according to the last successful configuration via CLUE, and make the IM session as CLUE-less.

   Even if the actual attributes of these media flows change such as the spatial information during this session after a CLUE channel has been removed, they may be only presented according to the last successful configuration in

each direction until a new CLUE channel is re-established. In this case, what the local parties are shown with regards to the remote parties may be inconsistent with the real situation in remote parties.

2) To re-negotiate the IM session via an updated SDP offer/answer, in order to have a normal IM session without of telepresence support.

5.8.5 SCTP connection status when CLUE is removed

A CLUE channel using SCTP is requested via an SDP offer/answer when an IM session is being established or during an existing IM session. However, a CLUE channel may be removed due to a few of reasons, for example a user is participating through a CLUE enabled mobile or PC using video but then request to transition back to audio mode (they don't require or have telepresence capabilities) because they want to start moving around or they don't want to be part of the video feed anymore. The session will then become to a non-CLUE session.

Then the issue comes on whether the SCTP association is kept open if a CLUE channel is removed, which impacts the SDP construction to facilitate the media processing in IMS. A list of options is described here to meet the above issue.

NOTE: The options below only relate to the case where an endpoint requests the removal of the CLUE channel. The behaviour related to when a CLUE channel is removed due to error is for further study.

1) To synchronize the removal the corresponding SCTP association with CLUE. The SCTP association may only be removed if no other application level data transmission is established within the same association.

2) To keep the corresponding SCTP association open. Then if a CLUE channel is re-negotiated via the SDP offer/answer during the IM session, the corresponding SCTP association does not need to be re-established again.

Editor's note: It is for further discussion on details about how much of SCTP association controlling that should be documented here, including whether other applications beside CLUE can use the same SCTP association. The closure of SCTP association due to the CLUE removal can be also specified as conditional, for example the SCTP association is only released due to the permanent reasons and kept on for the temporary cases (e.g. CLUE session is closed due to turn off of all cameras in the room), but this is still under study to address the clear distinctions.

6 Conclusion

Editor's note: This sub-clause provides the choice of solutions for telepresence using IMS based on the study in this document, which will be followed by the TS work.

Annex A (informative): Example signalling flows

A.1 Scope of signalling flows

This annex gives examples of signalling flows for an IM session supporting telepresence based on the Session Initiation Protocol (SIP), SIP Events, the Session Description Protocol (SDP) and the tools defined by IETF CLUE working group.

These signalling flows provide detailed signalling flows, which expand on the overview information flows provided in 3GPP TS 23.228 [4] and 3GPP TS 24.147 [2].

A.2 Flows demonstrating the establishment of an IM conference supporting telepresence

A.2.1 Introduction

Clause A.2 covers the signalling flows that show how an IM conference supporting telepresence is established in different scenarios.

A.2.2 User creating an IMS conference supporting telepresence

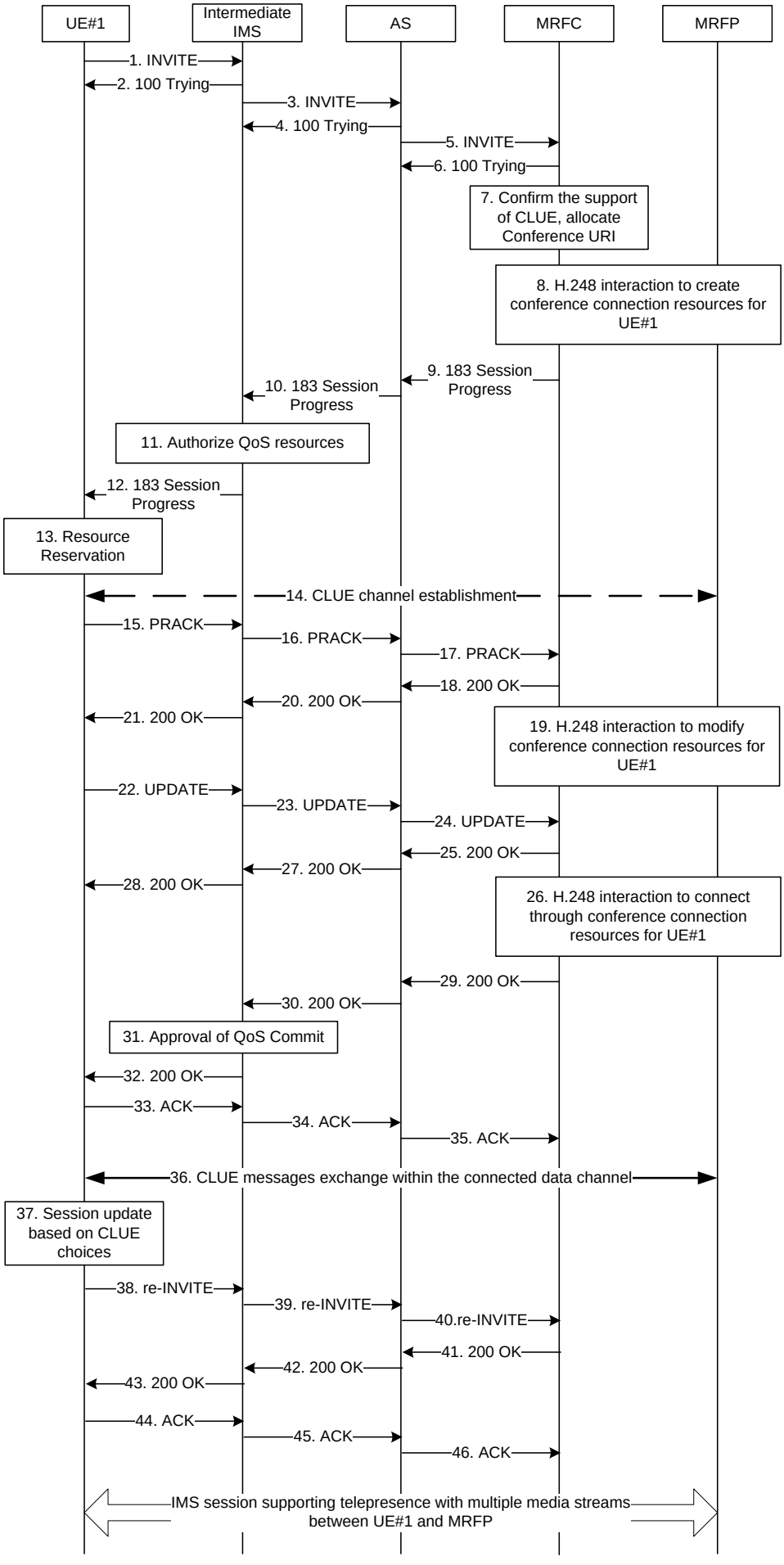
UE#1
Intermediate IMS
AS
MRFC
MRFP
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. INVITE
6. 100 Trying
7. Confirm the support of CLUE, allocate Conference URI
8. H.248 interaction to create conference connection resources for UE#1
9. 183 Session Progress
10. 183 Session Progress
11. Authorize QoS resources
12. 183 Session Progress
13. Resource Reservation
14. CLUE channel establishment
15. PRACK
16. PRACK
17. PRACK
18. 200 OK
20. 200 OK
21. 200 OK
19. H.248 interaction to modify conference connection resources for UE#1
22. UPDATE
23. UPDATE
24. UPDATE
25. 200 OK
27. 200 OK
28. 200 OK
26. H.248 interaction to connect through conference connection resources for UE#1
29. 200 OK
30. 200 OK
31. Approval of QoS Commit
32. 200 OK
33. ACK
34. ACK
35. ACK
36. CLUE messages exchange within the connected data channel
37. Session update based on CLUE choices
38. re-INVITE
39. re-INVITE
40.re-INVITE
41. 200 OK
42. 200 OK
43. 200 OK
44. ACK
45. ACK
46. ACK
IMS session supporting telepresence with multiple media streams between UE#1 and MRFP

Figure A.2.2.1: User creating an IMS conference supporting telepresence

Figure A.2.2.1 shows a user creating an IMS conference supporting telepresence by incorporating CLUE tools with the basic IMS SIP/SDP mechanism.

The details of the flows are as follows:

1 - 6. **SIP INVITE request (UE to intermediate IMS, AS, till MRFC)**

Based on the IMS conference procedures as specified in subclause A.3.2.1 of 3GPP TS 24.147 [2], a UE initiates the SIP INVITE request comprising a basic media session and a CLUE channel (via an application type of m= block in SDP), which indicates the UE supports CLUE and it wants to construct an IMS conference supporting telepresence.

The SIP INVITE request is forwarded till to MRFC.

Editor's note: The example of signalling flows shown here only introduces the basic idea for creating an IMS conference supporting telepresence, and it is noticed that IETF is still progressing on the entire CLUE tools to finalize the SIP based telepresence mechanism, so the details of the message blocks and how these different protocol messages interacts in the examples here are left for further completion.

7. **Allocate Conference URI**

The MRFC determines whether telepresence is supported in this IMS conference. If so, it allocates a conference URI for the request, based on local information and information gained from the conference-factory URI, as well as information gained from other elements of the SIP signalling.

8. **H.248 interaction to create connection**

The MRFC initiates a H.248 interaction to create bearer resources for UE#1 in MRFP and to determine media capabilities of the MRFP.

9 - 12. **SIP 183 (Session Progress) response (MRFC to UE)**

The MRFC determines the set of codecs that it is capable of supporting for this conference. It determines the intersection with those appearing in the SDP in the SIP INVITE request.

Since telepresence is supported, the media stream capabilities of the destination as well as the connection information for CLUE channel are returned in a SIP 183 (Session Progress) provisional response and finally forwarded to UE#1.

13. **Resource reservation**

The originating UE sets up the bearer in accordance with the media description received SDP.

14. **CLUE channel establishment**

With the negotiated connection information in SDP, the UE#1 and the MRFP establishes the CLUE channel between them.

Editor's note: The CLUE channel is offered during the initial SIP INVITE, and remain connected for the duration of the CLUE/SIP session. The details of bearer resource allocation and policy control for CLUE channel in IMS is for further study.

15 - 35. **Set up of basic media session**

The basic media session is processed as per procedures defined in subclause A.3.2.1 of 3GPP TS 24.147 [2].

36. **CLUE messages exchange**

Once the CLUE channel is connected, the UE#1 and the MRFP exchanges their media characteristics and capabilities by sending CLUE Advertisement and Configuration messages on both directions, see more about the usage of these CLUE messages in draft-ietf-clue-framework [9].

37. **Telepresence update**

With the media information negotiated over CLUE, the UE#1 constructs a new SDP offer/answer setting up the media transmission for telepresence based on the basic media session.

38 - 46. **SIP re-INVITE request (between UE and MRFC)**

The UE#1 initiates the SIP re-INVITE request to establish the IMS conference supporting telepresence containing multiple media streams with spatial relationship that negotiated via CLUE.

A.2.3 User getting invited to an IM conference supporting telepresence

Subclause A.2.3 covers the signalling flows that a TP UE getting invited to an IM conference supporting telepresence, which may be triggered for example after the conference focus receives a REFER request to invite a user join the conference.

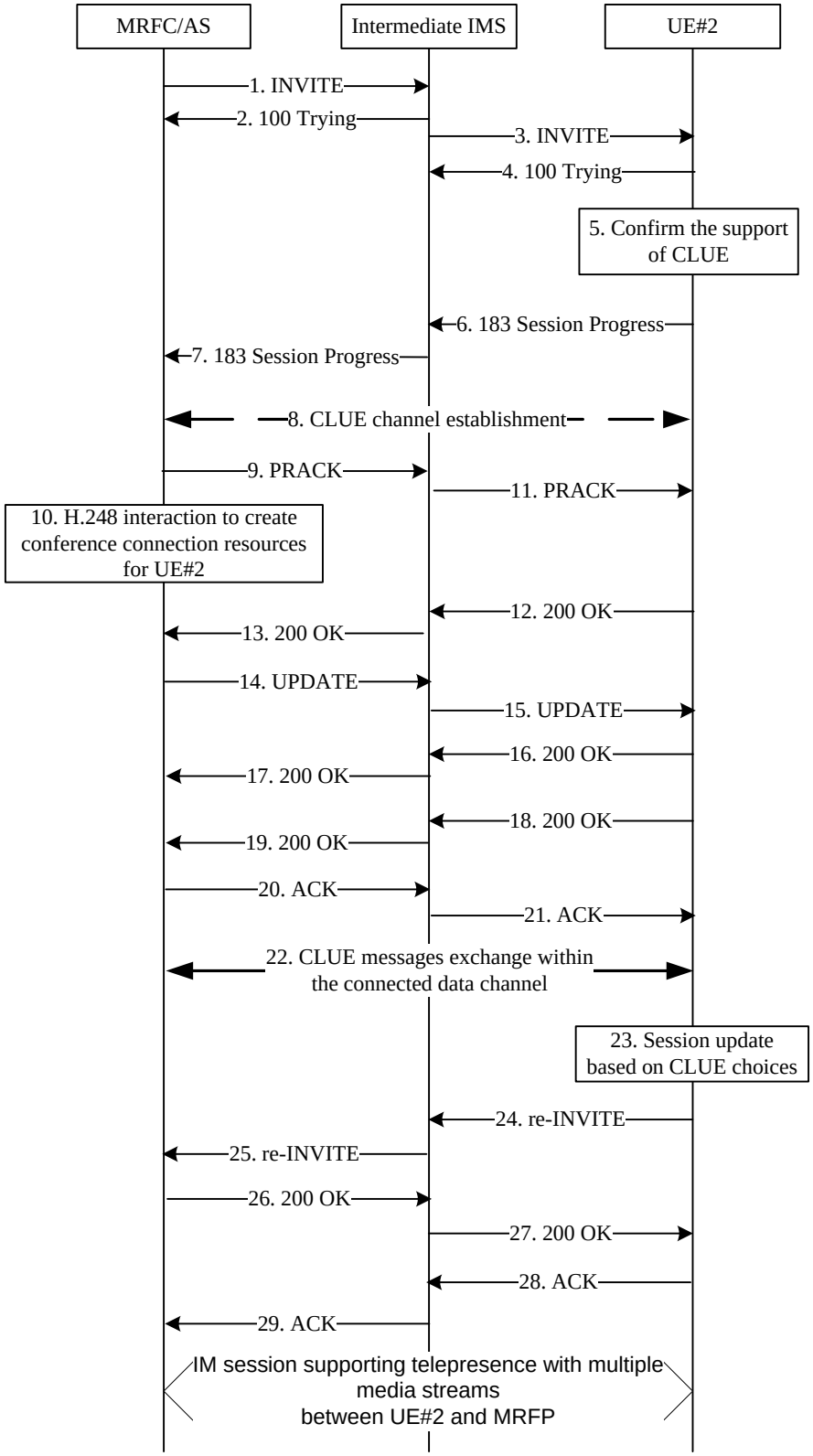

Figure A.2.3-1: A user getting invited to an IM conference supporting telepresence

Figure A.2.3-1 shows a user is invited to an IM conference supporting telepresence by incorporating CLUE tools with the basic IMS SIP/SDP mechanism.

The details of the flows are as follows:

1 - 4. **SIP INVITE request (MRFC/AS to intermediate IMS, till UE)**

Based on the IM conference procedures as specified in subclause A.4.3.1.3 of 3GPP TS 24.147 [2], the MRFC/AS initiates the SIP INVITE request containing a basic media session and a request for a CLUE channel (e.g. via a SDP m= line indicating "application" CLUE), which indicates the MRFC/AS supports CLUE and it determines to construct an IM conference supporting telepresence.

The SIP INVITE request is forwarded to UE#2.

Editor's note: The example of signalling flows shown here only introduces the basic idea for inviting a user to an IM conference supporting telepresence. The IETF is still progressing its work with respect to CLUE and finalizing the SIP based telepresence signalling mechanisms, so the details of the message blocks and how these different protocol messages interacts in the examples here are left for further completion.

5. **Confirm the support of CLUE**

UE#2 makes a decision whether the conference supports telepresence depending on the UE#2's CLUE capability.

6 - 7. **SIP 183 (Session Progress) response (UE to MRFC)**

UE#2 determines the set of codecs that it is capable of supporting for this conference. It determines the intersection with those appearing in the SDP in the SIP INVITE request.

Since telepresence is supported, the media stream capabilities of the destination as well as the connection information for the CLUE channel are returned in a SIP 183(session progress) provisional response and finally forwarded to MRFC/AS.

8. **CLUE channel establishment**

With the negotiated connection information in SDP, the UE#2 and the MRFC/MRFP establishes the CLUE channel between them.

Editor's note: The CLUE channel is offered during the initial SIP INVITE, and remain connected for the duration of the CLUE/SIP session. The details of bearer resource allocation and policy control for the CLUE channel in IMS is for further study.

9 - 21. **Set up of basic media session**

The basic media session is processed as per procedures defined in subclause A.4.3.1.3 of 3GPP TS 24.147 [2].

22. **CLUE messages exchange**

Once the CLUE channel is connected, the UE#2 and the MRFC/MRFP exchange their media characteristics and capabilities by sending CLUE "advertisement" and "configure" messages on both directions, see more about the usage of these CLUE messages in draft-ietf-clue-framework [9].

23. **Telepresence update**

With the media information negotiated over CLUE, the UE#2 constructs a new SDP offer/answer setting up the media transmission for telepresence based on the negotiated captures and encodings via CLUE.

24 - 29. **SIP re-INVITE request (between UE and MRFC)**

The UE#2 initiates the SIP re-INVITE request to establish the IM conference supporting telepresence containing multiple media streams with attributes or characteristics that were negotiated via CLUE.

A.3 Flows demonstrating an IM point to point call supporting telepresence

A.3.1 Introduction

Clause A.3 covers the flows that show how to establish an IM point to point call supporting telepresence, between two TP UEs via the intermediate IM network.

A.3.2 Call flow of the originating side

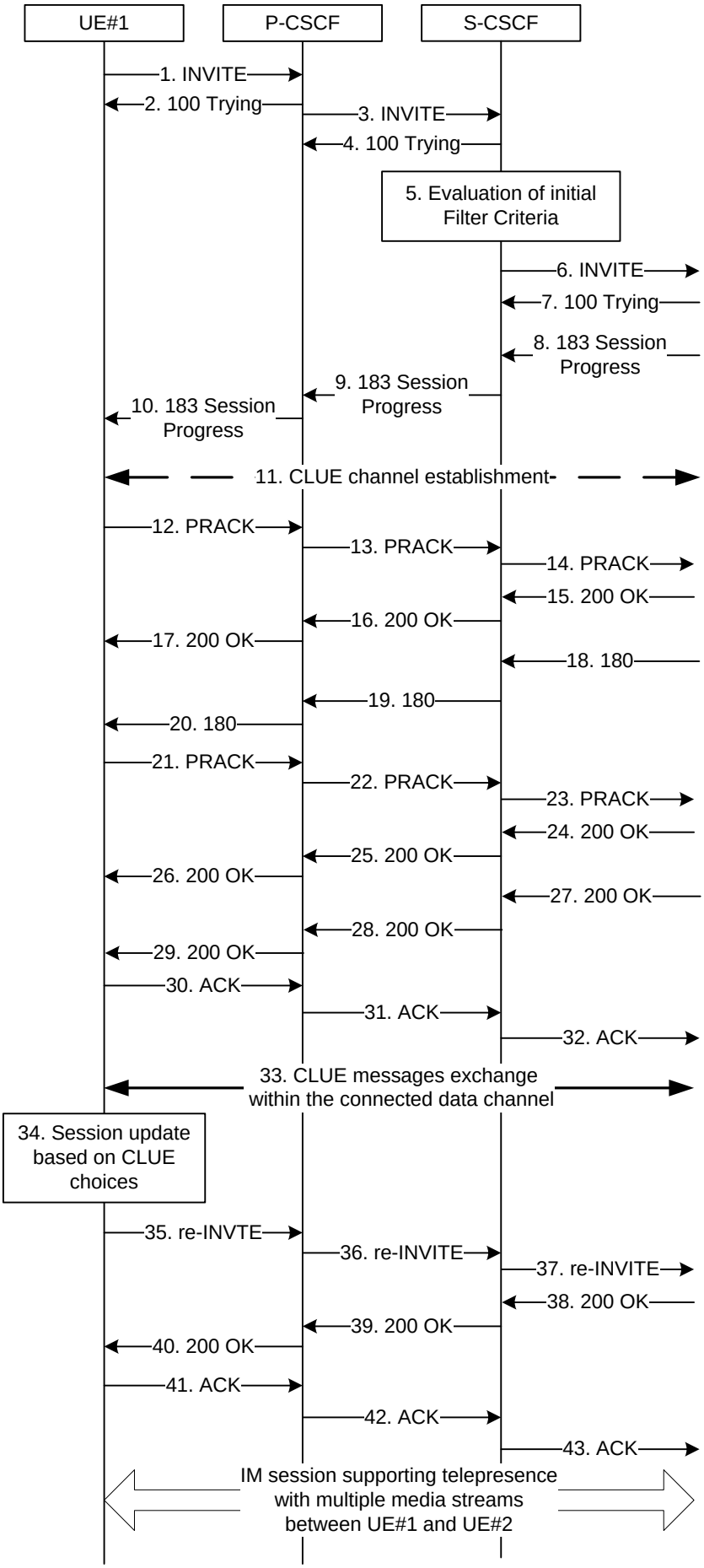
UE#1
P-CSCF
S-CSCF
1. INVITE
2. 100 Trying
3. INVITE
4. 100 Trying
5. Evaluation of initial Filter Criteria
6. INVITE
7. 100 Trying
8. 183 Session Progress
9. 183 Session Progress
10. 183 Session Progress
11. CLUE channel establishment
12. PRACK
13. PRACK
14. PRACK
15. 200 OK
16. 200 OK
17. 200 OK
18. 180
19. 180
20. 180
21. PRACK
22. PRACK
23. PRACK
24. 200 OK
25. 200 OK
26. 200 OK
27. 200 OK
28. 200 OK
29. 200 OK
30. ACK
31. ACK
32. ACK
33. CLUE messages exchange within the connected data channel
34. Session update based on CLUE choices
35. re-INVTE
36. re-INVITE
37. re-INVITE
38. 200 OK
39. 200 OK
40. 200 OK
41. ACK
42. ACK
43. ACK
IM session supporting telepresence with multiple media streams between UE#1 and UE#2

Figure A.3.2-1: UE originated IM point to point call supporting telepresence

Figure A.3.2-1 shows the TP UE initiating an IM point to point call supporting telepresence with a remote TP UE, by incorporating CLUE tools with the basic IMS SIP/SDP mechanism. The CLUE messages are exchanged to configure the available media captures between the two UEs, which facilitate the establishment and transportation of the media streams.

The details of the flows are as follows:

1 - 7. **SIP INVITE request (UE#1 to intermediate IMS)**

Based on the IM point to point call procedures as specified in 3GPP TS 24.229 [3], the UE#1 initiates the SIP INVITE request containing a basic media session and a request for a CLUE channel (e.g. via a SDP m= line indicating "application" for CLUE).

The SIP INVITE request is forwarded till to the remote UE.

8 - 10. **SIP 183 (Session Progress) response (the remote UE to UE#1)**

The S-CSCF forwards the 183 (Session Progress) response to UE#1.

11. **CLUE channel establishment**

With the negotiated connection information in SDP, UE#1 and the remote UE establish the CLUE channel between them.

Editor's note: The CLUE channel is offered during the initial SIP INVITE, and remains connected for the duration of the CLUE/SIP session. The details of bearer resource allocation and policy control for the CLUE channel in IMS is for further study.

12 - 32. **Set up of basic media session**

The basic media session is processed as per procedures defined in 3GPP TS 24.229 [3].

33. **CLUE messages exchange**

Once the CLUE channel is connected, UE#1 and the remote UE exchange their media characteristics and capabilities by sending CLUE "advertisement" and "configure" messages to select the media captures that will be transported on both directions, see more about the usage of these CLUE messages in draft-ietf-clue-framework [9].

34. **Telepresence update**

With the media capture information negotiated over CLUE, the UE#1 constructs a new SDP offer/answer setting up the media transmission in the session.

35 - 43. **SIP re-INVITE request (between UE#1 and the remote UE)**

The UE#1 initiates the SIP re-INVITE request to establish the IM point to point call supporting telepresence containing multiple media streams for the configured media captures.

A.3.3 Call flow of the terminating side

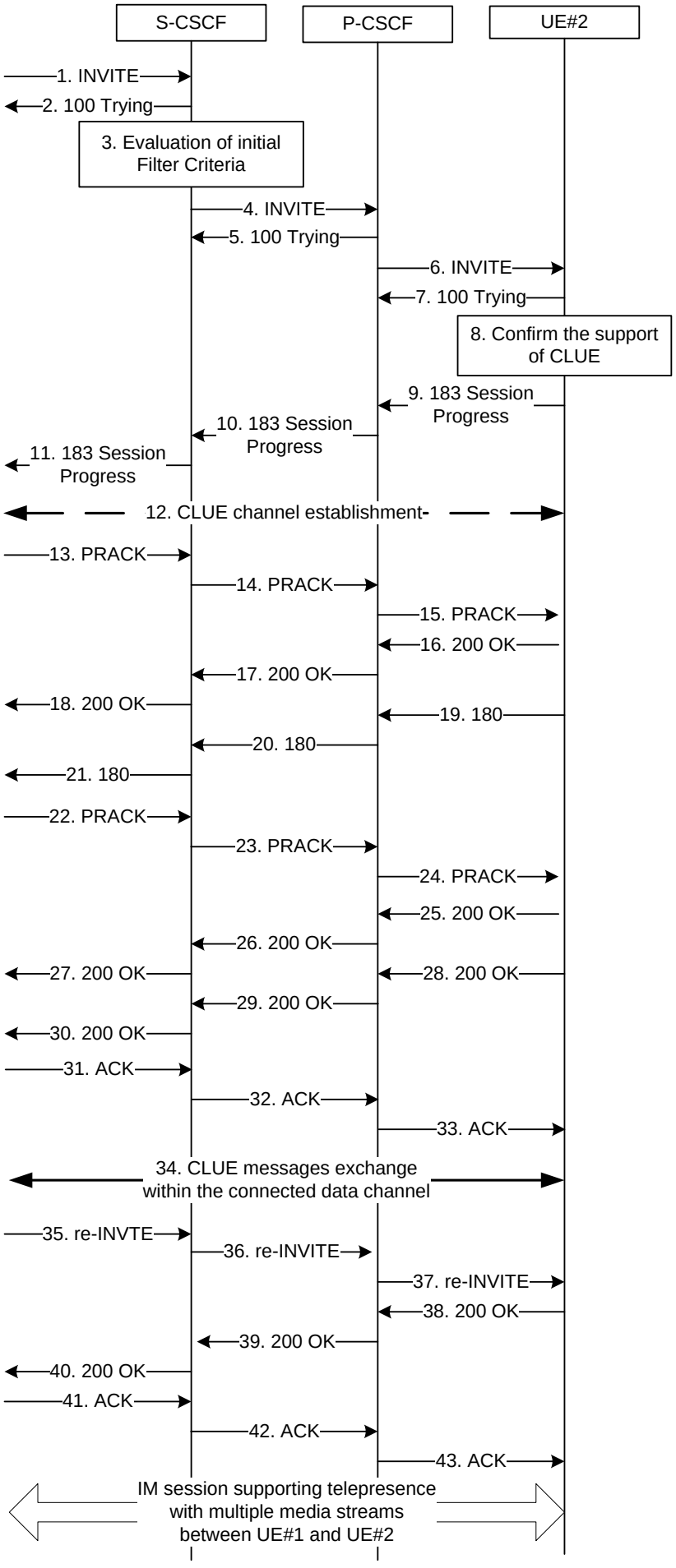
S-CSCF
P-CSCF
UE#2
1. INVITE
2. 100 Trying
3. Evaluation of initial Filter Criteria
4. INVITE
5. 100 Trying
6. INVITE
7. 100 Trying
8. Confirm the support of CLUE
9. 183 Session Progress
10. 183 Session Progress
11. 183 Session Progress
12. CLUE channel establishment
13. PRACK
14. PRACK
15. PRACK
16. 200 OK
17. 200 OK
18. 200 OK
19. 180
20. 180
21. 180
22. PRACK
23. PRACK
24. PRACK
25. 200 OK
26. 200 OK
27. 200 OK
28. 200 OK
29. 200 OK
30. 200 OK
31. ACK
32. ACK
33. ACK
34. CLUE messages exchange within the connected data channel
35. re-INVTE
36. re-INVITE
37. re-INVITE
38. 200 OK
39. 200 OK
40. 200 OK
41. ACK
42. ACK
43. ACK
IM session supporting telepresence with multiple media streams between UE#1 and UE#2

Figure A.3.3-1: UE terminated IM point to point call supporting telepresence

Figure A.3.3-1 shows the TP UE receiving an IM point to point call supporting telepresence from an originating TP UE, by incorporating CLUE tools with the basic IMS SIP/SDP mechanism. The CLUE messages are exchanged to configure the available media captures between the two UEs, which facilitate the establishment and transportation of the media streams.

The details of the flows are as follows:

1 - 7. **SIP INVITE request (Intermediate IMS to UE#2)**

Based on the IM point to point call procedures as specified in 3GPP TS 24.229 [3], the TP UE receives the SIP INVITE request containing a basic media session and a request for a CLUE channel (via a SDP m= line indicating "application" for CLUE).

8 . **Confirm the support of CLUE**

UE#2 determines whether telepresence is supported in this session, if so it completes the support information for CLUE channel in the SDP answer.

9 - 11. **SIP 183 (Session Progress) response (UE#2 to the originating UE)**

UE#2 determines the set of codecs that it is capable of supporting for this point to point call. It determines the intersection with those appearing in the SDP in the SIP INVITE request.

Since telepresence is supported, the media stream capabilities of the destination as well as the connection information for CLUE channel are returned in a SIP 183 (Session Progress) provisional response and finally forwarded to the originating UE.

12. **CLUE channel establishment**

With the negotiated connection information in SDP, UE#2 and the originating UE establish the CLUE channel between them.

Editor's note: The CLUE channel is offered during the initial SIP INVITE, and remain connected for the duration of the CLUE/SIP session. The details of bearer resource allocation and policy control for the CLUE channel in IMS is for further study.

13 - 33. **Set up of basic media session**

The basic media session is processed as per procedures defined in 3GPP TS 24.229 [3].

34. **CLUE messages exchange**

Once the CLUE channel is connected, the two UEs exchange their media characteristics and capabilities by sending CLUE "advertisement" and "configure" messages to select the media captures that will be transported on both directions, see more about the usage of these CLUE messages in draft-ietf-clue-framework [9].

35-43. **SIP re-INVITE request (between the originating UE and UE#2)**

With the media capture information negotiated over CLUE, the two UEs trigger a new SDP offer/answer setting up the media transmission in the session, to establish the IM point to point call supporting telepresence containing multiple media streams for the configured media captures.

Annex B (informative): Change history

Change history							
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New
2013-01					Initial skeleton provided by rapporteur		0.0.0
2013-01					With agreed scope after CT1#82 from C1-130503 and C1-130504	0.0.0	0.1.0
2013-06					Incorporated changes agreed at CT1#83 from C1-132234, C1-132236, C1-132620 and C1-132621	0.1.0	0.2.0
2013-08					Incorporated changes agreed at CT1#84 from C1-133218, C1-133219, C1-133220, C1-133221, C1-133222, C1-133223, C1-133224, C1-133225, C1-133226 and C1-133227	0.2.0	0.3.0
2013-10					Incorporated changes agreed at CT1#84bis from C1-134313, C1-134314, C1-134315, C1-134316, C1-134317, C1-134318, C1-134319, C1-134320, C1-134321 and C1-134322	0.3.0	0.4.0