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Mapping RTP streams to CLUE Media Captures
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Abstract

This document describes how the Real Time transport Protocol (RTP) is used in the context of the CLUE protocol. It also describes the mechanisms and recommended practice for mapping RTP media streams defined in SDP to CLUE Media Captures.

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[1.](#) Introduction

Telepresence systems can send and receive multiple media streams. The CLUE framework [[I-D.ietf-clue-framework](#)] defines Media Captures (MC) as a source of Media, such as from one or more Capture Devices. A Media Capture may also be constructed from other Media streams. A middle box can express conceptual Media Captures that it constructs from Media streams it receives. A Multiple Content Capture (MCC) is a special Media Capture composed of multiple Media Captures.

SIP offer answer [[RFC3264](#)] uses SDP [[RFC4566](#)] to describe the RTP[[RFC3550](#)] media streams. Each RTP stream has a unique SSRC within its RTP session. The content of the RTP stream is created by an encoder in the endpoint. This may be an original content from a camera or a content created by an intermediary device like an MCU (Multipoint Control Unit).

This document makes recommendations, for the CLUE architecture, about how RTP and RTCP streams should be encoded and transmitted, and how their relation to CLUE Media Captures should be communicated. The proposed solution supports multiple RTP topologies [[RFC7667](#)].

With regards to the media (audio, video and timed text), systems that support CLUE use RTP for the media, SDP for codec and media transport negotiation (CLUE individual encodings) and the CLUE protocol for Media Capture description and selection. In order to associate the media in the different protocols there are three mapping that need to be specified:

1. CLUE individual encodings to SDP

2. RTP streams to SDP (this is not a CLUE specific mapping)
3. RTP streams to MC to map the received RTP steam to the current MC in the MCC.

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC2119](#)[\[RFC2119\]](#) and indicate requirement levels for compliant RTP implementations.

The definitions from the CLUE framework document [\[I-D.ietf-clue-framework\]](#) [section 3](#) are used by this document as well.

3. RTP topologies for CLUE

The typical RTP topologies used by CLUE Telepresence systems specify different behaviors for RTP and RTCP distribution. A number of RTP topologies are described in [\[RFC7667\]](#). For CLUE telepresence, the relevant topologies include Point-to-Point, as well as Media-Mixing mixers, Media- Switching mixers, and Selective Forwarding Middleboxes.

In the Point-to-Point topology, one peer communicates directly with a single peer over unicast. There can be one or more RTP sessions, each sent on a separate 5-tuple, and having a separate SSRC space, with each RTP session carrying multiple RTP streams identified by their SSRC. All SSRCs are recognized by the peers based on the information in the RTCP SDES report that includes the CNAME and SSRC of the sent RTP streams. There are different Point-to-Point use cases as specified in CLUE use case [\[RFC7205\]](#). In some cases, a CLUE session which, at a high-level, is point-to-point may nonetheless have an RTP stream which is best described by one of the mixer topologies. For example, a CLUE endpoint can produce composite or switched captures for use by a receiving system with fewer displays than the sender has cameras. The Media Capture may be described using MCC.

For the Media Mixer topology [\[RFC7667\]](#), the peers communicate only with the mixer. The mixer provides mixed or composited media streams, using its own SSRC for the sent streams. If needed by CLUE endpoint, the conference roster information including conference participants, endpoints, media and media-id (SSRC) can be determined using the conference event package [\[RFC4575\]](#) element.

In the Media-Switching Mixer topology [\[RFC7667\]](#), the peer to mixer communication is unicast with mixer RTCP feedback. It is

conceptually similar to a compositing mixer as described in the previous paragraph, except that rather than compositing or mixing multiple sources, the mixer provides one or more conceptual sources selecting one source at a time from the original sources.

In the Selective Forwarding Middlebox (SFM) [[RFC7667](#)] topology, the peer to middlebox communication is unicast with RTCP feedback. Every potential sender in the conference has a source which may be "projected" by the SFM into every other RTP session in the conference; thus, even though the SFM establishes a separate RTP session with each endpoint, every original source is maintained with an independent SSRC to every receiver, maintaining separate decoding state and its original RTCP SDES information.

4. Mapping CLUE Capture Encodings to RTP streams

The different topologies described in [Section 3](#) create different SSRC distribution models and RTP stream multiplexing points.

Most video conferencing systems today can separate multiple RTP sources by placing them into RTP sessions using the SDP description, the video conferencing application can also have some knowledge about the usage of each RTP session. For example, video conferencing applications that have main and slides video sources can send each media source in a separate RTP session identified by the content attribute [[RFC4796](#)]. Demultiplexing at the media receiver is straightforward if the multiplexing point is at the UDP transport level, where each RTP stream uses a separate RTP session. This will also be true for mapping the RTP streams to Media Captures Encodings if each Media Capture Encodings uses a separate RTP session, and the consumer can identify it based on the receiving RTP port. In this case, SDP only needs to label the RTP session with an identifier that can be used to identify the Media Capture in the CLUE description. The SDP label attribute serves as this identifier. In this case, the mapping does not change even if the RTP session is switched using same or different SSRC.

The sending of each RTP stream in a separate RTP session is supported by CLUE endpoints but for scaling reasons, CLUE endpoints that support sending of several RTP streams in a single or multiple RTP sessions MUST support [[I-D.ietf-mmusic-sdp-bundle-negotiation](#)]. When sending multiple RTP streams in a single RTP session, the mapping of RTP streams to Captures Encodings needs to be considered.

MCCs bring another mapping issue, in that an MCC represents multiple Media Captures that can be sent as part of this MCC if configured by the consumer. When receiving an RTP stream which is mapped to the MCC, the consumer needs to know which original MC it is in order to

get the MC parameters from the advertisement. If a consumer requested a MCC, the original MC does not have a capture encoding, so it cannot be associated with an m-line using a label as described in CLUE signaling [[I-D.ietf-clue-signaling](#)]. This is important, for example, to get correct scaling information for the original MC, which may be different for the various MCs that are contributing to the MCC.

5. MCC Constituent CaptureID definition

For a MCC which can represent multiple switched MCs there is a need to know which MC is represented in the current RTP stream at any given time. This requires a mapping from the MCC RTP stream to the constituent MC. In order to address this mapping this document defines an RTP header extension and SDPS item that includes the captureID of the original MC, allowing the consumer to use the original source MC's attributes like the spatial information.

This mapping temporarily associates the SSRC of the MCC stream with the captureID of the single original MC that is currently switched into the MCC. This mapping cannot be used for the composed case where more than one original MC is composed into the MCC simultaneously.

If there is only one MC in the MCC then the media provider MUST send the captureID of the current constituent MC in the RTP header and as a RTCP SDPS message. When the media provider switches the MC it sends within an MCC, it MUST send the captureID value for the MC just switched into the MCC.

If there is more than one MC composed into the MCC then the media provider MUST NOT send any of the MCs' captureIDs using this mechanism. However, if an MCC is sending contributing source (CSRC) information in the RTP header for a composed capture, it MAY send the captureID values in the RTCP SDPS packets giving source information for these CSRC values.

If the media provider sends the captureID of a single MC switched into an MCC, then later sends a composed stream of multiple MCs in the same MCC, it MUST send the special value "-", a single dash character, as the captureID RTP header and SDPS message. The single dash character indicates there is no applicable value for the MCC constituent CaptureID. The media consumer interprets this as meaning any previous captureID value in this RTP header no longer applies. As [[I-D.ietf-clue-data-model-schema](#)] defines the captureID syntax as "xs:ID", the single dash character is not a legal captureID value, so there is no possibility of confusing it with an actual captureID.

5.1. RTCP CaptureID SDES Item

This document specifies a new RTCP SDES item.

```

      0                   1                   2                   3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| CaptureID=XX |      length      | CaptureID                        |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|      ....      |
+---+---+---+---+---+

```

This CaptureID is a variable-length UTF-8 string corresponding either to a CaptureID negotiated in the CLUE protocol, or the single character "-".

This SDES message MUST be sent in a compound RTCP packet unless support for Reduced-size RTCP has been negotiated as specified in [RFC 5506](#) [[RFC5506](#)].

5.2. RTP Header Extension

The CaptureID is also carried in an RTP header extension [[RFC5285](#)], using the mechanism defined in [[RFC7941](#)].

Support is negotiated within SDP using the URN "urn:ietf:params:rtp-hdext:CaptureID".

Packets tagged by the sender with the CaptureID then contain a header extension as shown below

```

      0                   1                   2                   3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| ID   | len-1 | CaptureID ...                                     |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
                                One-byte header extension form (0xBEDE)

```

```

      0                   1                   2                   3
      0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
| ID           | Len           | CaptureID                        |
+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+---+
|      ....      |
+---+---+---+---+---+
                                Two-byte header extension form (0x100x)

```


The CaptureID is sent in a header extension because for switched captures, receivers need to know which original MC corresponds to the media being sent for an MCC, in order to correctly apply geometric adjustments to the received media.

As discussed in [RFC7941], there is no need to send the CaptureId header extension with all RTP packets. Senders MAY choose to send it only when a new MC is sent. If such a mode is being used, the header extension SHOULD be sent in the first few RTP packets to reduce the risk of losing it due to packet loss. See [RFC7941] for more discussion of this.

6. Examples

In this partial advertisement the Media Provider advertises a composed capture VC7 made by a big picture representing the current speaker (VC3) and two picture-in-picture boxes representing the previous speakers (the previous one -VC5- and the oldest one -VC6).

```
<ns2:mediaCapture xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
  xsi:type="ns2:videoCaptureType" captureID="VC7" mediaType="video">
  <ns2:captureSceneIDREF>CS1</ns2:captureSceneIDREF>
  <ns2:nonSpatiallyDefinable>true</ns2:nonSpatiallyDefinable>
  <ns2:content>
    <ns2:captureIDREF>VC3</ns2:captureIDREF>
    <ns2:captureIDREF>VC5</ns2:captureIDREF>
    <ns2:captureIDREF>VC6</ns2:captureIDREF>
  </ns2:content>
  <ns2:maxCaptures>3</ns2:maxCaptures>
  <ns2:allowSubsetChoice>false</ns2:allowSubsetChoice>
  <ns2:description lang="en">big picture of the current speaker
    pips about previous speakers</ns2:description>
  <ns2:priority>1</ns2:priority>
  <ns2:lang>it</ns2:lang>
  <ns2:mobility>static</ns2:mobility>
  <ns2:view>individual</ns2:view>
</ns2:mediaCapture>
```

In this case the media provider will send capture IDs VC3, VC5 or VC6 as an RTP header extension and RTCP SDPS message for the RTP stream associated with the MC.

7. Acknowledgements

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8. IANA Considerations

This document defines a new extension URI in the RTP SDES Compact Header Extensions subregistry of the Real-Time Transport Protocol (RTP) Parameters registry, according to the following data:

Extension URI: urn:ietf:params:rtp-hdext:CaptureId

Description: CLUE CaptureId

Contact: roni.even@mail01.huawei.com

Reference: RFC XXXX

The IANA is requested to register one new RTCP SDES items in the "RTCP SDES Item Types" registry, as follows:

Value	Abbrev	Name	Reference
TBA	CCID	CLUE CaptureId	[RFCXXXX]

9. Security Considerations

The security considerations of the RTP specification, the RTP/SAVPF profile, and the various RTP/RTCP extensions and RTP payload formats that form the complete protocol suite described in this memo apply. It is not believed there are any new security considerations resulting from the combination of these various protocol extensions.

The Extended Secure RTP Profile for Real-time Transport Control Protocol (RTCP)-Based Feedback [[RFC5124](#)] (RTP/SAVPF) provides handling of fundamental issues by offering confidentiality, integrity and partial source authentication. CLUE endpoints MUST support RTP/SAVPF and DTLS-SRTP keying [[RFC5764](#)].

RTCP packets convey a Canonical Name (CNAME) identifier that is used to associate RTP packet streams that need to be synchronised across related RTP sessions. Inappropriate choice of CNAME values can be a privacy concern, since long-term persistent CNAME identifiers can be used to track users across multiple calls. CLUE endpoint MUST generate short-term persistent RTCP CNAMES, as specified in [RFC7022](#) [[RFC7022](#)], resulting in untraceable CNAME values that alleviate this risk.

Some potential denial of service attacks exist if the RTCP reporting interval is configured to an inappropriate value. This could be done by configuring the RTCP bandwidth fraction to an excessively large or small value using the SDP "b=RR:" or "b=RS:" lines [[RFC3556](#)], or some similar mechanism, or by choosing an excessively large or small value

for the RTP/AVPF minimal receiver report interval (if using SDP, this is the "a=rtcp-fb:... trr-int" parameter) [[RFC4585](#)] The risks are as follows:

1. the RTCP bandwidth could be configured to make the regular reporting interval so large that effective congestion control cannot be maintained, potentially leading to denial of service due to congestion caused by the media traffic;
2. the RTCP interval could be configured to a very small value, causing endpoints to generate high rate RTCP traffic, potentially leading to denial of service due to the non-congestion controlled RTCP traffic; and
3. RTCP parameters could be configured differently for each endpoint, with some of the endpoints using a large reporting interval and some using a smaller interval, leading to denial of service due to premature participant timeouts due to mismatched timeout periods which are based on the reporting interval (this is a particular concern if endpoints use a small but non-zero value for the RTP/AVPF minimal receiver report interval (trr-int) [[RFC4585](#)], as discussed in [[I-D.ietf-avtcore-rtp-multi-stream](#)]).

Premature participant timeout can be avoided by using the fixed (non-reduced) minimum interval when calculating the participant timeout ([[I-D.ietf-avtcore-rtp-multi-stream](#)]). To address the other concerns, endpoints SHOULD ignore parameters that configure the RTCP reporting interval to be significantly longer than the default five second interval specified in [[RFC3550](#)] (unless the media data rate is so low that the longer reporting interval roughly corresponds to 5% of the media data rate), or that configure the RTCP reporting interval small enough that the RTCP bandwidth would exceed the media bandwidth.

The guidelines in [[RFC6562](#)] apply when using variable bit rate (VBR) audio codecs such as Opus. The use of the encryption of the header extensions are RECOMMENDED, unless there are known reasons, like RTP middleboxes performing voice activity based source selection or third party monitoring that will greatly benefit from the information, and this has been expressed using API or signalling. If further evidence are produced to show that information leakage is significant from audio level indications, then use of encryption needs to be mandated at that time.

In multi-party communication scenarios using RTP Middleboxes, a lot of trust is placed on these middleboxes to preserve the sessions security. The middlebox SHOULD maintain the confidentiality, integrity and perform source authentication. The middlebox MAY

perform checks that prevents any endpoint participating in a conference to impersonate another. Some additional security considerations regarding multi-party topologies can be found in [\[RFC7667\]](#)

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