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RTP Payload Format for TSVCIS Codec
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Abstract

This document describes the RTP payload format for the Tactical Secure Voice Cryptographic Interoperability Specification (TSVCIS) speech coder. TSVCIS is a scalable narrowband voice coder supporting varying encoder data rates and fallbacks. It is implemented as an augmentation to the Mixed Excitation Linear Prediction Enhanced (MELPe) speech coder by conveying additional speech coder parameters for enhancing voice quality. TSVCIS augmented speech data is

processed in conjunction with its temporal matched MELP 2400 speech data. The RTP packetization of TSVCIS and MELPe speech coder data is described in detail.

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1. Introduction

This document describes how compressed Tactical Secure Voice Cryptographic Interoperability Specification (TSVCIS) speech as produced by the TSVCIS codec may be formatted for use as an RTP payload. The TSVCIS speech coder (or TSVCIS speech aware communications equipment on any intervening transport link) may adjust to restricted bandwidth conditions by reducing the amount of augmented speech data and relying on the underlying MELPe speech coder for the most constrained bandwidth links.

Details are provided for packetizing the TSVCIS augmented speech data along with MELPe 2400 bps speech parameters in a RTP packet. The sender may send one or more codec data frames per packet, depending

on the application scenario or based on transport network conditions, bandwidth restrictions, delay requirements, and packet loss tolerance.

1.1. Conventions

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 RFC 2119 [RFC2119].

Best current practices for writing an RTP payload format specification were followed [RFC2736].

2. Background

The MELP speech coder was developed by the US military as an upgrade from the LPC-based CELP standard vocoder for low-bitrate communications [MELP]. ("LPC" stands for "Linear-Predictive Coding", and "CELP" stands for "Code-Excited Linear Prediction".) MELP was further enhanced and subsequently adopted by NATO as MELPe for use by its members and Partnership for Peace countries for military and other governmental communications as international NATO Standard STANAG 4591 [MELPE].

The Tactical Secure Voice Cryptographic Interoperability Specification (TSVCIS) is a specification written by the Tactical Secure Voice Working Group (TSVWG) for enabling all modern tactical secure voice devices to be interoperable across the Department of Defense [TSVCIS]. One of the most important aspects is that the voice modes defined in TSVCIS are based on a fixed rate variant of Naval Research Lab's (NRL's) Variable Date Rate (VDR) Vocoder which uses the MELPe standard as its base [NRLVDR]. A complete TSVCIS speech frame consists of MELPe speech parameters and corresponding TSVCIS augmented speech data.

In addition to the augmented speech data, the TSVCIS specification identifies which speech coder and framing bits are to be encrypted, and how they are protected by forward error correction (FEC) techniques (using block codes). At the RTP transport layer, only the speech coder related bits need to be considered and are conveyed in unencrypted form. In most IP-based network deployments, standard link encryption methods (SRTP, VPNs, FIPS 140 link encryptors or Type 1 Ethernet encryptors) would be used to secure the RTP speech contents. Further, it is desirable to support the highest voice quality between endpoint which is only possible without the overhead of FEC.

TSVCIS augmented speech data is derived from the signal processing

and data already performed by the MELPe speech coder. For the purposes of this specification, only the general parameter nature of TSVCIS will be characterized. Depending on the bandwidth available (and FEC requirements), a varying number of TSVCIS specific speech coder parameters need to be transported. These are first byte-packed and then conveyed from encoder to decoder.

Byte packing of TSVCIS speech data into packed parameters is processed as per the following example:

```
   Two-bit field: bits A and B (A is MSB, B is LSB)
   Six-bit field: bits C, D, E, F, G, and H (C is MSB, H is LSB)

        MSB                                              LSB
         0      1      2      3      4      5      6      7
      +------+------+------+------+------+------+------+------+
      |  H   |  G   |  F   |  E   |  D   |  C   |  B   |  A   |
      +------+------+------+------+------+------+------+------+
```

This packing method places the two-bit field "first" in the lowest bits followed by the next six-bit field. Parameters may be split between octets with the most significant bits in the earlier octet. Any unfilled bits in the last octet SHOULD be filled with zero.

In order to accommodate a varying amount of TSVCIS augmented speech data, it is only necessary to specify the number of octets containing the packed TSVCIS parameters. The encoding to do so is presented in Section 3.2. The preferred sets of TSVCIS parameters is specified in the speech coder specification [TSVCIS] and is beyond the scope of this RFC to describe or limit.

3. Payload Format

The TSVCIS codec augments the standard MELP 2400, 1200 and 600 bitrates and hence uses 22.5, 67.5, or 90 ms frames with a sampling rate clock of 8 kHz, so the RTP timestamp MUST be in units of 1/8000 of a second.

The RTP payload for TSVCIS has the format shown in Figure 1. No additional header specific to this payload format is needed. This format is intended for situations where the sender and the receiver send one or more codec data frames per packet.

```
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
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                         RTP Header                            |
+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
```

```
|                                                               |
+                 one or more frames of TSVCIS                  |
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

Figure 1: Packet Format Diagram

The RTP header of the packetized encoded TSVCIS speech has the expected values as described in [RFC3550]. The usage of the M bit SHOULD be as specified in the applicable RTP profile -- for example, [RFC3551], where [RFC3551] specifies that if the sender does not suppress silence (i.e., sends a frame on every frame interval), the M bit will always be zero. When more than one codec data frame is present in a single RTP packet, the timestamp is, as always, that of the oldest data frame represented in the RTP packet.

The assignment of an RTP payload type for this new packet format is outside the scope of this document and will not be specified here. It is expected that the RTP profile for a particular class of applications will assign a payload type for this encoding, or if that is not done, then a payload type in the dynamic range shall be chosen by the sender.

3.1. MELPe Bitstream Definitions

The TCVCIS speech coder includes all three MELPe coder rates used as base speech parameters or as speech coders for bandwidth restricted links. RTP packetization of MELPe follows RFC 8130 and is repeated here for all three MELPe rates [RFC8130] which with promoted suggestions or recommendations now regarded as requirements. The bits previously labeled as RSVA, RSVB, and RSVC in RFC 8130 SHOULD be filled with rate coding, CODA, CODB, and CODC, as shown in Table 1 (compatible with Table 7 in Section 3.3 of [RFC8130]).

Coder Bitrate	CODA	CODB	CODC	Length
2400 bps	0	0	N/A	7
1200 bps	1	0	0	11
600 bps	0	1	N/A	7
Comfort Noise	1	0	1	2
TSVCIS data	1	1	N/A	var.

Table 1: TSVCIS/MELPe Frame Bitrate Indicators and Frame Length

The total number of bits used to describe one MELPe frame of 2400 bps speech is 54, which fits in 7 octets (with two rate code bits). For MELPe 1200 bps speech, the total number of bits used is 81, which fits in 11 octets (with three rate code bits and four unused bits). For MELPe 600 bps speech, the total number of bits used is 54, which fits in 7 octets (with two rate code bits). The comfort nosie frame consists of 13 bits, which fits in 2 octets (with three rate code bits). TSVCIS packed parameters will use the last code combination in a trailing byte as discussed in Section 3.2.

It should be noted that CODB for both the 2400 and 600 bps modes MAY deviate from the values in Table 1 when bit 55 is used as an end-to-end framing bit. Frame decoding would remain distinct as CODA being zero on its own would indicate a 7-byte frame for either rate and the use of 600 bps speech coding could be deduced from the RTP timestamp (and anticipated by the SDP negotiations).

3.1.1. 2400 bps Bitstream Structure

The 2400 bps MELPe RTP payload is constructed as per Figure 2. Note that CODA must be filled with 0 and CODB SHOULD be filled with 0 as per Section 3.1. CODB MAY contain an end-to-end framing bit if required by the endpoints.

```
        MSB                                             LSB
         0      1      2      3      4      5      6      7
      +------+------+------+------+------+------+------+------+
      | B_08 | B_07 | B_06 | B_05 | B_04 | B_03 | B_02 | B_01 |
      +------+------+------+------+------+------+------+------+
      | B_16 | B_15 | B_14 | B_13 | B_12 | B_11 | B_10 | B_09 |
      +------+------+------+------+------+------+------+------+
      | B_24 | B_23 | B_22 | B_21 | B_20 | B_19 | B_18 | B_17 |
      +------+------+------+------+------+------+------+------+
      | B_32 | B_31 | B_30 | B_29 | B_28 | B_27 | B_26 | B_25 |
      +------+------+------+------+------+------+------+------+
      | B_40 | B_39 | B_38 | B_37 | B_36 | B_35 | B_34 | B_33 |
      +------+------+------+------+------+------+------+------+
      | B_48 | B_47 | B_46 | B_45 | B_44 | B_43 | B_42 | B_41 |
      +------+------+------+------+------+------+------+------+
      | CODA | CODB | B_54 | B_53 | B_52 | B_51 | B_50 | B_49 |
      +------+------+------+------+------+------+------+------+
```

Figure 2: Packed MELPe 2400 bps Payload Octets

3.1.2. 1200 bps Bitstream Structure

The 1200 bps MELPe RTP payload is constructed as per Figure 3. Note that CODA, CODB, and CODC MUST be filled with 1, 0, and 0 respectively as per Section 3.1. RSV0 SHOULD be coded as 0.

```
        MSB                                               LSB
         0      1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+------+
     | B_08 | B_07 | B_06 | B_05 | B_04 | B_03 | B_02 | B_01 |
     +------+------+------+------+------+------+------+------+
     | B_16 | B_15 | B_14 | B_13 | B_12 | B_11 | B_10 | B_09 |
     +------+------+------+------+------+------+------+------+
     | B_24 | B_23 | B_22 | B_21 | B_20 | B_19 | B_18 | B_17 |
     +------+------+------+------+------+------+------+------+
     | B_32 | B_31 | B_30 | B_29 | B_28 | B_27 | B_26 | B_25 |
     +------+------+------+------+------+------+------+------+
     | B_40 | B_39 | B_38 | B_37 | B_36 | B_35 | B_34 | B_33 |
     +------+------+------+------+------+------+------+------+
     | B_48 | B_47 | B_46 | B_45 | B_44 | B_43 | B_42 | B_41 |
     +------+------+------+------+------+------+------+------+
     | B_56 | B_55 | B_54 | B_53 | B_52 | B_51 | B_50 | B_49 |
     +------+------+------+------+------+------+------+------+
     | B_64 | B_63 | B_62 | B_61 | B_60 | B_59 | B_58 | B_57 |
     +------+------+------+------+------+------+------+------+
     | B_72 | B_71 | B_70 | B_69 | B_68 | B_67 | B_66 | B_65 |
     +------+------+------+------+------+------+------+------+
     | B_80 | B_79 | B_78 | B_77 | B_76 | B_75 | B_74 | B_73 |
     +------+------+------+------+------+------+------+------+
     | CODA | CODB | CODC | RSV0 | RSV0 | RSV0 | RSV0 | B_81 |
     +------+------+------+------+------+------+------+------+
```

Figure 3: Packed MELPe 1200 bps Payload Octets

3.1.3. 600 bps Bitstream Structure

The 600 bps MELPe RTP payload is constructed as per Figure 4. Note CODA must be filled with 0 and CODB SHOULD be filled with 1 as per Section 3.1. CODB MAY contain an end-to-end framing bit if required by the endpoints.

```
        MSB                                               LSB
         0      1      2      3      4      5      6      7
     +------+------+------+------+------+------+------+------+
     | B_08 | B_07 | B_06 | B_05 | B_04 | B_03 | B_02 | B_01 |
     +------+------+------+------+------+------+------+------+
     | B_16 | B_15 | B_14 | B_13 | B_12 | B_11 | B_10 | B_09 |
     +------+------+------+------+------+------+------+------+
     | B_24 | B_23 | B_22 | B_21 | B_20 | B_19 | B_18 | B_17 |
     +------+------+------+------+------+------+------+------+
```

```
        | B_32 | B_31 | B_30 | B_29 | B_28 | B_27 | B_26 | B_25 |
        +------+------+------+------+------+------+------+------+
        | B_40 | B_39 | B_38 | B_37 | B_36 | B_35 | B_34 | B_33 |
        +------+------+------+------+------+------+------+------+
        | B_48 | B_47 | B_46 | B_45 | B_44 | B_43 | B_42 | B_41 |
        +------+------+------+------+------+------+------+------+
        | CODA | CODB | B_54 | B_53 | B_52 | B_51 | B_50 | B_49 |
        +------+------+------+------+------+------+------+------+
```

Figure 4: Packed MELPe 600 bps Payload Octets

3.1.4. Comfort Noise Bitstream Definition

The comfort noise MELPe RTP payload is constructed as per Figure 5. Note that CODA, CODB, and CODC MUST be filled with 1, 0, and 1 respectively as per Section 3.1.

```
           MSB                                                 LSB
            0      1      2      3      4      5      6      7
        +------+------+------+------+------+------+------+------+
        | B_08 | B_07 | B_06 | B_05 | B_04 | B_03 | B_02 | B_01 |
        +------+------+------+------+------+------+------+------+
        | CODA | CODB | CODC | B_13 | B_12 | B_11 | B_10 | B_09 |
        +------+------+------+------+------+------+------+------+
```

Figure 5: Packed MELPe Comfort Noise Payload Octets

3.2. TSVCIS Bitstream Definition

The TSVCIS augmented speech data as packed parameters MUST be placed immediately after a corresponding MELPe 2400 bps payload. The packed parameters are counted in octets (TC). In the preferred placement, shown in Figure 6, a single trailing octet SHALL be appended to include a two-bit rate code, CODA and CODB, (both bits set to one) and a six-bit modified count (MTC). The special modified count value of all ones (representing a MTC value of 63) SHALL NOT be used for this format as it is used as the indicator for the alternate packing format shown next. In a standard implementation, the TSVCIS speech coder uses a minimum of 15 octets for parameters in octet packed form. The modified count (MTC) MUST be reduced by 15 from the full octet count (TC). Computed MTC = TC-15. This accommodates a maximum of 77 parameter octets (maximum value of MTC is 62, 77 is the sum of 62+15).

```
           MSB                                                 LSB
            0      1      2      3      4      5      6      7
        +------+------+------+------+------+------+------+------+
     1  | T008 | T007 | T006 | T005 | T004 | T003 | T002 | T001 |
```

```
        +------+------+------+------+------+------+------+------+
     2  | T016 | T015 | T014 | T013 | T012 | T011 | T010 | T009 |
        +------+------+------+------+------+------+------+------+
     3  | T024 | T023 | T022 | T021 | T020 | T019 | T018 | T017 |
        +------+------+------+------+------+------+------+------+
     4  | T032 | T031 | T030 | T029 | T028 | T027 | T026 | T025 |
        +------+------+------+------+------+------+------+------+
     5  | T040 | T039 | T038 | T037 | T036 | T035 | T034 | T033 |
        +------+------+------+------+------+------+------+------+
     6  | T048 | T047 | T046 | T045 | T044 | T043 | T042 | T041 |
        +------+------+------+------+------+------+------+------+
     7  | TO56 | TO55 | T054 | T053 | T052 | T051 | T050 | T049 |
        +------+------+------+------+------+------+------+------+
     8  | T064 | T063 | T062 | T061 | T060 | T059 | T058 | T057 |
        +------+------+------+------+------+------+------+------+
     9  | T072 | T071 | T070 | T069 | T068 | T067 | T066 | T065 |
        +------+------+------+------+------+------+------+------+
    10  | T080 | T079 | T078 | T077 | T076 | T075 | T074 | T073 |
        +------+------+------+------+------+------+------+------+
    11  | T088 | T087 | T086 | T085 | T084 | T083 | T082 | T081 |
        +------+------+------+------+------+------+------+------+
    12  | TO96 | TO95 | T094 | T093 | T092 | T091 | T090 | T089 |
        +------+------+------+------+------+------+------+------+
    13  | T104 | T103 | T102 | T101 | T100 | T099 | T098 | T097 |
        +------+------+------+------+------+------+------+------+
    14  | T112 | T111 | T110 | T109 | T108 | T107 | T106 | T105 |
        +------+------+------+------+------+------+------+------+
    15  | T120 | T119 | T118 | T117 | T116 | T115 | T114 | T113 |
        +------+------+------+------+------+------+------+------+
        |                      .  .  .  .                       |
        +------+------+------+------+------+------+------+------+
   TC+1 | CODA | CODB |          modified octet count           |
        +------+------+------+------+------+------+------+------+
```

Figure 6: Preferred Packed TSVCIS Payload Octets

In order to accommodate all other NRL VDR configurations for TSVCIS, an alternate parameter placement MUST use two trailing bytes as shown in Figure 7. The last trailing byte MUST be filled with a two-bit rate code, CODA and CODB, (both bits set to one) and its six-bit count field MUST be filled with ones. The second to last trailing byte MUST contain the parameter count (TC) in octets and MAY represent any value from one to 255. The value of zero SHALL be considered as reserved.

```
          MSB                                              LSB
           0      1      2      3      4      5      6      7
        +------+------+------+------+------+------+------+------+
```

```
  1  | T008 | T007 | T006 | T005 | T004 | T003 | T002 | T001 |
     +------+------+------+------+------+------+------+------+
  2  | T016 | T015 | T014 | T013 | T012 | T011 | T010 | T009 |
     +------+------+------+------+------+------+------+------+
     |                      .  .  .  .                       |
     +------+------+------+------+------+------+------+------+
TC+1 |                      octet count                      |
     +------+------+------+------+------+------+------+------+
TC+2 | CODA | CODB |   1  |   1  |   1  |   1  |   1  |   1  |
     +------+------+------+------+------+------+------+------+
```

Figure 7: Length Unrestricted Packed TSVCIS Payload Octets

3.3. Multiple TSVCIS Frames in an RTP Packet

A TSVCIS RTP packet MAY consist of zero or more TSVCIS coder frames (each consisting of MELPe and TSVCIS coder data) followed by zero or one MELPe comfort noise frame. The presence of a comfort noise frame can be determined by its rate code bits in its last octet.

The default packetization interval is one coder frame (22.5, 67.5, or 90 ms) according to the coder bitrate (2400, 1200, or 600 bps). For some applications, a longer packetization interval is used to reduce the packet rate.

A TSVCIS RTP packet comprised of no coder frame and no comfort noise frame MAY be used periodically by an endpoint to indicate connectivity by an otherwise idle receiver.

TSVCIS coder frames in a single RTP packet MAY be of different coder bitrates. With the exception for the variable length TSVCIS parameter frames, the coder rate bits in the trailing byte identify the contents and length as per Table 1.

It is important to observe that senders have the following additional restrictions:

Senders SHOULD NOT include more TSVCIS or MELPe frames in a single RTP packet than will fit in the MTU of the RTP transport protocol.

Frames MUST NOT be split between RTP packets.

It is RECOMMENDED that the number of frames contained within an RTP packet be consistent with the application. For example, in telephony and other real-time applications where delay is important, then the fewer frames per packet the lower the delay, whereas for bandwidth-constrained links or delay-insensitive streaming messaging applications, more than one frame per packet or many frames per

packet would be acceptable.

Information describing the number of frames contained in an RTP packet is not transmitted as part of the RTP payload. The way to determine the number of TSVCIS/MELPe frames is to identify each frame type and length thereby counting the total number of octets within the RTP packet.

3.4. Congestion Control Considerations

The target bitrate of TSVCIS can be adjusted at any point in time, thus allowing congestion management. Furthermore, the amount of encoded speech or audio data encoded in a single packet can be used for congestion control, since the packet rate is inversely proportional to the packet duration. A lower packet transmission rate reduces the amount of header overhead but at the same time increases latency and loss sensitivity, so it ought to be used with care.

Since UDP does not provide congestion control, applications that use RTP over UDP SHOULD implement their own congestion control above the UDP layer [RFC8085] and MAY also implement a transport circuit breaker [RFC8083]. Work in the RMCAT working group [RMCAT] describes the interactions and conceptual interfaces necessary between the application components that relate to congestion control, including the RTP layer, the higher-level media codec control layer, and the lower-level transport interface, as well as components dedicated to congestion control functions.

4. Payload Format Parameters

This RTP payload format is identified using the TSVCIS media subtype, which is registered in accordance with RFC 4855 [RFC4855] and per the media type registration template from RFC 6838 [RFC6838].

4.1. Media Type Definitions

Type name: audio

Subtype names: TSVCIS

Required parameters: N/A

Optional parameters:

ptime: the recommended length of time (in milliseconds) represented by the media in a packet. It SHALL use the nearest rounded-up ms integer packet duration. For TSVCIS, this

corresponds to the following values: 23, 45, 68, 90, 112, 135, 156, and 180. Larger values can be used as long as they are properly rounded. See Section 6 of RFC 4566 [RFC4566].

maxptime: the maximum length of time (in milliseconds) that can be encapsulated in a packet. It SHALL use the nearest rounded-up ms integer packet duration. For TSVCIS, this corresponds to the following values: 23, 45, 68, 90, 112, 135, 156, and 180. Larger values can be used as long as they are properly rounded. See Section 6 of RFC 4566 [RFC4566].

bitrate: specifies the MELPe coder bitrates supported. Possible values are a comma-separated list of rates from the following set: 2400, 1200, 600. The modes are listed in order of preference; first is preferred. If "bitrate" is not present, the fixed coder bitrate of 2400 MUST be used.

tcmax: specifies the TSVCIS maximum value for TC supported or desired ranging from 1 to 255. If "tcmax" is not present, a default value of TBD is used.

[EDITOR NOTE - the value for TBD is to be discussed and stated. A value of 35 is suggested.]

Encoding considerations: This media subtype is framed and binary; see Section 4.8 of RFC 6838 [RFC6838].

Security considerations: Please see Section 8 of RFCxxxx (this RFC).

Interoperability considerations: N/A

Published specification: N/A

Applications that use this media type: N/A

Additional information: N/A

Deprecated alias names for this type: N/A

Magic number(s): N/A

File extension(s): N/A

Macintosh file type code(s): N/A

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Intended usage: COMMON

Restrictions on usage: The media subtype depends on RTP framing and hence is only defined for transfer via RTP [RFC3550]. Transport within other framing protocols is not defined at this time.

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Change controller: IETF Payload working group delegated from the IESG.

Provisional registration? (standards tree only): No

4.2. Mapping to SDP

The mapping of the above-defined payload format media subtype and its parameters SHALL be done according to Section 3 of RFC 4855 [RFC4855].

The information carried in the media type specification has a specific mapping to fields in the Session Description Protocol (SDP) [RFC4566], which is commonly used to describe RTP sessions. When SDP is used to specify sessions employing the TSVCIS codec, the mapping is as follows:

- o The media type ("audio") goes in SDP "m=" as the media name.

- o The media subtype (payload format name) goes in SDP "a=rtpmap" as the encoding name.

- o The parameter "bitrate" goes in the SDP "a=fmtp" attribute by copying it as a "bitrate=<value>" string.

- o The parameter "tcmax" goes in the SDP "a=fmtp" attribute by copying it as a "tcmax=<value>" string.

- o The parameters "ptime" and "maxptime" go in the SDP "a=ptime" and "a=maxptime" attributes, respectively.

When conveying information via SDP, the encoding name SHALL be "TSVCIS" (the same as the media subtype).

An example of the media representation in SDP for describing TSVCIS might be:

```
m=audio 49120 RTP/AVP 96
a=rtpmap:96 TSVCIS/8000
```

The optional media type parameter "bitrate", when present, MUST be included in the "a=fmtp" attribute in the SDP, expressed as a media type string in the form of a semicolon-separated list of parameter=value pairs. The string "value" can be one or more of 2400, 1200, and 600, separated by commas (where each bitrate value indicates the corresponding MELPe coder). An example of the media representation in SDP for describing TSVCIS when all three coder bitrates are supported might be:

```
m=audio 49120 RTP/AVP 96
a=rtpmap:96 TSVCIS/8000
a=fmtp:96 bitrate=2400,600,1200
```

The optional media type parameter "tcmax", when present, MUST be included in the "a=fmtp" attribute in the SDP, expressed as a media type string in the form of a semicolon-separated list of parameter=value pairs. The string "value" is an integer number in the range of 1 to 255 representing the maximum number of TSVCIS parameter octets supported. An example of the media representation in SDP for describing TSVCIS with a maximum of 101 octets supported is as follows:

```
m=audio 49120 RTP/AVP 96
a=rtpmap:96 TSVCIS/8000
a=fmtp:96 tcmax=101
```

Parameter "ptime" cannot be used for the purpose of specifying the TSVCIS operating mode, due to the fact that for certain values it will be impossible to distinguish which mode is about to be used (e.g., when ptime=68, it would be impossible to distinguish if the packet is carrying one frame of 67.5 ms or three frames of 22.5 ms).

Note that the payload format (encoding) names are commonly shown in upper case. Media subtypes are commonly shown in lower case. These names are case insensitive in both places. Similarly, parameter names are case insensitive in both the media subtype name and the default mapping to the SDP a=fmtp attribute.

4.3. Declarative SDP Considerations

For declarative media, the "bitrate" parameter specifies the possible bitrates used by the sender. Multiple TSVCIS rtpmap values (such as

97, 98, and 99, as used below) MAY be used to convey TSVCIS-coded voice at different bitrates. The receiver can then select an appropriate TSVCIS codec by using 97, 98, or 99.

```
m=audio 49120 RTP/AVP 97 98 99
a=rtpmap:97 TSVCIS/8000
a=fmtp:97 bitrate=2400
a=rtpmap:98 TSVCIS/8000
a=fmtp:98 bitrate=1200
a=rtpmap:99 TSVCIS/8000
a=fmtp:99 bitrate=600
```

For declarative media, the "tcmax" parameter specifies the maximum number of TSVCIS packed parameter octets used by the sender or the sender's communications channel.

4.4. Offer/Answer SDP Considerations

In the Offer/Answer model [RFC3264], "bitrate" is a bidirectional parameter. Both sides MUST use a common "bitrate" value or values. The offer contains the bitrates supported by the offerer, listed in its preferred order. The answerer MAY agree to any bitrate by listing the bitrate first in the answerer response. Additionally, the answerer MAY indicate any secondary bitrate or bitrates that it supports. The initial bitrate used by both parties SHALL be the first bitrate specified in the answerer response.

For example, if offerer bitrates are "2400,600" and answer bitrates are "600,2400", the initial bitrate is 600. If other bitrates are provided by the answerer, any common bitrate between the offer and answer MAY be used at any time in the future. Activation of these other common bitrates is beyond the scope of this document.

The use of a lower bitrate is often important for a case such as when one endpoint utilizes a bandwidth-constrained link (e.g., 1200 bps radio link or slower), where only the lower coder bitrate will work.

In the Offer/Answer model [RFC3264], "tcmax" is a bidirectional parameter. Both sides SHOULD use a common "tcmax" value. The offer contains the tcmax supported by the offerer. The answerer MAY agree to any tcmax equal or less than this value by stating the desired tcmax in the answerer response. The answerer alternatively MAY identify its own tcmax and rely on TSVCIS ignoring any augmented data it cannot use.

5. Discontinuous Transmissions

A primary application of TSVCIS is for radio communications of voice

conversations, and discontinuous transmissions are normal. When TSVCIS is used in an IP network, TSVCIS RTP packet transmissions may cease and resume frequently. RTP synchronization source (SSRC) sequence number gaps indicate lost packets to be filled by PLC, while abrupt loss of RTP packets indicates intended discontinuous transmissions.

If a TSVCIS coder so desires, it may send a MELPe comfort noise frame as per Appendix B of [SCIP210] prior to ceasing transmission. A receiver may optionally use comfort noise during its silence periods. No SDP negotiations are required.

6. Packet Loss Concealment

TSVCIS packet loss concealment (PLC) uses the special properties and coding for the pitch/voicing parameter of the MELPe 2400 bps coder. The PLC erasure indication utilizes any of the errored encodings of a non-voiced frame as identified in Table 1 of [MELPE]. For the sake of simplicity, it is preferred that a code value of 3 for the pitch/voicing parameter be used. Hence, set bits P0 and P1 to one and bits P2, P3, P4, P5, and P6 to zero.

When using PLC in 1200 bps or 600 bps mode, the MELPe 2400 bps decoder is called three or four times, respectively, to cover the loss of a low bitrate MELPe frame.

7. IANA Considerations

This memo requests that IANA registers TSVCIS as specified in Section 4.1. The media type is also requested to be added to the IANA registry for "RTP Payload Format MIME types" (http://www.iana.org/assignments/rtp-parameters).

8. Security Considerations

RTP packets using the payload format defined in this specification are subject to the security considerations discussed in the RTP specification [RFC3550] and in any applicable RTP profile such as RTP/AVP [RFC3551], RTP/AVPF [RFC4585], RTP/SAVP [RFC3711], or RTP/SAVPF [RFC5124]. However, as discussed in [RFC7202], it is not an RTP payload format's responsibility to discuss or mandate what solutions are used to meet such basic security goals as confidentiality, integrity, and source authenticity for RTP in general. This responsibility lies with anyone using RTP in an application. They can find guidance on available security mechanisms and important considerations in [RFC7201]. Applications SHOULD use one or more appropriate strong security mechanisms. The rest of this section discusses the security-impacting properties of the payload

format itself.

This RTP payload format and the TSVCIS decoder do not exhibit any significant non-uniformity in the receiver-side computational complexity for packet processing and thus are unlikely to pose a denial-of-service threat due to the receipt of pathological data. Additionally, the RTP payload format does not contain any active content.

Please see the security considerations discussed in [RFC6562] regarding VAD and its effect on bitrates.

9. RFC Editor Considerations

Note to RFC Editor: This section may be removed after carrying out all the instructions of this section.

10. References

10.1. Normative References

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