Conventions for the use of the Session Description Protocol (SDP) for Digital Circuit Connections

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Abstract

This document describes conventions for using the Session Description Protocol (SDP) for controlling digital circuits. These conventions describe:
- circuit addressing conventions for use on the SDP "c=" line
- content of the "m=" line(s) for digital circuits
- attributes to convey the parameters contained within the Bearer Capability, Low Layer Compatibility, and High Layer Compatibility Information Elements of ITU-T Recommendation Q.931.

These conventions have been defined for use in media gateway control, particularly in support of NAS operation, but may also be used by IP-based call signalling schemes (SIP, BICC) to control media exchange over digital circuits.

1. Introduction

The scope of SDP control is being extended to a variety of bearer types, particularly to serve the needs of media gateway control protocols such as Megaco/H.248 [2] and MGCP [3], but also those of the bearer-related portions of call signalling over the internet as represented by SIP [4] and BICC [5]. Control of ATM bearers was documented in [6]. This document uses [6] as a model for a rather
simpler case, the control of 64 kbit/s digital circuits. These circuits may carry voice, video or multiplexed multimedia, voiceband data (fax relay, modem relay), or baseband data (PPP, frame relay etc.).

The conventions in this document may be applied in three possible situations:

(1) For media gateway control at the boundary between an ISDN access network and another bearer network. In this case, SDP must capture bearer characteristics conveyed in the Q.931 call signalling protocol [7].

(2) For media gateway control at the boundary between an ISDN core network and another bearer network. In this case, SDP must capture bearer characteristics conveyed in the SS7 ISUP call signalling protocol [8]. Since a mapping has been defined between ISUP and Q.931 [9], the SDP conventions required will be in large part the same as in the first case.

(3) For control of TDM circuits across a network using SIP or BICC [5]. This is a potential future application, included here for logical completeness, since neither SIP nor BICC is currently being designed with TDM circuit networks in mind.

1.1 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 RFC 2119 [10].

"TDM" stands for "Time Division Multiplex" digital transmission.

In this document, the term "TDM circuit" is used to mean a 64 kbit/s TDM channel.

1.2 Scope

This document provides the means to describe media flows in TDM circuits. Although it will be of use in the general categories of applications described in the introduction, it is specifically aimed at satisfying the requirements of the Megaco/H.248 media gateway control protocol including the voice, voice-band data (and NAS operation in particular), and multimedia conferencing (H.320 and H.324i) applications.

This document provides conventions for:
- use of the SDP "b=" line to convey the TDM circuit information transfer rate
- addressing of TDM circuits on the SDP "c=" line
- the transport types TDM, PKT/TDM, and FRM/TDM
- a description of the content carried by the TDM circuit on the SDP "m=" line
- attributes to convey the content of the Q.931 Low Layer and High Layer Compatibility Information Elements.

The present issue of this document excludes the following:
1. Mapping of Layer 2 and Layer 3 protocol parameters (e.g. for X.25, frame relay) into SDP attributes. It is assumed that such mappings will be defined in separate protocol-specific documents if they are required.

2. Bearer capability negotiation. Q.931 and ISUP support the inclusion of multiple Bearer Capability Information Elements for negotiation. This document supports transfer of only one set of bearer capability information per session description.

3. Support of multi-rate (N x 64 kbit/s) service.

This document conforms to the syntactic conventions of SDP as defined in [1].

1.3 Why Are TDM-Circuit-Specific Conventions Needed?

SDP was originally designed for the description of media sessions carried over IP packets, typically using RTP [11] encapsulation and UDP transport. In contrast, description of media transport over TDM circuits must begin at a much lower level, with the basic organization of the bits across the 64 kbit/s channel. Moreover, the higher-layer organization of the content is typically negotiated "in-band", through protocols such as V.8bis or V.140. This forces a re-interpretation of the contents of the SDP "m=" line in particular, and the creation of a number of additional attributes to describe the lower layers of transport.

Addressing of TDM circuits is also different, and for media gateway control is actually irrelevant, since the information is conveyed by other means (terminationIDs in Megaco/H.248, and endpoint identifiers in MGCP). This affects the SDP "c=" line and makes redundant the port identification on the "m=" line.

The other lines of the SDP session description can generally be used without modification from their use as described in [1], with the following notes:

1. If the "b=" line is present, it MUST indicate a bandwidth of 64 (kbit/s). The modifier used is "AS". The effective user rate, if less than this, is indicated by an attribute within the media description.

2. The "k=" line MAY be present. There are probably consistency conditions on the media format value in this case.

1.4 Changes From The Previous Version

The main change from the previous version has been to limit the scope of the present document by placing greater reliance on the Megaco/H.248 multiplex concept. This has meant the removal of wideband or aggregated N x 64 kbit/s service from the scope of the document, and the reduction of H.320 and H.324 sessions to application/octet-stream media flows from the point of view of TDM transport. (Separate documents define SDP conventions for the H221, H223, and H226 transport types.)

MIME subtype registrations for audio/PCMU, audio/PCMA, audio/G721, and application/octet-stream over TDM have been added in the appendices.

2. "c=" Line For TDM circuits

The connection field ("c=" line) is structured as follows [1]:

```
connection-field = "c=" nettype space addrtype space
                  connection-address CRLF
```

This document reserves a nettype value of "TDM" for TDM circuits.

The present issue of this document proposes two naming schemes for TDM circuits: the NUL scheme (addrtype is "NUL") and the group-and-member scheme (addrtype is "GRP"). Future issues of this document may specify other schemes.

The NUL scheme is suitable for use with media gateway control, since other means are available (as mentioned above) for designating the TDM circuit. The NUL connection-address MUST be present, but may be any string satisfying the syntactical requirements of [1], for example, "x". The receiver MUST ignore the connection-address when addrtype is NUL.

The GRP scheme designates a logical or physical grouping of circuits within which individual 64 kbit/s channels may be identified by integer values. The GRP connection-address consists of two parts. The first part identifies the logical or physical group, while the second identifies the individual circuit within the group.

```
grp-connection-address = group-part "/" member-part
```

```
group-part = non-ws-string ; as defined in [1]
member-part = non-ws-string ; as defined in [1]
```

3. "m=" Line For TDM Circuits

[1] defines the syntax of the media field ("m=" line) as follows:

```
media-field = "m=" media space port ["/" integer]
              space proto 1*(space fmt) CRLF
```

3.1 Specification of Medium and Format

In accordance with [1], the media token must be a MIME type and the fmt token must reference a MIME subtype. Since existing MIME type registration is for packet transport, it will be necessary to add or
extend registrations to include TDM transport. Where possible, the extension route is preferable.

Based on RFC 2046 [13] and a review of the various fields of the Bearer Capability Information Element, the two possible settings for the media token appear to be "audio" and "application". The available range of subtypes is more problematic.

We begin the discussion with "audio". RFC 2046 defines one audio subtype: "basic". This denotes G.711 mu-law PCM. This would be quite acceptable to match the Q.931 User Information Layer 1 protocol codepoint "Recommendation G.711 mu-law", but leaves "Recommendation G.711 A-law" out in the cold. Very fortunately, the AVT Working Group has created a new document [14] to register RTP payload types as MIME subtypes. Two of these subtypes are audio/PCMA and audio/PCMU, corresponding to A-law and Mu-law companding respectively. The Q.931 codepoint "Recommendation G.721 [11] 32 kbit/s ADPCM and Recommendation I.460" is actually for G.726, which is covered in [14] by the audio/G726-16, audio/G726-24, audio/G726-32, and audio/G726-40 MIME subtypes.

The Q.931 codepoints "Recommendations H.221 and H.242" and "Recommendations H.223 and H.245" refer to the use of H.320 and H.324I multimedia conferencing, respectively. In the Megaco/H.248 model, the TDM circuits carrying these sessions feed into terminations representing the respective multiplexes. It is the responsibility of the multiplexes to manage the audio, video, data, and control flows. The SDP for this purpose is documented separately, on the premise that each multiplex represents another transport type. From the TDM point of view, the flows are undifferentiated, so the MIME subtype application/octet-stream is appropriate.

"application/octet-stream" is probably adequate to cover the other possibilities provided for in Q.931.

In summary, the possible medium/format combinations for TDM transport are:
- audio/pcm
- audio/pcm
- audio/g726-16, 24, 32, 40
- application/octet-stream

The MIME registrations for all of these must be updated to note the possibility of transport over TDM. This is done in the appendices to the present document.

If the nature of the medium (typically "audio") is known, it should be specified accordingly. Otherwise, medium and format are derived from the Transmission Mode, Information Transfer Capability, and User Information Layer 1 Protocol of the bearer, as follows:

1. Set media = "application" if Transmission Mode is not "circuit", or if Information Transfer Capability is "unrestricted digital information" or "restricted digital information".

2. If Transmission Mode is "circuit" and Information Transfer
Capability is "Speech" or "3.1 kHz audio", set media = "audio".

3. If Transmission Mode is "circuit" and Information Transfer Capability is "Unrestricted digital information with tones and announcements", set media = "audio" while the call is being set up, then set it to "application".

4. If Transmission Mode is "circuit" and Information Transfer Capability is "Video", set media = "application". "Application" is more appropriate than "video" as a MIME type because the bit stream carries more than just video and an application tool is required to interpret it.

3.2 Specification of Port

Port number is inapplicable to TDM circuits, but must be specified to satisfy SDP syntax. Where the present specification is being used in circumstances in which the offer-answer model [15] applies, setting port = 0 indicates rejection of a media stream. It is therefore RECOMMENDED that the sender set port = 1 except when it is being used in this way. The receiver must ignore non-zero port values, and must ignore zero values unless the application is one to which the offer-answer model applies. Megaco/H.248 in particular does not conform to the offer-answer model, and port is therefore irrelevant.

3.3 Specification of Protocol

Q.931 and Q.939 distinguish between protocol information which the network sees and may modify (in the Bearer Capability Information Element) and protocol information which is available only between endpoints (in the Low Layer Compatibility Information Element).

Depending on endpoint intentions, any of the protocol information at layers 1, 2, or 3 may appear in either place. The only information which is guaranteed to be visible to the network is the transfer mode (circuit, packet, or frame mode). It is therefore proposed that the transport profile on the "m=" line indicate the transfer mode, but that additional protocol information be indicated on attribute lines within the media description. This document accordingly defines three transport profiles:

. "TDM" denotes circuit mode (octet-oriented) transport over a TDM circuit.

. "PKT/TDM" denotes packet mode transport over a TDM circuit

. "FRM/TDM" denotes frame mode transport over a TDM circuit.

The audio MIME type applies only to TDM transport. The application/octet-string MIME type may be carried by any of the three transports.

4. Attributes For TDM circuits

4.1 Audio Transfer Capability
When present, attribute "spchonly" indicates that an audio connection is suitable only for speech (Q.931 Information Transfer Capability = speech) and not for modem or FAX signals.

4.2 Bandwidth Restriction

a=56kmax

When present, this attribute indicates that the transfer rate for user data is limited to 56 kbit/s per channel. ITU-T Recommendation I.464 gives further details of operation under these circumstances.

4.3 Protocol Profile

The protocol profile attribute is required to distinguish payloads characterized by the application/octet-string MIME type.

As mentioned above, Q.931 provides two places for user protocols to be specified: in Bearer Capability, where they are subject to inspection and modification by network equipment such as gateways or proxies, and in Low Layer Compatibility, where they are placed for the information of the remote peer. Rules for the choice of placement are given in Recommendation Q.939.

The present document assumes that if a protocol is exposed to the network, all parameters describing that protocol are also exposed. Thus it is unnecessary to provide segregated versions of the various protocol parameters, only of the protocol stacks themselves.

a=netprof:<profile>
a=e2eprof:<profile>

Attribute "netprof" lists the protocols which the sender is prepared to expose to network inspection. Attribute "e2eprof" lists those which are intended for remote peer use only. Attribute "netprof" SHOULD be present if media = "application" on the "m=" line, even if it is empty.

<profile> consists of up to three protocol designators, one per layer, separated by "/". The protocols are ordered from highest to lowest. Missing layers are omitted, along with their separators. For any given layer:
- no protocol is specified in either "netprof" or "e2eprof", or
- some protocol is specified in "netprof", or
- some protocol is specified in "e2eprof".

Protocol parameters for protocols listed in "e2eprof" SHOULD be transmitted by network entities without modification.

Examples:

a=netprof:Q922A
frame relay

a=e2eprof:X25P/X25L/V110
X.25 packet layer over X.25 link layer over V.110 rate adaption
(circuit mode operation with user rate less than 64 kbit/s).

a=e2eprof:PPP
layers 1 and 2 are specified in "netprof" or not needed (e.g.
because framing is auto-sensed).

4.4.1 Layer 1 Protocols

The following table contains the Layer 1 protocols defined in this
document. They correspond to the non-audio codepoints for the User
information layer 1 protocol given in Q.931.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>V110</td>
<td>ITU-T standardized rate adaption V.110, I.460 and X.30. Requires TDM transport.</td>
</tr>
<tr>
<td>V120</td>
<td>ITU-T standardized rate adaption V.120. Requires TDM transport.</td>
</tr>
<tr>
<td>X31</td>
<td>ITU-T standardized rate adaption X.31 HDLC flag stuffing. Requires PKT/TDM (packet-mode) transport.</td>
</tr>
<tr>
<td>H221</td>
<td>An H.320 session using the H.221 multiplex. Requires TDM transport.</td>
</tr>
<tr>
<td>H223</td>
<td>An H.324/I session using the H.223 multiplex [Note 1]. Requires TDM transport.</td>
</tr>
</tbody>
</table>

Note 1: The H223 codepoint is not intended to preclude the use of an H.226 multiplex for multilink operation in accordance with H.324 Annex F.

4.4.2 Layer 2 Protocols

The Layer 2 codepoints defined in Q.931 and Q.933 are shown in the table below. The Layer 2 protocol MUST be specified in attribute "netprof" if either PKT/TDM (packet mode) or FRM/TDM (frame mode) transport is being used.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q921</td>
<td>Recommendation Q.921/I.441 (typically used for D-channel data).</td>
</tr>
<tr>
<td>X25L</td>
<td>Recommendation X.25, link layer.</td>
</tr>
<tr>
<td>ISO8802</td>
<td>LAN logical link control (ISO/IEC 8802-2) Requires TDM transport.</td>
</tr>
</tbody>
</table>
Q922  Recommendation Q.922 (frame switching). Layer 1 must be unspecified. Requires FRM/TDM (frame mode) transport.

Q922A Core aspects of frame mode (Annex A/Q.922) (frame relay). Layer 1 must be unspecified. Requires FRM/TDM (frame mode) transport.

ISO1745 Basic mode (ISO/IEC 1745)


T71 Extended LAPB; for half duplex operation (Recommendation T.71)

HDLC-ARM HDLC ARM (ISO/IEC 4335).

HDLC-NRM HDLC NRM (ISO/IEC 4335).

T70MIN Recommendation T.70 minimum network layer

4.4.3 Layer 3 Protocols

The Layer 3 codepoints defined in Q.931 are shown in the table below.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q931</td>
<td>Recommendation Q.931 (i.e. call signalling).</td>
</tr>
<tr>
<td>X25P</td>
<td>Recommendation X.25, packet layer.</td>
</tr>
<tr>
<td>IP</td>
<td>Internet Protocol (RFC 791) Requires TDM transport.</td>
</tr>
<tr>
<td>PPP</td>
<td>Point to Point Protocol (RFC 1598, RFC 1618, or RFC 1973, depending on lower layer). Requires TDM transport.</td>
</tr>
<tr>
<td>X25PLP</td>
<td>ISO/IEC 8208 [41] (X.25 packet level protocol for data terminal equipment)</td>
</tr>
<tr>
<td>ISO8878</td>
<td>ITU-T Rec. X.223 and ISO/IEC 8878 (use of ISO/IEC 8208 and Recommendation X.25 to provide the OSI-CONS)</td>
</tr>
<tr>
<td>ISO8473</td>
<td>ISO/IEC 8473 (OSI connectionless mode protocol)</td>
</tr>
<tr>
<td>T70MIN</td>
<td>Recommendation T.70 minimum network layer</td>
</tr>
</tbody>
</table>

4.5 User Rate
a=userbw:<bits>

<bits> is the user data rate in bits per second per 64 kbit/s channel within the TDM circuit. This attribute is useful in cases where the user rate information is not passed end-to-end through in-band signalling and negotiation.

4.6 In-Band Negotiation

a=ibneg

This attribute if present indicates that in-band negotiation is supported by the V.110, X.30, I.460 or modem layer 1 protocol.

4.7 V.110/X.30/I.460 Protocol Parameters

a=v110parms:<parms>

<parms> consists of a comma-separated list of parameters. The only required parameter is the intermediate rate for rate adaptation, which has the form:

"intrat="<kbits>

<kbits> is the intermediate rate in kbit/s, and has the possible values 8, 16, 32, or "NONE".

The remaining parameters are keyword values, as follows:

"sendNIC" indicates by its presence that network-independent clocking will be sent with the outgoing media stream.

"sendFC" indicates that flow control will be sent with the outgoing media stream.

"recvNIC" indicates that network-independent clocking may be present in the incoming media stream.

"recvFC" indicates that flow control may be present in the incoming media stream.

Note that the directionality convention used here is entity-relative, whereas the directionality convention in Q.931 is call-relative. The two conventions coincide at the end of the TDM circuit closer to the calling party, but are opposed at the end closer to the called party. The convention in this document is the more suitable for media gateway control, since the media gateway is unaware of call direction.

4.8 V.120 Protocol Parameters

a=v120parms:<parms>

<parms> consists of a comma-separated list of parameters, as follows. These parameters are required unless otherwise indicated.
"mode"=<mode>
Indicates whether rate adaptation mode is bit-transparent
(<mode> = "transp") or protocol-sensitive (<mode> = "protdep").

"llineg"=<negotiation>
Indicates whether and how Logical Link Identifier (LLI)
negotiation is done. <negotiation> has the possible values
"NONE" (default) if LLI = 256 is the only value supported, "OB"
if negotiation is possible over a temporary signalling channel,
or "IB" if negotiation is done on LLI 0.

"hdr"
Optional keyword parameter. If present, indicates that the
rate adaption header is included.

"multifrm"
Optional keyword parameter. If present, indicates that
multiframe establishment is supported.

"assgn"
Optional keyword parameter. If present, indicates that the
message originator is "Assignor only". If absent, message
originator is "Default assignee".

4.9 Asynchronous Parameters

a=asynch:stop=<sbits>,data=<dbits>,parity=<par>,duplex=<dlx>

If present, indicates asynchronous data transport.

4.10 Modem

a=modem:<modem>

If present, indicates data transport via modem. <modem> indicates
the type of modem used. It may have values "V34" or "V90". Other
values may be added in subsequent issues of this document if
required. Requires TDM transport and medium specified as audio/PCMU
or audio/PCMA.

Security Considerations

This document deals with the signalling of information to direct the
transfer of user information across TDM circuits. Threats to
security may be identified both at the signalling level and at the
media transport level. See [1] for a discussion of security issues
at the signalling level.

Media transport is in general subject to threats to integrity and
confidentiality. (Injection of spurious media into an ongoing
session is classed here as a breach of integrity. Passing of
spurious media outside of an established session is considered to be
a signalling problem.) These threats are sharply reduced for TDM as
opposed to IP bearer transport. However, the user is not normally
aware of what sort of transport is in use on an end-to-end basis,
and the media flow may well pass from one network to another. Where
integrity or confidentiality are a concern, end-to-end encryption of the media stream should be considered.

References


14. S. Casner, P.Hoschka, "MIME Type Registration of RTP Payload Type Formats", IETF work in progress.

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