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Conventions for the use of the Session Description Protocol (SDP) for ATM Bearer Connections

Status of this Memo

This document specifies an Internet standards track protocol for the Internet community, and requests discussion and suggestions for improvements. Please refer to the current edition of the "Internet Official Protocol Standards" (STD 1) for the standardization state and status of this protocol. Distribution of this memo is unlimited.

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Abstract

This document describes conventions for using the Session Description Protocol (SDP) described in RFC 2327 for controlling ATM Bearer Connections, and any associated ATM Adaptation Layer (AAL). The AALs addressed are Type 1, Type 2 and Type 5. This list of conventions is meant to be exhaustive. Individual applications can use subsets of these conventions. Further, these conventions are meant to comply strictly with the SDP syntax as defined in RFC 2327.

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1. Introduction

SDP will be used in conjunction with a connection handling /device control protocol such as Megaco (H.248) [26], SIP [18] or MGCP [25] to communicate the information needed to set up ATM and AAL2 bearer connections. These connections include voice connections, voiceband data connections, clear channel circuit emulation connections, video connections and baseband data connections (such as fax relay, modem relay, SSCOP, frame relay etc.).

These conventions use standard SDP syntax as defined in RFC 2327 [1] to describe the ATM-level and AAL-level connections, addresses and other parameters. In general, parameters associated with layers higher than the ATM adaptation layer are included only if they are tightly coupled to the ATM or AAL layers. Since the syntax conforms to RFC 2327, standard SDP parsers should react in a well-defined and safe manner on receiving session descriptions based on the SDP conventions in this document. This is done by extending the values of fields defined in RFC 2327 rather than by defining new fields. This is true for all SDP lines except the of the media attribute lines, in which case new attributes are defined. The SDP protocol allows the definition of new attributes in the media attribute lines which are free-form. For the remaining lines, the fact that the <networkType> field in an SDP descriptor is set to "ATM" should preclude the misinterpretation of extended parameter values by RFC 2327-compliant SDP parsers.

These conventions are meant to address the following ATM applications:

1. Applications in which a new SVC is set-up for each service connection. These SVCs could be AAL1 or AAL5 SVCs or single-CID AAL2 SVCs.

2. Applications in which existing path resources are assigned to service connections. These resources could be:

   * AAL1/AAL5 PVCs, SPVCs or cached SVCs,
   * AAL2 single-CID PVCs, SPVCs or cached SVCs,
   * CIDs within AAL2 SVCs/PVCs/SPVCs that multiplex multiple CIDs.
   * Subchannels (identified by CIDs) within AAL1 [8] or AAL2 [11] SVCs/PVCs/SPVCs.

Note that the difference between PVCs and SPVCs is in the way the bearer virtual circuit connection is set up. SPVCs are a class of PVCs that use bearer signaling, as opposed to node-by-node provisioning, for connection establishment.

This document is limited to the case when the network type is ATM. This includes raw RTP encapsulation [45] or voice sample encapsulation [46] over AAL5 with no intervening IP layer. It does not address SDP usage for IP, with or without ATM as a lower layer.

In some cases, IP connection set-up is independent of lower layers, which are configured prior to it. For example, AAL5 PVCs that connect IP routers can be used for VoIP calls. In other cases, VoIP call set-up is closely tied to ATM-level connection set-up. This might require a chaining of IP and ATM descriptors, as described in section 5.6.4.1.

This document makes no assumptions on who constructs the session descriptions (media gateway, intermediate ATM/AAL2 switch, media gateway controller etc.). This will be different in different applications. Further, it allows the use of one session description for both directions of a connection (as in SIP and MGCP applications) or the use of separate session descriptions for different directions. It also addresses the ATM multicast and anycast capabilities.

This document makes no assumptions about how the SDP description will be coded. Although the descriptions shown here are encoded as text, alternate codings are possible:

- Binary encoding such as ASN.1. This is an option (in addition to text encoding) in the Megaco context.

- Use of extended ISUP parameters [36] to encode the information in SDP descriptors, with conversion to/from binary/text-based SDP encoding when needed.

1.1 Key words to indicate Requirement Levels

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 [62].

2. Representation of Certain Fields within SDP description lines

This document conforms to the syntactic conventions of standard SDP as defined in RFC 2327 [1].

2.1 Representation of Extension Attributes

The SDP protocol [1] requires that non-standard attributes and codec names use an "X-" prefix.

In this internet document, the "X-" prefix is used consistently for codec names (Table 2) that have not been registered with the IANA. The IANA-registered codec names listed in [31] do not use this prefix, regardless of whether they are statically or dynamically assigned payload types.

However, this prefix is not used for the extension SDP attributes defined in this document. This has been done to enhance legibility.

This document suggests that parsers be flexible in the use of the "X-" prefix convention. They should accept codec names and attribute names with or without the "X-" prefix.

2.2 Representation of Parameter Values

Depending on the format of their representation in SDP, the parameters defined in this document fall into the following classes:

(1) Parameters always represented in a decimal format.
(2) Parameters always represented in a hexadecimal format.
(3) Parameters always represented as character strings.
(4) Parameters that can be represented in either decimal or hexadecimal format.

No prefixes are needed for classes 1 - 3, since the format is fixed. For class 4, a "0x" prefix shall always be used to differentiate the hexadecimal from the decimal format.

For both decimal and hex representations, if the underlying bit field is smaller or larger than the binary equivalent of the SDP representation, then leading 0 bits should be added or removed as needed. Thus, 3 and 0x3 translate into the following five-bit pattern: 0 0011. The SDP representations 0x12 and 18 translate into the following five-bit pattern: 1 0010.

Leading 0 digits shall not be used in decimal representations. Generally, these are also not used in hexadecimal representations. Exceptions are when an exact number of hex digits is expected, as in the case of NSAP addresses. Parsers shall not reject leading zeros in hex values.

Both single-character and multi-character string values are enclosed in double quotes (i.e., "). By contrast, single quotes (i.e., ') are used for emphasizing keywords rather than to refer to characters or strings.

In the text representation of decimal and hex numbers, digits to the left are more significant than digits to the right.

2.3 Directionality Convention

This section defined the meaning of the terms 'forward' and 'backward' as used in this document. This is specially applicable to parameters that have a specific direction associated with them.

In this document, 'forward' refers to the direction away from the ATM node under consideration, while 'backward' refers to the direction towards the ATM node. This convention must be used in all SDP-based session descriptions regardless of whether underlying bearer is an SVC, a dynamically allocated PVC/SPVC or a dynamically allocated CID. This is regardless of which side originates the service connection. If ATM SVC or AAL2 Q.2630.1 signaling is used, the directionality convention is independent of which side originates the SVC or AAL2 connection.

This provides a simple way of identifying the direction in which a parameter is applicable, in a manner that is independent of the underlying ATM or AAL2 bearer. This simplicity comes at a price, described below.

The convention used by all ATM/AAL2 signaling specifications (e.g., Q.2931 Section 1.3.3 and Q.2630.1) mandates that forward direction is from the end initiating setup/establishment via bearer signaling towards the end receiving the setup/establishment request. The backward direction is in the opposite direction. In some cases, the 'forward' and 'backward' directions of the ATM signaling convention

might be the exact opposite of the SDP convention described above, requiring the media gateway to perform the necessary translation. An example case in which this is needed is described below.

Consider an SDP description sent by a media gateway controller to the gateway originating a service-level call. In the backward SVC call set-up model, this gateway terminates (rather than originates) an SVC call. The media gateway refers to the traffic descriptor (and hence the PCR) in the direction away from this gateway as the forward traffic descriptor and forward PCR. Clearly, this is at odds with ATM SVC signaling which refers to this very PCR as the backward PCR. The gateway needs to be able to perform the required swap of directions. In this example, the media gateway terminating the service level call (and hence originating the SVC call) does not need to perform this swap.

Certain parameters within attributes are defined exclusively for the forward or backward directions. Examples for the forward direction are the <fsssar> subparameter within the 'aal2sscs3661unassured' media attribute line, the <fsssar>, <fsscopsdu> and <fsscopuu> subparameters within the 'aal2sscs3661assured' media attribute line, the <fsscopsdu> and <fsscopuu> subparameters within the 'aal5sscop' media attribute line, and the <fmaxFrame> parameter within the 'aal2sscs3662' media attribute line. Examples for the backward direction are the <bsssar> subparameter within the 'aal2sscs3661unassured' media attribute line, the <bsssar>, <bsscopsdu> and <bsscopuu> subparameters within the 'aal2sscs3661assured' media attribute line, the <bsscopsdu> and <bsscopuu> subparameters within the 'aal5sscop' media attribute line, and the <bmaxFrame> parameter within the 'aal2sscs3662' media attribute line.

2.4 Case convention

As defined in RFC 2327 [1], SDP syntax is case-sensitive. Since these ATM conventions conform strictly with SDP syntax, they are case-sensitive. SDP line types (e.g., "c", "m", "o", "a") and fields in the SDP lines should be built according to the case conventions in [1] and in this document. It is suggested, but not required, that SDP parsers for ATM applications be case-tolerant where ignoring case does not result in ambiguity. Encoding names, which are defined outside the SDP protocol, are case-insensitive.

2.5 Use of special characters in SDP parameter values

In general, RFC 2327-conformant string values of SDP parameters [1] do not include special characters that are neither alphabets nor digits. An exception is the "/" character used in the value "RTP/AVP" of transport sub-field of the ’m’ line.

String values used in SDP descriptions of ATM connections retain this convention, while allowing the use of the special character "/" in a manner commensurate with [1]. In addition, the special characters "$" and "-" are used in the following manner. A "$" value is a wildcard that allows the recipient of the SDP description to select any permitted value of the parameter. A "-" value indicates that it is not necessary to specify the value of the parameter in the SDP description because this parameter is irrelevant for this application, or because its value can be known from another source such as provisioning, defaults, another protocol, another SDP descriptor or another part of the same SDP descriptor. If the use of these special characters is construed as a violation of RFC 2327 [1] syntax, then reserved string values can be used. The string "CHOOSE" can be used in lieu of "$". The string "OMIT" can be used in lieu of "-" for an omitted parameter.

3. Capabilities Provided by SDP conventions

To support the applications listed in section 1, the SDP conventions in this document provide the following session control capabilities:

* Identification of the underlying bearer network type as ATM.

* Identification by an ATM network element of its own address, in one of several possible formats. A connection peer can initiate SVC set-up to this address. A call agent or connection peer can select an pre-established bearer path to this address.

* Identification of the ATM bearer connection that is to be bound to the service-level connection. Depending on the application, this is either a VCC or a subchannel (identified by a CID) within a VCC.

* Identification of media type: audio, video, data.

* In AAL1/AAL5 applications, declaration of a set of payload types that can be bound to the ATM bearer connection. The encoding names and payload types defined for use in the RTP context [31] are re-used for AAL1 and AAL5, if applicable.

* In AAL2 applications, declaration of a set of profiles that can be bound to the ATM bearer connection. A mechanism for dynamically defining custom profiles within the SDP session description is included. This allows the use of custom profiles for connections that span multi-network interfaces.

* A means of correlating service-level connections with underlying ATM bearer connections. The backbone network connection identifier or bnc-id specified in ITU Q.1901 [36] standardization work is used for this purpose. In order to provide a common SDP base for applications based on Q.1901 and SIP/SIP+, the neutral term 'eecid' is used in lieu of 'bnc-id' in the SDP session descriptor.

* A means of mapping codec types and packetization periods into service types (voice, voiceband data and facsimile). This is useful in determining the encoding to use when the connection is upspeeded in response to modem or facsimile tones.

* A means of describing the adaptation type, QoS class, ATM transfer capability/service category, broadband bearer class, traffic parameters, CPS parameters and SSCS parameters related the underlying bearer connection.

* Means for enabling or describing special functions such as leaf- initiated-join, anycast and SVC caching.

* For H.323 Annex C applications, a means of specifying the IP address and port number on which the node will receive RTCP messages.

* A means of chaining consecutive SDP descriptors so that they refer to different layers of the same connection.

4. Format of the ATM Session Description

The sequence of lines in the session descriptions in this document conforms to RFC 2327 [1]. In general, a session description consists of a session-level part followed by zero or more media-level parts. ATM session descriptions consist of a session-level part followed by one or two media-level parts. The only two media applicable are the ATM bearer medium and RTCP control (where applicable).

The session level part consists of the following lines:

```
v=  (protocol version, zero or one line)
o=  (origin, zero or one line)
s=  (session name, zero or one line)
```

```
c=  (connection information, one line)
b=  (bandwidth, zero or more lines)
t=  (timestamp, zero or one line)
k=  (encryption key, zero or one line)
```

In ATM session descriptions, there are no media attribute lines in the session level part. These are present in the media-level parts.

The media-level part for the ATM bearer consists of the following lines:

```
m=  (media information and transport address, one line)
b=  (bandwidth, zero or more lines)
k=  (encryption key, zero or more lines)
a=  (media attribute, zero or more lines)
```

The media-level part for RTCP control consists of the following lines:

```
m=  (media information and transport address, one line)
c=  (connection information for control only, one line)
```

In general, the 'v', 'o', 's', and 't' lines are mandatory. However, in the Megaco [26] context, these lines have been made optional. The 'o', 's', and 't' lines are omitted in most MGCP [25] applications.

Note that SDP session descriptors for ATM can contain bandwidth (b=) and encryption key (k=) lines. Like all other lines, these lines should strictly conform to the SDP standard [1].

The bandwidth (b=) line is not necessarily redundant in the ATM context since, in some applications, it can be used to convey application-level information which does not map directly into the atmTrfcDesc media attribute line. For instance, the 'b' line can be used in SDP descriptors in RTSP commands to describe content bandwidth.

The encryption key line (k=) can be used to indicate an encryption key for the bearer, and a method to obtain the key. At present, the encryption of ATM and AAL2 bearers has not been conventionalized, unlike the encryption of RTP payloads. Nor has the authentication or encryption of ATM or AAL2 bearer signaling. In the ATM and AAL2 contexts, the term 'bearer' can include 'bearer signaling' as well as 'bearer payloads'.

The order of lines in an ATM session description is exactly in the RFC 2327-conformant order depicted above. However, there is no order of the media attribute ('a') lines with respect to other 'a' lines.

The SDP protocol version for session descriptions using these conventions is 0. In conformance with standard SDP, it is strongly recommended that the 'v' line be included at the beginning of each SDP session description. In some contexts such as Megaco, the 'v' line is optional and may be omitted unless several session descriptions are provided in sequence, in which case the 'v' line serves as a delimiter. Depending on the application, sequences of session descriptions might refer to:

- Different connections or sessions.
- Alternate ways of realizing the same connection or session.
- Different layers of the same session (section 5.6.4.1).

The 'o', 's' and 't' lines are included for strict conformance with RFC 2327. It is possible that these lines might not carry useful information in some ATM-based applications. Therefore, some applications might omit these lines, although it is recommended that they not do so. For maximum interoperability, it is preferable that SDP parsers not reject session descriptions that do not contain these lines.

5. Structure of the Session Description Lines

5.1 The Origin Line

The origin line for an ATM-based session is structured as follows:

```
o=<username> <sessionID> <version> <networkType>
  <addressType> <address>
```

The <username> is set to "-".

The <sessionID> can be set to one of the following:

* an NTP timestamp referring to the moment when the SDP session descriptor was created.
* a Call ID, connection ID or context ID that uniquely identifies the session within the scope of the ATM node. Since calls can comprise multiple connections (sessions), call IDs are generally not suitable for this purpose.

NTP time stamps can be represented as decimal or hex integers. The part of the NTP timestamp that refers to an integer number of seconds is sufficient. This is a 32-bit field

On the other hand, call IDs, connection IDs and context IDs can be can be 32 hex digits long.

The <sessionID> field is represented as a decimal or hex number of up to 32 digits. A "0x" prefix is used before the hex representation. The <version> refers to the version of the SDP session descriptor (not that of the SDP protocol). This is can be set to one of the following:

* 0.
* an NTP timestamp referring to the moment when the SDP session descriptor was modified. If the SDP session descriptor has not been modified by an intermediate entity (such as an MGC), then the <version> timestamp will be the same as the <sessionId> timestamp, if any. As with the <sessionId>, only the integer part of the NTP timestamp is used.

When equated to the integer part of an NTP timestamp, the <version> field is 10 digits wide. This is more restricted than [1], which allows unlimited size. As in [1], the most significant digit is non-zero when an NTP timestamp is used.

The <networkType> in SDP session descriptions for ATM applications should be assigned the string value "ATM" or wildcarded to a "$" or "-".

The <addressType> and <address> parameters are identical to those for the connection information ('c') line (Section 5.3). Each of these parameters can be wildcarded per the conventions described for the 'c' line in Section 5.3. These parameters should not me omitted since this would violate SDP syntax [1].

As with the 'c' line, SDP parsers are not expected to check the consistency of <networkType> with <addressType>, <address> pairs. The <addressType> and <address> need to be consistent with each other.

5.2 The Session Name Line

In general, the session name line is structured as follows:

```
s=<sessionName>
```

For ATM-based sessions, the <sessionName> parameter is set to a "-". The resulting line is:

```
s=-
```

5.3 The Connection Information Line

In general, the connection information line [1] is structured as follows:

```
c=<networkType> <addressType> <address>
```

For ATM networks, additional values of <networkType>, <addressType> and <address> are defined, over and above those listed in [1]. The ABNF syntax (Section 9) for ATM SDP does not limit the ways in which <networkType> can be combined with <addressType>, <address> pairs. However, some combinations will not be valid in certain applications, while others will never be valid. Invalid combinations should be rejected by application-specific functions, and not by generic parsers. The ABNF syntax does limit the ways in which <addressType> and <address> can be paired.

For ATM networks, the value of <networkType> should be set to "ATM". Further, this may be wildcarded to "$" or "-". If this is done, an node using ATM as the basic transport mechanism will select a value of "ATM". A node that interfaces with multiple network types ("IN", "ATM" etc.) that include ATM can also choose a value of "ATM".

When the SDP description is built by a node such as a media gateway, the <address> refers to the address of the node building the SDP description. When this description is forwarded to another node, it still contains the original node’s address. When the media gateway controller builds part or all of the SDP description, the local descriptor contains the address of the local node, while the remote descriptor contains the address of the remote node. If the <address> and/or <addressType> are irrelevant or are known by other means, they can be set to a "$" or a "-", as described below.

Additionally, in all contexts, the ’m’ line can have an ATM address in the <virtualConnectionId> subparameter which, if present, is the remote address if the ’c’ line address is local, and vice versa.

For ATM networks, the <addressType> can be NSAP, E164 or GWID (ALIAS). For ATM networks, the <address> syntax depends on the syntax of the <addressType>. SDP parsers should check the consistency of <addressType> with <address>.

NSAP: If the addressType is NSAP, the address is expressed in the standard dotted hex form. This is a string of 40 hex digits, with dots after the 2nd, 6th, 10th, 14th, 18th, 22nd, 26th, 30th, 34th and 38th digits. The last octet of the NSAP address is the ’selector’ field that is available for non-standard use. An example of a line with an NSAP address is:

```
c=ATM NSAP 47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
```

A "0x" prefix shall not be used in this case since this is always in hexadecimal format.

E164: If the addressType is E164, the address is expressed as a decimal number with up to 15 digits. For example:

```
c=ATM E164 9738294382
```

The use of E.164 numbers in the B-ISDN context is defined in ITU E.191. There is a disparity between the ATM forum and the ITU in the use of E.164 numbers for ATM addressing. The ATM forum (e.g., UNI Signaling 4.0) allows only International Format E.164 numbers, while the ITU (e.g., Q.2931) allows private numbering plans. Since the goal of this SDP specification is to interoperate with all bearer signaling protocols, it allows the use of numbers that do not conform to the E.164 International Format. However, to maximize overall consistency, network administrators can restrict the provisioning of numbers to the E.164 International Format.

GWID (ALIAS): If the addressType is GWID, it means that the address is a Gateway Identifier or Node Alias. This may or may not be globally unique. In this format, the address is expressed as an alphanumeric string ("A"-"Z", "a"-"z", "0" - "9",".","-","_"). For example:

```
c=ATM GWID officeABCmgx101vism12
```

Since these SDP conventions can be used for more than gateways, the string "ALIAS" can be used instead of "GWID" in the ’c’ line. Thus, the example above is equivalent to:

```
c=ATM ALIAS officeABCmgx101vism12
```

An example of a GWID (ALIAS)is the CLLI code used for telecom equipment. For all practical purposes, it should be adequate for the GWID (ALIAS) to be a variable length string with a maximum size of 32 characters.

The connection information line is always present in an SDP session descriptor. However, each of the parameters on this line can be wildcarded to a "$" or a "-", independently of whether other parameters on this line are wildcarded or not. Not all syntactically legal wildcard combinations are meaningful in a particular application.

Examples of meaningful wildcard combinations in the ATM context are:

```
c=- - -
c=$ $ $
c=ATM - -
c=ATM $ $
c=ATM <addressType> -
c=ATM <addressType> $
```

Specifying the ATM address type without specifying the ATM address is useful when the recipient is asked to select an ATM address of a certain type (NSAP, E.164 etc.).

Examples of syntactically legal wildcard combinations of dubious utility are:

```
c=- $ -
c=- $ $
c=- <addressType> -
c=$ <addressType> $
c=- <addressType> <address>
c=$ <addressType> <address>
```

Note that <addressType> and/or <address> should not omitted without being set to a "-" or "$" since this would violate basic SDP syntax [1].

5.4 The Timestamp Line

The timestamp line for an SDP session descriptor is structured as follows:

```
t= <startTime> <stopTime>
```

Per Ref. [49], NTP time stamps use a 32 bit unsigned representation of seconds, and a 32 bit unsigned representation of fractional seconds. For ATM-based sessions, the <startTime>parameter can be made equal to the NTP timestamp referring to the moment when the SDP session descriptor was created. It can also be set to 0 indicating its irrelevance. If it made equal to the NTP timestamp in seconds, the fractional part of the NTP timestamp is omitted. When equated to the integer part of an NTP timestamp, the <startTime> field is 10 digits wide. This is more restricted than [1], which allows unlimited size. As in [1], the most significant digit is non-zero when an NTP timestamp is used.

The <stopTime> parameter is set to 0 for ATM-based SDP descriptors.

5.5 Media Information Line for ATM connections

The general format of the media information line adapted for AAL1 and AAL5 applications is:

```
m=<media> <virtualConnectionId> <transport> <format list>
```

The general format of the media information line adapted for AAL2 applications is:

```
m=<media> <virtualConnectionId> <transport#1> <format list#1>
        <transport#2> <format list#2> ... <transport#M> <format list#M>
```

Note that <virtualConnectionId> is equivalent to <port> in [1].

The subparameter <media> can take on all the values defined in [1]. These are: "audio", "video", "application", "data" and "control".

When the <transport> parameter has more than one value in the ’m’ line, the <transport> <format list> pairs can be arranged in preferential order.

5.5.1 The Virtual Connection ID

In applications in which the media-level part of a session descriptor is bound to an ATM virtual circuit, the <virtualConnectionId> can be in one of the following formats:

* <ex_vcci>
* <addressType>-<address>/<ex_vcci>
* <address>/<ex_vcci>
* <ex_bcg>/<ex_vcci>
* <ex_portId>/<ex_vpi>/<ex_vci>
* <ex_bcg>/<ex_vpi>/<ex_vci>
* <ex_vpci>/<ex_vci>
* <addressType>-<address>/<ex_vpci>/<ex_vci>
* <address>/<ex_vpci>/<ex_vci>

In applications in which the media-level part of a session descriptor is bound to a subchannel within an ATM virtual circuit, the <virtualConnectionId> can be in one of the following formats:

* <ex_vcci>/<ex_cid>
* <addressType>-<address>/<ex_vcci>/<ex_cid>
* <address>/<ex_vcci>/<ex_cid>
* <ex_bcg>/<ex_vcci>/<ex_cid>
* <ex_portId>/<ex_vpi>/<ex_vci>/<ex_cid>
* <ex_bcg>/<ex_vpi>/<ex_vci>/<ex_cid>

```
      * <ex_vpci>/<ex_vci>/<ex_cid>
      * <addressType>-<address>/<ex_vpci>/<ex_vci>/<ex_cid>
      * <address>/<ex_vpci>/<ex_vci>/<ex_cid>
```

Here,

```
       <ex_vcci> = VCCI-<vcci>
       <ex_vpci> = VPCI-<vpci>
       <ex_bcg> = BCG-<bcg>
       <ex_portId> = PORT-<portId>
       <ex_vpi> = VPI-<vpi>
       <ex_vci> = VCI-<vci>
       <ex_cid> = CID-<cid>
```

The <vcci>, <vpi>, <vci>, <vpci> and <cid> are decimal numbers or hexadecimal numbers. An "0x" prefix is used before their values when they are in the hex format.

The <portId> is always a hexadecimal number. An "0x" prefix is not used with it.

The <addressType> and <address> are identical to their definitions above for the connection information line with the difference that this address refers to the remote peer in the media information line. Since the <virtualConnectionId>, as defined here, is meant for use in ATM networks, the values of <addressType> and <address> in the <virtualConnectionId> are limited to ATM-specific values.

The <vpi>, <vci> and <cid> are the Virtual Path Identifier, Virtual Circuit Identifier and Channel Identifier respectively. The <vpi> is an 8 or 12 bit field. The <vci> is a 16-bit field. The <cid> is an 8-bit field ([8] and [11]). For AAL1 applications, it corresponds to the channel number defined in Annex C of [8].

The <vpci> is a 16-bit field defined in Section 4.5.16 of ITU Q.2931 [Ref. 15]. The <vpci> is similar to the <vpi>, except for its width and the fact that it retains its value across VP crossconnects. In some applications, the size of the <vpci> is the same as the size of the <vpi> (8 or 12 bits). In this case, the most significant 8 or 4 bits are ignored.

The <vcci> is a 16-bit field defined in ITU Recommendation Q.2941.2 [32]. The <vcci> is similar to the <vci>, except for the fact that it retains its value across VC crossconnects.

In general, <vpci> and <vcci> values are unique between a pair of nodes. When they are unique between a pair of nodes but not unique within a network, they need to be qualified, at any node, by the ATM

address of the remote node. These parameters can be pre-provisioned or signaled. When signaled, the <vpci> is encapsulated in the connection identifier information element of SVC signaling messages. The <vcci> is encapsulated in the Generic Information Transport (GIT) information element of SVC signaling messages. In an ATM node pair, either node can assign <vcci> values and signal it to the other end via SVC signaling. A glare avoidance scheme is defined in [32] and [44]. This mechanism works in SVC applications. A different glare avoidance technique is needed when a pool of existing PVCs/SPVCs is dynamically assigned to calls. One such scheme for glare reduction is the assignment of <vcci> values from different ends of the <vcci> range, using the lowest or highest available value as applicable.

When <vpci> and <vcci> values are pre-provisioned, administrations have the option of provisioning them uniquely in a network. In this case, the ATM address of the far end is not needed to qualify these parameters.

In the AAL2 context, the definition of a VCC implies that there is no CID-level switching between its ends. If either end can assign <cid> values, then a glare reduction mechanism is needed. One such scheme for glare reduction is the assignment of <cid> values from different ends of the <cid> range, using the lowest or highest available value as applicable.

The <portId> parameter is used to identify the physical trunk port on an ATM module. It can be represented as a hexadecimal number of up to 32 hex digits.

In some applications, it is meaningful to bundle a set of connections between a pair of ATM nodes into a bearer connection group. The <bcg> subparameter is an eight bit field that allows the bundling of up to 255 VPCs or VCCs.

In some applications, it is necessary to wildcard the <virtualConnectionId> parameter, or some elements of this parameter. The "$" wildcard character can be substituted for the entire <virtualConnectionId> parameter, or some of its terms. In the latter case, the constant strings that qualify the terms in the <virtualConnectionId> are retained. The concatenation <addressType>-<address> can be wildcarded in the following ways:

* The entire concatenation, <addressType>-<address>, is replaced with a "$".
* <address> is replaced with a "$", but <addressType> is not.

Examples of wildcarding the <virtualConnectionId> in the AAL1 and AAL5 contexts are: $, VCCI-$, BCG-100/VPI-20/VCI-$. Examples of wildcarding the <virtualConnectionId> in the AAL2 context are: $, VCCI-40/CID-$, BCG-100/VPI-20/VCI-120/CID-$, NSAP-$/VCCI-$/CID-$, $/VCCI-$/CID-$.

It is also permissible to set the entire <virtualConnectionId> parameter to a "-" indicating its irrelevance.

5.5.2 The Transport Parameter

The <transport> parameter indicates the method used to encapsulate the service payload. These methods are not defined in this document, which refers to existing ATMF and ITU-T standards, which, in turn, might refer to other standards. For ATM applications, the following <transport> values are defined:

Table 1: List of Transport Parameter values used in SDP in the ATM context

Transport	Controlling Document for Encapsulation of Service Payload
AAL1/ATMF	af-vtoa-0078.000 [7]
AAL1/ITU	ITU-T H.222.1 [51]
AAL5/ATMF	af-vtoa-0083.000 [46]
AAL5/ITU	ITU-T H.222.1 [51]
AAL2/ATMF	af-vtoa-0113.000 [44] and af-vmoa-0145.000 [52]
AAL2/ITU	ITU-T I.366.2 [13]
AAL1/custom AAL2/custom AAL5/custom	Corporate document or application-specific interoperability statement.
AAL1/<corporateName> AAL2/<corporateName> AAL5/<corporateName> AAL1/IEEE:<oui> AAL2/IEEE:<oui> AAL5/IEEE:<oui>	Corporate document
RTP/AVP	Annex C of H.323 [45]

In H.323 Annex C applications [45], the <transport> parameter has a value of "RTP/AVP". This is because these applications use the RTP protocol [2] and audio/video profile [3]. The fact that RTP is carried directly over AAL5 per [45] can be indicated explicitly via the aalApp media attribute.

A value of "AAL1/custom", "AAL2/custom" or "AAL5/custom" for the <transport> parameter can indicate non-standard or semi-standard encapsulation schemes defined by a corporation or a multi-vendor agreement. Since there is no standard administration of this convention, care should be taken to preclude inconsistencies within the scope of a deployment.

The use of <transport> values "AAL1/<corporateName>", "AAL2/<corporateName>", "AAL5/<corporateName>", "AAL1/IEEE:<oui>", "AAL2/IEEE:<oui>" and "AAL5/IEEE:<oui>" is similar. These indicate non-standard transport mechanisms or AAL2 profiles which should be used consistently within the scope of an application or deployment. The parameter <corporateName> is the registered, globally unique name of a corporation (e.g., Cisco, Telcordia etc.). The parameter <oui> is the hex representation of a three-octet field identical to the OUI maintained by the IEEE. Since this is always represented in hex, the "0x" prefix shall not be used. Leading zeros can be omitted. For example, "IEEE:00000C" and "IEEE:C" both refer to Cisco Systems, Inc.

5.5.3 The Format List for AAL1 and AAL5 applications

In the AAL1 and AAL5 contexts, the <format list> is a list of payload types:

<payloadType#1> <payloadType#2>...<payloadType#n>

In most AAL1 and AAL5 applications, the ordering of payload types implies a preference (preferred payload types before less favored ones). The payload type can be statically assigned or dynamically mapped. Although the transport is not the same, SDP in the ATM context leverages the encoding names and payload types registered with IANA [31] for RTP. Encoding names not listed in [31] use a "X-" prefix. Encodings that are not statically mapped to payload types in [31] are to be dynamically mapped at the time of connection establishment to payload types in the decimal range 96-127. The SDP 'atmmap' attribute (similar to 'rtpmap') is used for this purpose.

In addition to listing the IANA-registered encoding names and payload types found in [31], Table 2 defines a few non-standard encoding names(with "X-" prefixes).

5.5.4 The Format List for AAL2 applications

In the AAL2 context, the <format list> is a list of AAL2 profile types:

<profile#1> <profile#2>...<profile#n>

In most applications, the ordering of profiles implies a preference (preferred profiles before less favored ones). The <profile> parameter is expressed as a decimal number in the range 1-255.

5.5.5 Media information line construction

Using the parameter definitions above, the ’m’ for AAL1-based audio media can be constructed as follows:

```
m=audio <virtualConnectionId> AAL1/ATMF  <payloadType#1>
          <payloadType#2>...<payloadType #n>
```

Note that only those payload types, whether statically mapped or dynamically assigned, that are consistent with af-vtoa-78 [7] can be used in this construction.

Backwards compatibility note: The transport value "AAL1/AVP" used in previous versions of this document should be considered equivalent to the value "AAL1/ATMF" defined above. "AAL1/AVP" is unsuitable because the AVP profile is closely tied to RTP.

An example ’m’ line use for audio media over AAL1 is:

```
m=audio VCCI-27 AAL1/ATMF 0
```

This indicates the use of an AAL1 VCC with VCCI=24 to carry PCMU audio that is encapsulated according to ATMF’s af-vtoa-78 [7].

Another example of the use of the ’m’ line use for audio media over AAL1 is:

```
m=audio $  AAL1/ATMF 0 8
```

This indicates that any AAL1 VCC may be used. If it exists already, then its selection is subject to glare rules. The audio media on this VCC is encapsulated according to ATMF’s af-vtoa-78 [7]. The encodings to be used are either PCMU or PCMA, in preferential order.

The ’m’ for AAL5-based audio media can be constructed as follows:

```
m=audio <virtualConnectionId> AAL5/ATMF  <payloadType#1>
          <payloadType#2>...<payloadType #n>
```

An example ’m’ line use for audio media over AAL5 is:

```
m=audio PORT-2/VPI-6/$  AAL5/ITU  9  15
```

implies that any VCI on VPI= 6 of trunk port #2 may be used. The identities of the terms in the virtual connection ID are implicit in the application context. The audio media on this VCC is encapsulated according to ITU-T H.222.1 [51]. The encodings to be used are either ITU-T G.722 or ITU-T G.728 (LD-CELP), in preferential order.

The ’m’ for AAL5-based H.323 Annex C audio [45] can be constructed as follows:

```
m=audio <virtualConnectionId> RTP/AVP <payloadType#1>
              <payloadType#2>...<payloadType #n>
```

For example:

```
m=audio PORT-9/VPI-3/VCI-$  RTP/AVP 2 96
a=rtpmap:96 X-G727-32
a=aalType:AAL5
a=aalApp:itu_h323c - -
```

implies that any VCI on VPI= 3 of trunk port #9 may be used. This VC encapsulates RTP packets directly on AAL5 per [45]. The ’rtpmap’ (rather than the ’atmmap’) attribute is used to dynamically map the payload type of 96 into the codec name X-G727-32 (Table 2). This name represents 32 kbps EADPCM.

The ’m’ line for AAL5-based video media can be constructed as follows:

```
m=video <virtualConnectionId> AAL5/ITU  <payloadType#1>
          <payloadType#2>...<payloadType #n>
```

In this case, the use of AAL5/ITU as the transport points to H.222.1 as the controlling standard [51]. An example ’m’ line use for video media is:

```
m=video PORT-9/VPI-3/VCI-$  AAL5/ITU  33
```

This indicates that any VCI on VPI= 3 of trunk port #9 may be used. The video media on this VCC is encapsulated according to ITU-T H.222.1 [51]. The encoding scheme is an MPEG 2 transport stream ("MP2T" in Table 1). This is statically mapped per [31] to a payload type of 33.

Using the parameter definitions in the previous subsections, the media information line for AAL2-based audio media can be constructed as follows:

```
m=<media> <virtualConnectionId> <transport#1> <format list#1>
        <transport#2> <format list#2> ... <transport#M> <format list#M>
```

where <format list#i> has the form <profile#i_1>...<profile#i_N> Unlike the ’m’ line for AAL1 or AAL5 applications, the ’m’ line for AAL2 applications can have multiple <transport> parameters, each followed by a <format list>. This is because it is possible to

consider definitions from multiple sources (ATMF, ITU and non-standard documents) when selecting AAL2 profile to be bound to a connection.

In most applications, the ordering of profiles implies a preference (preferred profiles before less favored ones). Therefore, there can be multiple instances of the same <transport> value in the same 'm' line.

An example 'm' line use for audio media over AAL2 is:

```
m=audio VCCI-27/CID-19 AAL2/ITU 7 AAL2/custom 100 AAL2/ITU 1
```

This indicates the use of CID #19 on VCCI #27 to carry audio. It provides a preferential list of profiles for this connection: profile AAL2/ITU 7 defined in [13], AAL2/custom 100 defined in an application-specific or interoperability document and profile AAL2/ITU 1 defined in [13].

Another example of the use of the 'm' line use for audio media over AAL2 is:

```
m=audio VCCI-$/CID-$  AAL2/ATMF 6 8
```

This indicates that any AAL2 CID may be used, subject to any applicable glare avoidance/reduction rules. The profiles that can be bound to this connection are AAL2/ATMF 6 defined in af-vtoa-0113.000 [44] and AAL2/ATMF 8 defined in af-vmoa-0145.000 [52]. These sources use non-overlapping profile number ranges. The profiles they define fall under the <transport> category "AAL2/ATMF". This application does not order profiles preferentially. This rule is known a priori. It is not embedded in the 'm' line.

Another example of the use of the 'm' line use for audio media over AAL2 is:

```
m=audio VCCI-20/CID-$  AAL2/xyzCorporation 11
```

AAL2 VCCs in this application are single-CID VCCs. Therefore, it is possible to wildcard the CID. The single-CID VCC with VCCI=20 is selected. The AAL2 profile to be used is AAL2/xyzCorporation 11 defined by xyzCorporation.

In some applications, an "-" can be used in lieu of:

- <format list>
- <transport> and <format list>

This implies that these parameters are irrelevant or are known by other means (such as defaults). For example:

```
m=audio VCCI-234 - -
a=aalType:AAL1
```

indicates the use of VCCI=234 with AAL1 adaptation and unspecified encoding.

In another example application, the 'aal2sscs3662' attribute can indicate <faxDemod> = "on" and any other competing options as "off", and the <aalType> attribute can indicate AAL2. Thus:

```
m=audio VCCI-123/CID-5 - -
a=aalType:AAL2
a=aal2sscs3662:audio off off on off on off off off - - -
```

Besides indicating an audio medium, a VCCI of 123 and a CID of 5, the 'm' line indicates an unspecified profile. The media attribute lines indicate an adaptation layer of AAL2, and the use of the audio SAP [13] to carry demodulated facsimile.

The media information line for "data" media has one of the following the following formats:

```
m=data <virtualConnectionId> - -
m=data - - -
```

The data could be circuit emulation data carried over AAL1 or AAL2, or packet data carried over AAL5. Media attribute lines, rather than the 'm' line, are used to indicate the adaptation type for the data media. Examples of the representation of data media are listed below.

```
m=data  PORT-7/VPI-6/VCI-$  - -
a=aalApp:AAL5_SSCOP-                            -
```

implies that any VCI on VPI= 6 of trunk port #7 may be used. This VC uses SSCOP on AAL5 to transport data.

```
m=data  PORT-7/VPI-6/VCI-50  - -
a=aalType:AAL1_SDT
a=sbc:6
```

implies that VCI 50 on VPI 6 on port 7 uses structured AAL1 to transfer 6 x 64 kbps circuit emulation data. This may be alternately represented as:

```
m=data  PORT-7/VPI-6/VCI-50  - -
b=AS:384
a=aalType:AAL1_SDT
```

The following lines:

```
m=data VCCI-123/CID-5 - -
a=aalType:AAL2
a=sbc:2
```

imply that CID 5 of VCCI 123 is used to transfer 2 x 64 kbps circuit emulation data.

In the AAL1 context, it is also permissible to represent circuit mode data as an "audio" codec. If this is done, the codec types used are X-CCD or X-CCD-CAS. These encoding names are dynamically mapped into payload types through the 'atmmap' attribute. For example:

```
m=audio VCCI-27 AAL1/AVP 98
a=atmmap:98 X-CCD
a=sbc:6
```

implies that AAL1 VCCI=27 is used for 6 x 64 transmission.

In the AAL2 context, the X-CCD codec can be assigned a profile type and number. Even though it is not possible to construct a profile table as described in ITU I.366.2 for this "codec", it is preferable to adopt the common AAL2 profile convention in its case. An example AAL2 profile mapping for the X-CCD codec could be as follows:

PROFILE TYPE	PROFILE NUMBER	"CODEC" (ONLY ONE)
"custom"	200	X-CCD

The profile does not identify the number of subchannels ('n' in nx64). This is known by other means such as the 'sbc' media attribute line.

For example, the media information line:

```
m=audio $ AAL2/custom 200
a=sbc:6
```

implies 384 kbps circuit emulation using AAL2 adaptation.

It is not necessary to define a profile with the X-CCD-CAS codec, since this method of CAS transport [7] is not used in AAL2 applications.

5.6 The Media Attribute Lines

In an SDP line sequence, the media information line ’m’ is followed by one or more media attribute or ’a’ lines. Media attribute lines are per the format below:

```
a=<attribute>:<value>
```

or

```
a=<value>
```

In general, media attribute lines are optional except when needed to qualify the media information line. This qualification is necessary when the "m" line for an AAL1 or AAL5 session specifies a payload type that needs to be dynamically mapped. The ’atmmap’ media attribute line defined below is used for this purpose.

In attribute lines, subparameters that are meant to be left unspecified are set to a "-". These are generally inapplicable or, if applicable, are known by other means such as provisioning. In some cases, a media attribute line with all parameters set to "-" carries no information and should be preferably omitted. In other cases, such as the ’lij’ media attribute line, the very presence of the media attribute line conveys meaning.

There are no restrictions placed by RFC 2327 [1] regarding the order of ’a’ lines with respect to other ’a’ lines. However, these lines must not contradict each other or the other SDP lines. Inconsistencies are not to be ignored and should be flagged as errors. Repeated media attribute lines can carry additional information. These should not be inconsistent with each other.

Applications will selectively use the optional media attribute lines listed below. This is meant to be an exhaustive list for describing the general attributes of ATM bearer networks.

The base specification for SDP, RFC 2327 [1], allows the definition f new attributes. In keeping with this spirit, some of the attributes defined in this document can also be used in SDP descriptions of IP nd other non-ATM sessions. For example, the ’vsel’, ’dsel’ and ’fsel’ attributes defined below refer generically to codec-s. These can be bed for service-specific codec negotiation and assignment in non-ATM s well as ATM applications.

SDP media attributes defined in this document for use in the ATM context are classified as:

* ATM bearer connection attributes (Section 5.6.1)
* AAL attributes (Section 5.6.2)
* Service attributes (Section 5.6.3).
* Miscellaneous media attributes, that cannot be classified as ATM, AAL or service attributes (Section 5.6.4).

In addition to these, the SDP attributes defined in [1] can also be used in the ATM context. Examples are:

* The attributes defined in RFC 2327 which allow indication of the direction in which a session is active. These are a=sendonly, a=recvonly, a=sendrecv, a=inactive.

* The 'Ptime' attribute defined in RFC 2327. It indicates the packet period. It is not recommended that this attribute be used in ATM applications since packet period information is provided with other parameters (e.g., the profile type and number in the 'm' line, and the 'vsel', 'dsel' and 'fsel' attributes). Also, for AAL1 applications, 'ptime' is not applicable and should be flagged as an error. If used in AAL2 and AAL5 applications, 'ptime' should be consistent with the rest of the SDP description.

* The 'fmtp' attribute used to designate format-specific parameters.

5.6.1 ATM bearer connection attributes

The following is a summary list of the SDP media attributes that can be used to describe ATM bearer connections. These are detailed in subsequent subsections.

* The 'eecid' attribute. This stands for 'end-to-end connection identifier'. It provides a means of correlating service-level connections with underlying ATM bearer connections. In the Q.1901 [36] context, the eecid is synonymous with the bnc-id (backbone network connection identifier).

* The 'aalType' attribute. This is used to indicate the nature of the ATM adaptation layer (AAL).

* The 'capability' attribute, which indicates the ATM transfer capability (ITU nomenclature), synonymous with the ATM Service Category (ATMF nomenclature).

* The 'qosClass' attribute, which indicates the QoS class of the ATM bearer connection.

* The ’bcob’ attribute, which indicates the broadband connection oriented bearer class, and whether end-to-end timing is required.

* The ’stc’ attribute, which indicates susceptibility to clipping.

* The ’upcc’ attribute, which indicates the user plane connection configuration.

* The ’atmQOSparms’ attribute, which is used to describe certain key ATM QoS parameters.

* The ’atmTrfcDesc’ attribute, which is used to describe ATM traffic descriptor parameters.

* The ’abrParms’ attribute, which is used to describe ABR-specific parameters. These parameters are per the UNI 4.0 signaling specification [5].

* The ’abrSetup’ attribute, which is used to indicate the ABR parameters needed during call/connection establishment.

* The ’bearerType’ attribute, which is used to indicate whether the underlying bearer is an ATM PVC/SPVC, an ATM SVC, or a subchannel within an existing ATM SVC/PVC/SPVC.

* The ’lij’ attribute, which is used to indicate the presence of a connection that uses the Leaf-initiated-join capability described in UNI 4.0 [5], and to optionally describe parameters associated with this capability.

* The ’anycast’ attribute, which is used to indicate the applicability of the anycast function described in UNI 4.0 [5], and to optionally qualify it with certain parameters.

* The ’cache’ attribute, which is used to enable SVC caching and to specify an inactivity timer for SVC release.

* The ’bearerSigIE’ attribute, which can be used to represent ITU Q-series information elements in bit-map form. This is useful in describing parameters that are not closely coupled to the ATM and AAL layers. Examples are the B-HLI and B-LLI IEs specified in ITU Q.2931 [15], and the user-to-user information element described in ITU Q.2957 [48].

5.6.1.1 The ’eecid’ attribute

The ’eecid’ attribute is synonymous with the 4-byte ’bnc-id’ parameter used by T1SI, the ATM forum and the ITU (Q.1901) standardization effort. The term ’eecid’ stands for ’end-to-end connection identifier’, while ’bnc-id’ stands for ’backbone network connection identifier’. The name "backbone" is slightly misleading since it refers to the entire ATM network including the ATM edge and ATM core networks. In Q.1901 terminology, an ATM "backbone" connects TDM or analog edges.

While the term ’bnc-id’ might be used in the bearer signaling plane and in an ISUP (Q.1901) call control plane, SDP session descriptors use the neutral term ’eecid’. This provides a common SDP baseline for applications that use ISUP (Q.1901) and applications that use SIP/SIP+.

Section 5.6.6 depicts the use of the eecid in call establishment procedures. In these procedures, the eecid is used to correlate service-level calls with SVC set-up requests.

In the forward SVC establishment model, the call-terminating gateway selects an eecid and transmits it via SDP to the call-originating gateway. The call originating gateway transmits this eecid to the call terminating gateway via the bearer set-up message (SVC set-up or Q.2630.1 establish request).

In the backward SVC establishment model, the call-originating gateway selects an eecid and transmits it via SDP to the call-terminating gateway. The call terminating gateway transmits this eecid to the call originating gateway via the bearer set-up message (SVC set-up or Q.2630.1 establish request).

The value of the eecid attribute values needs to be unique within the node terminating the SVC set-up but not across multiple nodes. Hence, the SVC-terminating gateway has complete control over using and releasing values of this parameter. The eecid attribute is used to correlate, one-to-one, received bearer set-up requests with service-level call control signaling.

Within an SDP session description, the eecid attribute is used as follows:

```
a=eecid:<eecid>
```

where <eecid> consists of up to 8 hex digits (equivalent to 4 octets). Since this is always represented in hex, the "0x" prefix shall not be used.

Within the text representation of the <eecid> parameter, hex digits to the left are more significant than hex digits to the right (Section 2.2).

This SDP document does not specify how the eecid (synonymous with bnc-id) is to be communicated through bearer signaling (Q.931, UNI, PNNI, AINI, IISP, proprietary signaling equivalent, Q.2630.1). This is a task of these bearer signaling protocols. However, the following informative statements are made to convey a sense of the interoperability that is a goal of current standardization efforts:

- ITU Q.2941.3 and the ATMF each recommend the use of the GIT IE for carrying the eecid (synonymous with bnc-id) in the set-up message of ATM signaling protocols (Q.2931, UNI 4.0, PNNI, AINI, IISP). The coding for carrying the eecid (bnc-id) in the GIT IE is defined in ITU Q.2941.3 and accepted by the ATM forum.

- Another alternate method is to use the called party subaddress IE. In some networks, this might be considered a protocol violation and is not the recommended means of carrying the eecid (bnc-id). The GIT IE is the preferred method of transporting the eecid (bnc-id) in ATM signaling messages.

- The establish request (ERQ) message of the Q.2630.1 [37] signaling protocol can use the SUGR (Served User Generated Reference) IE to transport the eecid (bnc-id).

The node assigning the eecid can release and re-use it when it receives a Q.2931 [15] set-up message or a Q.2630.1 [37] establish request message containing the eecid.

However, in both cases (backward and forward models), it is recommended that this eecid be retained until the connection terminates. Since the eecid space is large enough, it is not necessary to release it as soon as possible.

5.6.1.2 The ’aalType’ attribute

When present, the ’aalType’ attribute is used to indicate the ATM adaptation layer. If this information is redundant with the ’m’ line, it can be omitted. The format of the ’aalType’ media attribute line is as follows:

```
a=aalType: <aalType>
```

Here, <aalType> can take on the following string values: "AAL1", "AAL1_SDT", "AAL1_UDT", "AAL2", "AAL3/4", "AAL5" and "USER_DEFINED_AAL". Note that "AAL3/4" and "USER DEFINED AAL" are not addressed in this document.

5.6.1.3 The ’capability’ attribute

When present, the ’capability’ attribute indicates the ATM Transfer Capability described in ITU I.371 [28], equivalent to the ATM Service Category described in the UNI 4.1 Traffic Management specification [6].

The ’capability’ media attribute line is structured in one of the following ways:

```
a=capability:<asc> <subtype>

a=capability:<atc> <subtype>
```

Possible values of the <asc> are enumerated below:

"CBR", "nrt-VBR", "rt-VBR", "UBR", "ABR", "GFR"

Possible values of the <atc> are enumerated below:

"DBR","SBR","ABT/IT","ABT/DT","ABR"

Some applications might use non-standard <atc> and <asc> values not listed above. Equipment designers will need to agree on the meaning and implications of non-standard transfer capabilities / service capabilities.

The <subtype> field essentially serves as a subscript to the <asc> and <atc> fields. In general, it can take on any integer value, or the "-" value indicating that it does not apply or that the underlying data is to be known by other means, such as provisioning.

For an <asc> value of CBR and an <atc> value of DBR, the <subtype> field can be assigned values from Table 4-6 of ITU Q.2931 [15]. These are:

<asc>/<atc>	<subtype>	Meaning
"CBR"/"DBR"	1	Voiceband signal transport (ITU G.711, G.722, I.363)
"CBR"/"DBR"	2	Circuit transport (ITU I.363)
"CBR"/"DBR"	4	High-quality audio signal transport (ITU I.363)
"CBR"/"DBR"	5	Video signal transport (ITU I.363)

Note that [15] does not define a <subtype> value of 3.

For other values of the <asc> and <atc> parameters, the following values can be assigned to the <subtype> field, based on [6] and [28].

<asc>/<atc>	<subtype>	Meaning
nrt-VBR	1	nrt-VBR.1
nrt-VBR	2	nrt-VBR.2
nrt-VBR	3	nrt-VBR.3
rt-VBR	1	rt-VBR.1
rt-VBR	2	rt-VBR.2
rt-VBR	3	rt-VBR.3
UBR	1	UBR.1
UBR	2	UBR.2
GFR	1	GFR.1
GFR	2	GRR.2
SBR	1	SBR1
SBR	2	SBR2
SBR	3	SBR3

It is beyond the scope of this specification to examine the equivalence of some of the ATMF and ITU definitions. These need to be recognized from the ATMF and ITU source specifications and exploited, as much as possible, to simplify ATM node design.

When the bearer connection is a single AAL2 CID connection within a multiplexed AAL2 VC, the ’capability’ attribute does not apply.

5.6.1.4 The ’qosClass’ attribute

When present, the ’qosClass’ attribute indicates the QoS class specified in ITU I.2965.1 [34].

The ’qosClass’ media attribute line is structured as follows:

```
a=qosClass:<qosClass>
```

Here, <qosClass> is an integer in the range 0 - 5.

<qosClass>	Meaning
0	Default QoS
1	Stringent
2	Tolerant
3	Bi-level
4	Unbounded
5	Stringent bi-level

5.6.1.5 The ’bcob’ attribute

When present, the ’bcob’ attribute represents the broadband connection oriented bearer class defined in [5], [15] and [33]. It can also be used to indicate whether end-to-end timing is required.

The ’bcob’ media attribute line is structured as follows:

a=bcob:<bcob> <eetim>

Here, <bcob> is the decimal or hex representation of a 5-bit field. The following values are currently defined:

<bcob>	Meaning
0x01	BCOB-A
0x03	BCOB-C
0x05	Frame relaying bearer service
0x10	BCOB-X
0x18	BCOB-VP (transparent VP service)

The <eetim> parameter can be assigned a value of "on" or "off" depending on whether end-to-end timing is required or not (Table 4-8 of [15]).

Either of these parameters can be left unspecified by setting it to a "-". A ’bcob’ media attribute line with all parameters set to "-" carries no information and should be omitted.

5.6.1.6 The ’stc’ attribute

When present, the ’stc’ attribute represents susceptibility to clipping. The ’stc’ media attribute line is structured as follows:

a=stc:<stc>

Here, <stc> is the decimal equivalent of a 2-bit field. Currently, all values are unused and reserved with the following exceptions:

<stc> value	Binary Equivalent	Meaning
0	00	Not susceptible to clipping
1	01	Susceptible to clipping

5.6.1.7 The ’upcc’ attribute

When present, the ’upcc’ attribute represents the user plane connection configuration. The ’upcc’ media attribute line is structured as follows:

a=upcc:<upcc>

Here, <upcc> is the decimal equivalent of a 2-bit field. Currently, all values are unused and reserved with the following exceptions:

<upcc> value	Binary Equivalent	Meaning
0	00	Point to point
1	01	Point to multipoint

5.6.1.8 The ’atmQOSparms’ attribute

When present, the ’atmQOSparms’ attribute is used to describe certain key ATM QoS parameters.

The ’atmQOSparms’ media attribute line is structured as follows:

a=atmQOSparms:<directionFlag><cdvType><acdv><ccdv><eetd><cmtd><aclr>

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <cdvType> parameter can take on the string values of "PP" and "2P". These refer to the peak-to-peak and two-point CDV as defined in UNI 4.0 [5] and ITU Q.2965.2 [35] respectively.

The CDV parameters, <acdv> and <ccdv>, refer to the acceptable and cumulative CDVs respectively. These are expressed in units of microseconds and represented as the decimal equivalent of a 24-bit field. These use the cell loss ratio, <aclr>, as the "alpha" quantiles defined in the ATMF TM 4.1 specification [6] and in ITU I.356 [47].

The transit delay parameters, <eetd> and <cmtd>, refer to the end-to-end and cumulative transit delays respectively in milliseconds. These are represented as the decimal equivalents of 16-bit fields. These parameters are defined in Q.2965.2 [35], UNI 4.0 [5] and Q.2931 [15].

The <aclr> parameter refers to forward and backward acceptable cell loss ratios. This is the ratio between the number of cells lost and the number of cells transmitted. It is expressed as the decimal equivalent of an 8-bit field. This field expresses an order of magnitude n, where n is an integer in the range 1-15. The Cell Loss Ratio takes on the value 10 raised to the power of minus n.

The <directionFlag> is always specified. Except for the <directionFlag>, the remaining parameters can be set to "-" to indicate that they are not specified, inapplicable or implied. However, there must be some specified parameters for the line to be useful in an SDP description.

There can be several ’atmQOSparms’ lines in an SDP description.

An example use of these attributes for an rt-VBR, single-CID AAL2 voice VC is:

```
a=atmQOSparms:f PP  8125 3455 32000 -  11
a=atmQOSparms:b PP  4675 2155 18000 -  12
```

This implies a forward acceptable peak-to-peak CDV of 8.125 ms, a backward acceptable peak-to-peak CDV of 4.675 ms, forward cumulative peak-to-peak CDV of 3.455 ms, a backward cumulative peak-to-peak CDV of 2.155 ms, a forward end-to-end transit delay of 32 ms, a backward end-to-end transit delay of 18 ms, an unspecified forward cumulative transit delay, an unspecified backward cumulative transit delay, a forward cell loss ratio of 10 raised to minus 11 and a backward cell loss ratio of 10 to the minus 12.

An example of specifying the same parameters for the forward and backward directions is:

```
a=atmQOSparms:fb PP  8125 3455 32000 -  11
```

This implies a forward and backward acceptable peak-to-peak CDV of 8.125 ms, a forward and backward cumulative peak-to-peak CDV of 3.455 ms, a forward and backward end-to-end transit delay of 32 ms, an unspecified cumulative transit delay in the forward and backward directions, and a cell loss ratio of 10 raised to minus 11 in the forward and backward directions.

5.6.1.9 The 'atmTrfcDesc' attribute

When present, the 'atmTrfcDesc' attribute is used to indicate ATM traffic descriptor parameters. There can be several 'atmTrfcDesc' lines in an SDP description.

The 'atmTrfcDesc' media attribute line is structured as follows:

```
a=atmTrfcDesc:<directionFlag><clpLvl>
          <pcr><scr><mbs><cdvt><mcr><mfs><fd><te>
```

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <directionFlag> is always specified. Except for the <directionFlag>, the remaining parameters can be set to "-" to indicate that they are not specified, inapplicable or implied. However, there must be some specified parameters for the line to be useful in an SDP description.

The <clpLvl> (CLP level) parameter indicates whether the rates and bursts described in these media attribute lines apply to CLP values of 0 or (0+1). It can take on the following string values: "0", "0+1" and "-". If rates and bursts for both <clpLvl> values are to be described, then it is necessary to use two separate media attribute lines for each direction in the same session descriptor. If the <clpLvl> parameter is set to "-", then it implies that the CLP parameter is known by other means such as default, MIB provisioning etc.

The meaning, units and applicability of the remaining parameters are per [6] and [28]:

PARAMETER	MEANING	UNITS	APPLICABILITY
<pcr>	PCR	Cells/ second	CBR, rt-VBR, nrt-VBR, ABR, UBR, GFR; CLP=0,0+1
<scr>	SCR	Cells/ second	rt-VBR, nrt-VBR; CLP=0,0+1
<mbs>	MBS	Cells	rt-VBR, nrt-VBR, GFR; CLP=0,0+1

<cdvt>	CDVT	Microsec.	CBR, rt-VBR, nrt-VBR, ABR, UBR, GFR; CLP=0,0+1
<mcr>	MCR	Cells/ second	ABR,GFR; CLP=0+1
<mfs>	MFS	Cells	GFR; CLP=0,0+1
<fd>	Frame Discard Allowed	"on"/"off"	CBR, rt-VBR, nrt-VBR, ABR, UBR, GFR; CLP=0+1
<te>	CLP tagging Enabled	"on"/"off"	CBR, rt-VBR, nrt-VBR, ABR, UBR, GFR; CLP=0

<fd> indicates that frame discard is permitted. It can take on the string values of "on" or "off". Note that, in the GFR case, frame discard is always enabled. Hence, this subparameter can be set to "-" in the case of GFR. Since the <fd> parameter is independent of CLP, it is meaningful in the case when <clpLvl> = "0+1". It should be set to "-" for the case when <clpLvl> = "0".

<te> (tag enable) indicates that CLP tagging is allowed. These can take on the string values of "on" or "off". Since the <te> parameter applies only to cells with a CLP of 0, it is meaningful in the case when <clpLvl> = "0". It should be set to "-" for the case when <clpLvl> = "0+1".

An example use of these media attribute lines for an rt-VBR, single-CID AAL2 voice VC is:

```
a=atmTrfcDesc:f 0+1 200   100  20   - - - on  -
a=atmTrfcDesc:f 0   200   80   15   - - - -  off
a=atmTrfcDesc:b 0+1 200   100  20   - - - on -
a=atmTrfcDesc:b 0   200   80   15   - - - -  off
```

This implies a forward and backward PCR of 200 cells per second all cells regardless of CLP, forward and backward PCR of 200 cells per second for cells with CLP=0, a forward and backward SCR of 100 cells per second for all cells regardless of CLP, a forward and backward SCR of 80 cells per second for cells with CLP=0, a forward and backward MBS of 20 cells for all cells regardless of CLP, a forward

and backward MBS of 15 cells for cells with CLP=0, an unspecified CDVT which can be known by other means, and an MCR and MFS which are unspecified because they are inapplicable. Frame discard is enabled in both the forward and backward directions. Tagging is not enabled in either direction.

The <pcr>, <scr>, <mbs>, <cdvt>, <mcr> and <mfs> are represented as decimal integers, with range as defined in Section 6. See section 2.2 regarding the omission of leading zeros in decimal representations.

5.6.1.10 The ’abrParms’ attribute

When present, the ’abrParms’ attribute is used to indicate the ’ additional’ ABR parameters specified in the UNI 4.0 signaling specification [5]. There can be several ’abrParms’ lines in an SDP description.

The ’abrParms’ media attribute line is structured as follows:

```
a=abrParms:<directionFlag><nrm><trm><cdf><adtf>
```

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <directionFlag> is always specified. Except for the <directionFlag>, the remaining parameters can be set to "-" to indicate that they are not specified, inapplicable or implied. However, there must be some specified parameters for the line to be useful in an SDP description.

These parameters are mapped into the ABR service parameters in [6] in the manner described below. These parameters can be represented in SDP as decimal integers, with fractions permitted for some. Details of the meaning, units and applicability of these parameters are in [5] and [6].

In SDP, these parameters are represented as the decimal or hex equivalent of the binary fields mentioned below.

PARAMETER	MEANING	FIELD SIZE
<nrm>	Maximum number of cells per forward Resource Management cell	3 bits
<trm>	Maximum time between forward Resource Management cells	3 bits
<cdf>	Cutoff Decrease Factor	3 bits
<adtf>	Allowed Cell Rate Decrease Time Factor	10 bits

5.6.1.11 The ’abrSetup’ attribute

When present, the ’abrSetup’ attribute is used to indicate the ABR parameters needed during call/connection establishment (Section 10.1.2.2 of the UNI 4.0 signaling specification [5]). This line is structured as follows:

a=abrSetup:<ficr><bicr><ftbe><btbe><crmrtt><frif><brif><frdf><brdf>

These parameters are defined as follows:

PARAMETER	MEANING	REPRESENTATION
<ficr>	Forward Initial Cell Rate (Cells per second)	Decimal equivalent of 24-bit field
<bicr>	Backward Initial Cell Rate (Cells per second)	Decimal equivalent of 24-bit field
<ftbe>	Forward transient buffer exposure (Cells)	Decimal equivalent of 24-bit field
<btbe>	Backward transient buffer exposure (Cells)	Decimal equivalent of 24-bit field
<crmrtt>	Cumulative RM round-trip time (Microseconds)	Decimal equivalent of 24-bit field
<frif>	Forward rate increase factor (used to derive cell count)	Decimal integer 0 -15
<brif>	Backward rate increase factor (used to derive cell count)	Decimal integer 0 -15
<frdf>	Forward rate decrease factor (used to derive cell count)	Decimal integer 0 -15
<brdf>	Backward rate decrease factor (used to derive cell count)	Decimal integer 0 -15

See Section 2.3 for a definition of the terms ’forward’ and ’backward’.

If any of these parameters in the ’abrSetup’ media attribute line is not specified, is inapplicable or is implied, then it is set to h "-".

5.6.1.12 The ’bearerType’ attribute

When present, the ’bearerType’ attribute is used to indicate whether the underlying bearer is an ATM PVC/SPVC, an ATM SVC, or a subchannel within an existing ATM SVC/PVC/SPVC. Additionally, for ATM SVCs and AAL2 CID connections, the ’bearerType’ attribute can be used to indicate whether the media gateway initiates connection set-up via bearer signaling (Q.2931-based or Q.2630.1 based). The format of the ’bearerType’ media attribute line is as follows:

a=bearerType: <bearerType> <localInitiation>

The <bearerType> field can take on the following string values:

"PVC", "SVC", "CID", with semantics as defined above. Here, "PVC" includes both the PVC and SPVC cases.

In the case when the underlying bearer is a PVC/SPVC, or a CID assigned by the MGC rather than through bearer signaling, the <localInitiation> flag can be omitted or set to "-". In the case when bearer signaling is used, this flag can be omitted when it is known by default or by other means whether the media gateway initiates the connection set-up via bearer signaling. Only when this is to be indicated explicitly that the <localInitiation> flag takes on the values of "on" or "off". An "on" value indicates that the media gateway is responsible for initiating connection set-up via bearer signaling (SVC signaling or Q.2630.1 signaling), an "off" value indicates otherwise.

5.6.1.13 The ’lij’ attribute

When present, the ’lij’ attribute is used to indicate the presence of a connection that uses the Leaf-initiated-join capability described in UNI 4.0 [5], and to optionally describe parameters associated with this capability. The format of the ’lij’ media attribute line is as follows:

a=lij: <sci><lsn>

The <sci> (screening indication) is a 4-bit field expressed as a decimal or hex integer. It is defined in the UNI 4.0 signaling specification [5]. It is possible that the values of this field will be defined later by the ATMF and/or ITU. Currently, all values are reserved with the exception of 0, which indicates a ’Network Join without Root Notification’.

The <lsn> (leaf sequence number) is a 32-bit field expressed as a decimal or hex integer. Per the UNI 4.0 signaling specification [5], it is used by a joining leaf to associate messages and responses during LIJ (leaf initiated join) procedures.

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

5.6.1.14 The ’anycast’ attribute

When present, the ’anycast’ attribute line is used to indicate the applicability of the anycast function described in UNI 4.0 [5]. Optional parameters to qualify this function are provided. The format of the ’anycast’ attribute is:

```
a=anycast: <atmGroupAddress> <cdStd> <conScpTyp> <conScpSel>
```

The <atmGroupAddress> is per Annex 5 of UNI 4.0 [5]. Within an SDP descriptor, it can be represented in one of the formats (NSAP, E.164, GWID/ALIAS) described elsewhere in this document.

The remaining subparameters mirror the connection scope selection information element in UNI 4.0 [5]. Their meaning and representation is as shown below:

PARAMETER	MEANING	REPRESENTATION
<cdStd>	Coding standard for the connection scope selection IE Definition: UNI 4.0 [5]	Decimal or hex equivalent of 2 bits
<conScpTyp>	Type of connection scope Definition: UNI 4.0 [5]	Decimal or hex equivalent of 4 bits
<conScpSel>	Connection scope selection Definition: UNI 4.0 [5]	Decimal or hex equivalent of 8 bits

Currently, all values of <cdStd> and <conScpTyp> are reserved with the exception of <cdStd> = 3 (ATMF coding standard) and <conScpTyp> = 1 (connection scope type of ’organizational’).

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

5.6.1.15 The ’cache’ attribute

This attribute is used to enable SVC caching. This attribute has the following format:

```
a=cache:<cacheEnable><cacheTimer>
```

The <cacheEnable> flag indicates whether caching is enabled or not, corresponding to the string values of "on" and "off" respectively.

The <cacheTimer> indicates the period of inactivity following which the SVC is to be released by sending an SVC release message into the network. This is specified as the decimal or hex equivalent of a 32-bit field, indicating the timeout in seconds. As usual, leading zeros can be omitted. For instance,

```
a=cache:on 7200
```

implies that the cached SVC is to be deleted if it is idle for 2 hours.

The <cacheTimer> can be set to "-" if it is inapplicable or implied.

5.6.1.16 The ’bearerSigIE’ attribute

ATM signaling standards provide ’escape mechanisms’ to represent, signal and negotiate higher-layer parameters. Examples are the B-HLI and B-LLI IEs specified in ITU Q.2931 [15], and the user-to-user information element described in ITU Q.2957 [48].

The ’bearerSigIE’(bearer signaling information element) attribute is defined to allow a similar escape mechanism that can be used with these ATM SDP conventions. The format of this media attribute line is as follows:

```
a=bearerSigIE: <bearerSigIEType> <bearerSigIELng> <bearerSigIEVal>
```

When an ’bearerSigIE’ media attribute line is present, all its subparameters are mandatory. The "0x" prefix is not used since these are always represented in hex.

The <bearerSigIEType> is represented as exactly 2 hex digits. It is the unique IE identifier as defined in the ITU Q-series standards. Leading zeros are not omitted. Some pertinent values are 7E (User-user IE per ITU Q.2957 [48]), 5F (B-LLI IE) and 5D (B-HLI IE). B-LLI and B-HLI, which stand for Broadband Low-layer Information and Broadband High-layer Information respectively, are defined in ITU Q.2931 [15]. Both of these refer to layers above the ATM adaptation layer.

The <bearerSigIELng> consists of 1-4 hex digits. It is the length of the information element in octets. Leading zeros may be omitted.

The <bearerSigIEVal> is the value of the information element, represented as a hexadecimal bit map. Although the size of this bit map is network/ service dependent, setting an upper bound of 256 octets (512 hex digits) is adequate. Since this a bit map, leading zeros should not be omitted. The number of hex digits in this bit map is even.

5.6.2 ATM Adaptation Layer (AAL) attributes

The following is a summary list of the SDP media attributes that can be used to describe the ATM Adaptation Layer (AAL). These are detailed in subsequent subsections.

* The 'aalApp' attribute, which is used to point to the controlling standard for an application layer above the ATM adaptation layer.

* The 'cbrRate' attribute, which represents the CBR rate octet defined in Table 4-6 of ITU Q.2931 [15].

* The 'sbc' attribute, which denotes the subchannel count in the case of n x 64 clear channel communication.

* The 'clkrec' attribute, which indicates the clock recovery method for AAL1 unstructured data transfer (UDT).

* The 'fec' attribute, which indicates the use of forward error correction.

* The 'prtfl' attribute, which indicates indicate the fill level of partially filled cells.

* The 'structure' attribute, which is used to indicate the presence or absence of AAL1 structured data transfer (SDT), and the size of the SDT blocks.

* The 'cpsSDUsize' attribute, which is used to indicate the maximum size of the CPCS SDU payload.

* The 'aal2CPS' attribute, which is used to indicate that an AAL2 CPS sublayer as defined in ITU I.363.2 [13] is associated with the VCC referred to in the 'm' line. Optionally, it can be used to indicate selected CPS options and parameter values for this VCC.

* The 'aal2CPSSDUrate' attribute, which is used to place an upper bound on the SDU bit rate for an AAL2 CID.

* The ’aal2sscs3661unassured’ attribute, which is used to indicate the presence of an AAL2 SSCS sublayer with unassured transmission as defined in ITU I.366.1 [12]. Optionally, it can be used to indicate selected options and parameter values for this SSCS.

* The ’aal2sscs3661assured’ attribute, which is used to indicate the presence of an AAL2 SSCS sublayer with assured transmission as defined in ITU I.366.1 [12]. Optionally, it can be used to indicate selected options and parameter values for this SSCS.

* The ’aal2sscs3662’ attribute, which is used to indicate the presence of an AAL2 SSCS sublayer as defined in ITU I.366.2. Optionally, it can be used to indicate selected options and parameter values for this SSCS.

* The ’aal5sscop’ attribute, which is used to indicate the existence of an SSCOP protocol layer over an AAL5 CPS layer, and the parameters which pertain to this SSCOP layer.

5.6.2.1 The ’aalApp’ attribute

When present, the ’aalApp’ attribute is used to point to the controlling standard for an application layer above the ATM adaptation layer. The format of the ’aalApp’ media attribute line is as follows:

```
a=aalApp: <appClass> <oui> <appId>
```

If any of the subparameters, <appClass>, <oui> or <appId>, is meant to be left, unspecified, it is set to "-". However, an ’aalApp’ attribute line with all subparameters set to "-" carries no information and should be omitted.

The <appClass>, or application class, field can take on the string values listed below.

This list is not exhaustive. An "X-" prefix should be used with <appClass> values not listed here.

<appClass>	Meaning
"itu_h323c"	Annex C of H.323 which specifies direct RTP on AAL5 [45].
"af83"	af-vtoa-0083.001, which specifies variable size AAL5 PDUs with PCM voice and a null SSCS [46].

"AAL5_SSCOP"	SSCOP as defined in ITU Q.2110 [43] running over an AAL5 CPS [21]. No information is provided regarding any layers above SSCOP such as Service Specific Coordination Function (SSCF) layers.
"itu_i3661_unassured"	SSCS with unassured transmission, per ITU I.366.1 [12].
"itu_i3661_assured"	SSCS with assured transmission, per ITU I.366.1 [12]. This uses SSCOP [43].
"itu_i3662"	SSCS per ITU I.366.2 [13].
"itu_i3651"	Frame relay SSCS per ITU I.365.1 [39].
"itu_i3652"	Service-specific coordination function, as defined in ITU I.365.2, for Connection Oriented Network Service (SSCF-CONS) [40]. This uses SSCOP [43].
"itu_i3653"	Service-specific coordination function, as defined in ITU I.365.3, for Connection Oriented Transport Service (SSCF-COTS) [41]. This uses SSCOP [43].
"itu_i3654"	HDLC Service-specific coordination function, as defined in ITU I.365.4 [42].
"FRF5"	Use of the FRF.5 frame relay standard [53], which references ITU I.365.1 [39].
"FRF8"	Use of the FRF.8.1 frame relay standard [54]. This implies a null SSCS and the mapping of the frame relay header into the ATM header.
"FRF11"	Use of the FRF.11 frame relay standard [55].
"itu_h2221"	Use of the ITU standard H.222.1 for audiovisual communication over AAL5 [51].

The <oui>, or Organizationally Unique Identifier, refers to the organization responsible for defining the <appId>, or Application Identifier. The <oui> is maintained by the IEEE. One of its uses is in 802 MAC addresses. It is a three-octet field represented as one to six hex digits. Since this is always represented in hex, the "0x" prefix is not used. Leading zeros may be omitted.

The <appId> subparameter refers to the application ID, a hex number consisting of up to 8 digits. Leading zeros may be omitted. The "0x" prefix is not used, since the representation is always hexadecimal. Currently, the only organization that has defined application identifiers is the ATM forum. These have been defined in the context of AAL2 ([44], [52], Section 5 of [61]). Within SDP, these can be used with <appClass> = itu_i3662. The <oui> value for the ATM forum is 0x00A03E.

In the following example, the aalApp media attribute line is used to indicate 'Loop Emulation Service using CAS (POTS only) without the Emulated Loop Control Protocol (ELCP) [52]. The Application ID is defined by the ATM forum [61]. The SSCS used is per ITU I.366.2 [13].

```
a=aalApp:itu_i3662 A03E A
```

If leading zeros are not dropped, this can be represented as:

```
a=aalApp:itu_i3662 00A03E 0000000A
```

Since application identifiers have been specified only in the context of the AAL2 SSCS defined in ITU I.366.2 [13],the <appClass> can be set to '-' without ambiguity. The aalApp media attribute line can be reduced to:

```
a=aalApp:- A03E A
```

or

```
a=aalApp:- 00A03E 0000000A
```

5.6.2.2 The 'cbrRate' attribute

When present, the 'cbrRate' attribute is used to represent the CBR rate octet defined in Table 4-6 of ITU Q.2931 [15]. The format of this media attribute line is:

```
a=cbrRate: <cbrRate>
```

Here, <cbrRate> is represented as exactly two hex digits. The "0x" prefix is omitted since this parameter is always represented in hex. Values currently defined by the ITU are:

VALUE (hex)	MEANING
01	64 kbps
04	1544 kbps
05	6312 kbps
06	32064 kbps
07	44736 kbps
08	97728 kbps
10	2048 kbps
11	8448 kbps
12	34368 kbps
13	139264 kbps
40	n x 64 kbps
41	n x 8 kbps

It is preferable that the cbrRate attribute be omitted rather than set to an unspecified value of "-", since it conveys no information in the latter case.

5.6.2.3 The ’sbc’ attribute

The ’sbc’ media attribute line denotes the subchannel count and is meaningful only in the case of n x 64 clear channel communication. A clear n x 64 channel can use AAL1 (ATM forum af-vtoa-78) or AAL2 adaptation (ITU I.366.2). Although no such standard definition exists, it is also possible to use AAL5 for this purpose. An n x 64 clear channel is represented by the encoding names of "X-CCD" and "X-CCD-CAS" in Table 2.

The format of the ’sbc’ media attribute line is as follows:

```
a=sbc:<sbc>
```

Here, <sbc> can be expressed as a decimal or hex integer. This attribute indicates the number of DS0s in a T1 or E1 frame that are aggregated for transmitting clear channel data. For T1-based applications, it can take on integral values in the inclusive range [1...24]. For E1-based applications, it can take on integral values in the inclusive range [1...31]. When omitted, other means are to be used to determine the subchannel count.

Use of the 'sbc' attribute provides a direct way to indicate the number of 64 kbps subchannels bundled into an n x 64 clear channel. An alternate mechanism to indicate this exists within the SDP bandwidth information, or 'b', line [1]. In this case, instead of specifying the number of subchannels, the aggregate bandwidth in kbps is specified. The syntax of the 'b' line, copied verbatim from [1], is as follows:

```
b=<modifier>:<bandwidth-value>
```

In the case of n x 64 clear channels, the <modifier> is assigned a text string value of "AS", indicating that the 'b' line is application-specific. The <bandwidth-value> parameter, which is a decimal number indicating the bandwidth in kbps, is limited to one of the following values in the n x 64 clear channel application context:

```
64, 128, 192, 256, 320, 384, 448, 512, 576, 640, 704, 768, 832,
896, 960, 1024, 1088, 1152, 1216, 1280, 1344, 1408, 1472, 1600,
1664, 1728, 1792, 1856, 1920, 1984
```

Thus, for n x 64 circuit mode data service,

```
a=sbc:6
```

is equivalent to

```
b=AS:384
```

The media attribute line

```
a=sbc:2
```

is equivalent to

```
b=AS:128
```

5.6.2.4 The ’clkrec’ attribute

When present, the ’clkrec’ attribute is used to indicate the clock recovery method. This attribute is meaningful in the case of AAL1 unstructured data transfer (UDT). The format of the ’clkrec’ media attribute line is as follows:

```
a=clkrec:<clkrec>
```

The <clkrec> field can take on the following string values: "NULL", "SRTS" or "ADAPTIVE". SRTS and adaptive clock recovery are defined in ITU I.363.1 [10]. "NULL" indicates that the stream (e.g., T1/E1) encapsulated in ATM is synchronous to the ATM network or is retimed, before AAL1 encapsulation, via slip buffers.

5.6.2.5 The ’fec’ attribute

When present, the ’fec’ attribute is used to indicate the use of forward error correction. Currently, there exists a forward error correction method defined for AAL1 in ITU I.363.1 [10]. The format of the ’fec’ media attribute line is as follows:

```
a=fec:<fecEnable>
```

The <fecEnable> flag indicates the presence of absence of Forward Error Correction. It can take on the string values of "NULL", "LOSS_SENSITIVE" and "DELAY_SENSITIVE". An "NULL" value implies disabling this capability. FEC can be enabled differently for delay-sensitive and loss-sensitive connections.

5.6.2.6 The ’prtfl’ attribute

When present, the ’prtfl’ attribute is used to indicate the fill level of cells. When this attribute is absent, then other means (such as provisionable defaults) are used to determine the presence and level of partial fill.

This attribute indicates the number of non-pad payload octets, not including any AAL SAR or convergence sublayer octets. For example, in some AAL1 applications that use partially filled cells with padding at the end, this attribute indicates the number of leading payload octets not including any AAL overhead.

The format of the ’prtfl’ media attribute line is as follows:

```
a=prtfl:<partialFill>
```

Here, <partialFill> can be expressed as a decimal or a hex integer.

In general, permitted values are integers in the range 1 - 48 inclusive. However, this upper bound is different for different adaptations since the AAL overhead, if any, is different. If the specified partial fill is greater than or equal to the maximum fill, then complete fill is used. Using a ’partial’ fill of 48 always disables partial fill.

In the AAL1 context, this media attribute line applies uniformly to both P and non-P cells. In AAL1 applications that do not distinguish between P and non-P cells, a value of 47 indicates complete fill (i.e., the absence of partial fill). In AAL1 applications that distinguish between P and non-P cells, a value of 46 indicates no padding in P-cells and a padding of one in non-P cells.

If partial fill is enabled (i.e there is padding in at least some cells), then AAL1 structures must not be split across cell boundaries. These shall fit in any cell. Hence, their size shall be less than or equal to the partial fill size. Further, the partial fill size is preferably an integer multiple of the structure size. If not, then the partial fill size stated in the SDP description shall be truncated to an integer multiple (e.g., a partial fill size of 40 is truncated to 36 to support six 6 x 64 channels).

5.6.2.7 The ’structure’ attribute

This attribute applies to AAL1 connections only. When present, the ’structure’ attribute is used to indicate the presence or absence of structured data transfer (SDT), and the size in octets of the SDT blocks. The format of the ’structure’ media attribute line is as follows:

```
a=structure: <structureEnable> <blksz>
```

where the <structureEnable> flag indicates the presence of absence of SDT. It can take on the values of "on" or "off". An "on" value implies AAL1 structured data transfer (SDT), while an "off" value implies AAL1 unstructured data transfer (UDT).

The block size field, <blksz>, is an optional 16-bit field [15] that can be represented in decimal or hex. It is set to a "-" when not applicable, as in the case of unstructured data transfer (UDT). For SDT, it can be set to a "-" when <blksz> is known by other means. For instance, af-vtoa-78 [7] fixes the structure size for n x 64 service, with or without CAS. The theoretical maximum value of <blksz> is 65,535, although most services use much less.

5.6.2.8 The ’cpsSDUsize’ attribute

When present, the ’cpsSDUsize’ attribute is used to indicate the maximum size of the CPCS SDU payload. There can be several ’ cpsSDUsize’ lines in an SDP description.

The format of this media attribute line is as follows:

```
a=cpsSDUsize:<directionFlag><cpcs>
```

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <cpcs> fields is a 16-bit integer that can be represented in decimal or in hex. The meaning and values of these fields are as follows:

Application	Field	Meaning	Values
AAL5	<cpcs>	Maximum CPCS-SDU size	1- 65,535
AAL2	<cpcs>	Maximum CPCS-SDU size	45 or 64

5.6.2.9 The ’aal2CPS’ attribute

When present, the ’aal2CPS’ attribute is used to describe parameters associated with the AAL2 CPS layer.

The format of the ’aal2CPS’ media attribute line is as follows:
a=aal2CPS:<cidLowerLimit><cidUpperLimit><timerCU> <simplifiedCPS>

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

The <cidLowerLimit> and <cidUpperLimit> can be assigned integer values between 8 and 255 [11], with the limitation that <cidUpperLimit> be greater than or equal to <cidLowerLimit>. For instance, for POTS applications based on [52], <cidLowerLimit> and <cidUpperLimit> can have values of 16 and 223 respectively.

The <timerCU> integer represents the "combined use" timerCU defined in ITU I.363.2. This timer is represented as an integer number of microseconds. It is represented as the decimal integer equivalent of 32 bits.

The <simplifiedCPS> parameter can be assigned the values "on" or "off". When it is "on", the AAL2 CPS simplification described in [52] is adopted. Under this simplification, each ATM cell contains exactly on AAL2 packet. If necessary, octets at the end of the cell are padded with zeros. Since the <timerCU> value in this context is always 0, it can be set to "-".

5.6.2.10 The 'aal2CPSSDUrate' attribute

When present, the 'aal2CPSSDUrate' attribute is used to place an upper bound on the SDU bit rate for an AAL2 CID. This is useful for limiting the bandwidth used by a CID, specially if the CID is used for frame mode data defined in [13], or with the SSSAR defined in [12]. The format of this media attribute line is as follows:

```
a=aal2CPSSDUrate: <fSDUrate><bSDUrate>
```

The fSDUrate and bSDUrate are the maximum forward and backward SDU rates in bits/second. These are represented as decimal integers, with range as defined in Section 6. If any of these parameters in these media attribute lines is not specified, is inapplicable or is implied, then it is set to "-".

5.6.2.11 The 'aal2sscs3661unassured' attribute

When present, the 'aal2sscs3661unassured' attribute is used to indicate the options that pertain to the unassured transmission SSCS defined in ITU I.366.1 [12]. This SSCS can be selected via the aalApp attribute defined below, or by virtue of the presence of the 'aal2sscs3661unassured' attribute. The format of this media attribute line is as follows:

```
a=aal2sscs3661unassured: <ted> <rastimer> <fsssar> <bsssar>
```

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

The <ted> flag indicates the presence or absence of transmission error detection as defined in I.366.1. It can be assigned the values of "on" or "off". An "on" value indicates presence of the capability.

The <rastimer> subparameter indicates the SSSAR reassembly timer in microseconds. It is represented as the decimal equivalent of 32 bits.

The <fsssar> and <bsssar> fields are 24-bit integers that can be represented in decimal or in hex. The meaning and values of the <fsssar> and <bsssar> fields are as follows:

Field	Meaning	Values
<fsssar>	Maximum SSSAR-SDU size forward direction	1- 65,568
<bsssar>	Maximum SSSAR-SDU size backward direction	1- 65,568

If present, the SSTED (Service-Specific Transmission Error Detection) sublayer is above the SSSAR (Service-Specific Segmentation and Reassembly) sublayer [12]. Since the maximum size of the SSTED-SDUs can be derived from the maximum SSSAR-SDU size, it need not be specified separately.

5.6.2.12 The 'aal2sscs3661assured' attribute

When present, the 'aal2sscs3661assured' attribute is used to indicate the options that pertain to the assured transmission SSCS defined in ITU I.366.1 [12] on the basis of ITU Q.2110 [43]. This SSCS can be selected via the aalApp attribute defined below, or by virtue of the presence of the 'aal2sscs3661assured' attribute. The format of this media attribute line is as follows:

```
a=aal2sscs3661assured: <rastimer> <fsssar> <bsssar> <fsscopsdu>
                       <bsscopsdu><fsscopuu> <bsscopuu>
```

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

The <rastimer> subparameter indicates the SSSAR reassembly timer in microseconds. It is represented as the decimal equivalent of 32 bits.

The <fsssar> and <bsssar> fields are 24-bit integers that can be represented in decimal or in hex. The <fsscopsdu>, <bsscopsdu>, <fsscopuu> and <bsscopuu> fields are 16-bit integers that can be represented in decimal or in hex. The meaning and values of these fields is as follows:

Field	Meaning	Values
<fsssar>	Maximum SSSAR-SDU size forward direction	1- 65,568

<bsssar>	Maximum SSSAR-SDU size backward direction	1- 65,568
<fsscopsdu>	Maximum SSCOP-SDU size forward direction	1- 65,528
<bsscopsdu>	Maximum SSCOP-SDU size backward direction	1- 65,528
<fsscopuu>	Maximum SSCOP-UU field size, forward direction	1- 65,524
<bsscopuu>	Maximum SSCOP-UU field size, backward direction	1- 65,524

The SSTED (Service-Specific Transmission Error Detection) sublayer is above the SSSAR (Service-Specific Segmentation and Reassembly) sublayer [12]. The SSADT (Service-Specific Assured Data Transfer) sublayer is above the SSTED sublayer. Since the maximum size of the SSTED-SDUs and SSADT-SDUs can be derived from the maximum SSSAR-SDU size, they need not be specified separately.

The SSCOP protocol defined in [43] is used by the Assured Data Transfer service defined in [12]. In the context of the ITU I.366.1 SSCS, it is possible to use the 'aal2sscs3661assured' attribute to limit the maximum sizes of the SSCOP SDUs and UU (user-to-user) fields in either direction. Note that it is necessary for the parameters on the 'aal2sscs3661assured' media attribute line to be consistent with each other.

5.6.2.13 The 'aal2sscs3662' attribute

When present, the 'aal2sscs3662' attribute is used to indicate the options that pertain to the SSCS defined in ITU I.366.2 [13]. This SSCS can be selected via the aalApp attribute defined below, or by the presence of the 'aal2sscs3662' attribute.

The format of this media attribute line is as follows:

```
a=aal2sscs3662: <sap> <circuitMode> <frameMode> <faxDemod>
                <cas> <dtmf> <mfall> <mfr1> <mfr2>
                <PCMencoding> <fmaxFrame> <bmaxFrame>
```

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor. Additionally, the values of these fields need to be consistent with each other. Inconsistencies should be flagged as errors.

The <sap> field can take on the following string values: "AUDIO" and "MULTIRATE". These correspond to the audio and multirate Service Access Points (SAPs) defined in ITU I.366.2.

For the multirate SAP, the following parameters on the aal2sscs3662 attribute line do not apply: <faxDemod>,<cas>, <dtmf>, <mfall>, <mfr1>, <mfr2> and <PCMencoding>. These are set to "-" for the multirate SAP.

The <circuitMode> flag indicates whether the transport of circuit mode data is enabled or disabled, corresponding to the string values of "on" and "off" respectively. For the multirate SAP, it cannot have a value of "off". For the audio SAP, it can be assigned a value of "on", "off" or "-". Note that the <sbc> attribute, defined elsewhere in this document, can be used to specify the number of 64 kbps subchannels bundled into a circuit mode data channel.

The <frameMode> flag indicates whether the transport of frame mode data is enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <faxDemod> flag indicates whether facsimile demodulation and remodulation are enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <cas> flag indicates whether the transport of Channel Associated Signaling (CAS) bits in AAL2 type 3 packets is enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <dtmf> flag indicates whether the transport of DTMF dialled digits in AAL2 type 3 packets is enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <mfall> flag indicates whether the transport of MF dialled digits in AAL2 type 3 packets is enabled or disabled, corresponding to the string values of "on" and "off" respectively. This flag enables MF dialled digits in a generic manner, without specifying type (e.g., R1, R2 etc.).

The <mfr1> flag indicates whether the transport, in AAL2 type 3 packets, of MF dialled digits for signaling system R1 is enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <mfr2> flag indicates whether the transport, in AAL2 type 3 packets, of MF dialled digits for signaling system R2 is enabled or disabled, corresponding to the string values of "on" and "off" respectively.

The <PCMencoding> field indicates whether PCM encoding, if used, is based on the A-law or the Mu-law. This can be used to qualify the ’generic PCM’ codec stated in some of the AAL2 profiles. The <PCMencoding> field can take on the string values of "PCMA" and "PCMU".

The <fmaxFrame> and <bmaxFrame> fields are 16-bit integers that can be represented in decimal or in hex. The meaning and values of the <fmaxFrame> and <bmaxFrame> fields are as follows:

Field	Meaning	Values
<fmaxFrame>	Maximum length of a frame mode data unit, forward direction	1- 65,535
<bmaxFrame>	Maximum length of a frame mode data unit, backward direction	1- 65,535

5.6.2.14 The ’aal5sscop’ attribute

When present, the ’aal5sscop’ attribute is used to indicate the existence of an SSCOP [43] protocol layer over an AAL5 CPS layer [21], and the parameters which pertain to this SSCOP layer. SSCOP over AAL5 can also be selected via the aalApp attribute defined below. The format of the ’aal5sscop’ media attribute line is as follows:

```
a=aal5sscop: <fsscopsdu> <bsscopsdu> <fsscopuu> <bsscopuu>
```

Each of these fields can be set to a "-" when the intention is to not specify them in an SDP descriptor.

The representation, meaning and values of the <fsscopsdu>, <bsscopsdu>, <fsscopuu> and <bsscopuu> fields are identical to those for the ’aal2sscs3661assured’ media attribute line (Section 5.6.2.12). Note that it is necessary for the parameters on the ’aal5sscop’ media attribute line to be consistent with each other.

5.6.3 Service attributes

The following is a summary list of the SDP media attributes that can be used to describe the services that use the ATM Adaptation Layer (AAL). These attributes are detailed in subsequent subsections.

* The ’atmmap’ attribute. In the AAL1 and AAL5 contexts, this is used to dynamically map payload types into codec strings.

* The ’silenceSupp’ attribute, used to indicate the use of of voice activity detection for silence suppression, and to optionally parameterize the silence suppression function.

* The ’ecan’ attribute, used to indicate the use of of echo cancellation, and to parameterize the this function.

* The ’gc’ attribute, used to indicate the use of of gain control, and to parameterize the this function.

* The ’profileDesc’ attribute, which can be used to describe AAL2 profiles. Although any AAL2 profile can be so described, this attribute is useful for describing, at connection establishment time, custom profiles that might not be known to the far end. This attribute applies in the AAL2 context only.

* The ’vsel’ attribute, which indicates a prioritized list of 3-tuples for voice service. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

* The ’dsel’ attribute, which indicates a prioritized list of 3-tuples for voiceband data service. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

* The ’fsel’ attribute, which indicates a prioritized list of 3-tuples for facsimile service. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

* The ’onewaySel’ attribute, which indicates a prioritized list of 3-tuples for one direction of an asymmetric connection. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

* The ’codecconfig’ attribute, which is used to represent the contents of the single codec information element (IE) defined in ITU Q.765.5 [57].

* The ’isup_usi’ attribute which is used to represent the bearer capability information element defined in Section 4.5.5 of ITU Q.931 [59], and reiterated as the user service information element (IE) in Section 3.57 of ITU Q.763 [60].

* The 'uiLayer1_Prot' attribute, which is used to represent the 'User Information Layer 1 protocol' field within the bearer capability information element defined in Section 4.5.5 of ITU Q.931 [59].

5.6.3.1 The 'atmmap' attribute

The 'atmmap' attribute is defined on the basis of the 'rtpmap' attribute used in RFC 2327.

```
a=atmmap:<payloadType> <encodingName>
```

The 'atmmap' attribute is used to dynamically map encoding names into payload types. This is necessary for those encoding names which have not been assigned a static payload type through IANA [31]. Payload types and encoding techniques that have been registered with IANA for RTP are retained for AAL1 and AAL5.

The range of statically defined payload types is in the range 0-95. All static assignments of payload types to codecs are listed in [31]. The range of payload types defined dynamically via the 'atmmap' attribute is 96-127.

In addition to reiterating the payload types and encoding names in [31], Table 2 defines non-standard encoding names (with "X-" prefixes). Note that [31], rather than Table 2, is the authoritative list of standard codec names and payload types in the ATM context.

Table 2: Encoding Names and Payload Types

Encoding Technique	Encoding Name	Payload type
PCM - Mu law	"PCMU"	0 (Statically Mapped)
32 kbps ADPCM	"G726-32"	2 (Statically Mapped)
Dual rate 5.3/6.3kbps	"G723"	4 (Statically Mapped)
PCM- A law	"PCMA"	8 (Statically Mapped)
7 KHz audio coding within 64 kbps	"G722"	9 (Statically Mapped)
LD-CELP	"G728"	15 (Statically Mapped)
CS-ACELP (normal/low-complexity)	"G729"	18 (Statically Mapped)

Low-complexity CS-ACELP	"X-G729a"	None, map dynamically
Normal CS-ACELP w/ ITU defined silence suppression	"X-G729b"	None, map dynamically
Low-complexity CS-ACELP w/ ITU defined silence suppression	"X-G729ab"	None, map dynamically
16 kbps ADPCM	"X-G726-16"	None, map dynamically
24 kbps ADPCM	"X-G726-24"	None, map dynamically
40 kbps ADPCM	"X-G726-40"	None, map dynamically
Dual rate 5.3/6.3 kbps - high rate	"X-G7231-H"	None, map dynamically
Dual rate 5.3/6.3 kbps - low rate	"X-G7231-L"	None, map dynamically
Dual rate 5.3/6.3 kbps - high rate w/ ITU-defined silence suppression	"X-G7231a-H"	None, map dynamically
Dual rate 5.3/6.3 kbps - high rate w/ ITU-defined silence suppression	"X-G7231a-L"	None, map dynamically
16 kbps EADPCM	"X-G727-16"	None, map dynamically
24 kbps EADPCM	"X-G727-24"	None, map dynamically
32 kbps EADPCM	"X-G727-32"	None, map dynamically
n x 64 kbps Clear Channel without CAS per af-vtoa-78 [7]	"X-CCD"	None, map dynamically

n x 64 kbps Clear Channel with CAS per af-vtoa-78 [7]	"X-CCD-CAS"	None, map dynamically
GSM Full Rate	"GSM"	3 (Statically Mapped)
GSM Half Rate	"GSM-HR"	None, map dynamically
GSM-Enhanced Full Rate	"GSM-EFR"	None, map dynamically
GSM-Enhanced Half Rate	"GSM-EHR"	None, map dynamically
Group 3 fax demod.	"X-FXDMOD-3"	None, map dynamically
Federal Standard FED-STD 1016 CELP	"1016"	1 (Statically Mapped)
DVI4, 8 KHz [3]	"DVI4"	5 (Statically Mapped)
DVI4, 16 KHz [3]	"DVI4"	6 (Statically Mapped)
LPC [3], Linear Predictive Coding	"LPC"	7 (Statically Mapped)
L16 [3], Sixteen Bit Linear PCM, Double channel	"L16"	10 (Statically Mapped)
L16 [3], Sixteen Bit Linear PCM, Single channel	"L16"	11 (Statically Mapped)
QCELP [3]	"QCELP"	12 (Statically Mapped)
MPEG1/MPEG2 audio	"MPA"	14 (Statically Mapped)
DVI4, 11.025 KHz[3]	"DVI4"	16 (Statically Mapped)
DVI4, 22.05 KHz [3]	"DVI4"	17 (Statically Mapped)
MPEG1/MPEG2 video	"MPV"	32 (Statically Mapped)
MPEG 2 audio/video transport stream	"MP2T"	33 (Statically Mapped)
ITU H.261 video	"H261"	31 (Statically Mapped)

ITU H.263 video	"H263"	33 (Statically Mapped)
ITU H.263 video 1998 version	"H263-1998"	None, map dynamically
MPEG 1 system stream	"MP1S"	None, map dynamically
MPEG 2 program stream	"MP2P"	None, map dynamically
Redundancy	"RED"	None, map dynamically
Variable rate DVI4	"VDVI"	None, map dynamically
Cell-B	"CelB"	25
JPEG	"JPEG"	26
nv	"nv"	28
L8, Eight Bit Linear PCM	"L8"	None, map dynamically
ITU-R Recommendation BT.656-3 for digital video	"BT656"	None, map dynamically
Adaptive Multirate -Full Rate (3GPP)[58]	"FR-AMR"	None, map dynamically
Adaptive Multirate -Half Rate (3GPP)[58]	"HR-AMR"	None, map dynamically
Adaptive Multirate - UMTS(3GPP) [58]	"UMTS-AMR"	None, map dynamically
Adaptive Multirate - Generic [58]	"AMR"	None, map dynamically

5.6.3.2 The ’silenceSupp’ attribute

When present, the ’silenceSupp’ attribute is used to indicate the use or non-use of silence suppression. The format of the ’silenceSupp’ media attribute line is as follows:

```
a=silenceSupp: <silenceSuppEnable> <silenceTimer> <suppPref> <sidUse>
                 <fxnslevel>
```

If any of the parameters in the silenceSupp media attribute line is not specified, is inapplicable or is implied, then it is set to "-".

The <silenceSuppEnable> can take on values of "on" or "off". If it is "on", then silence suppression is enabled.

The <silenceTimer> is a 16-bit field which can be represented in decimal or hex. Each increment (tick) of this timer represents a millisecond. The maximum value of this timer is between 1 and 3 minutes. This timer represents the time-lag before silence suppression kicks in. Even though this can, theoretically, be as low as 1 ms, most DSP algorithms take more than that to detect silence. Setting <silenceTimer> to a large value (say 1 minute> is equivalent to disabling silence suppression within a call. However, idle channel suppression between calls on the basis of silence suppression is still operative in non-switched, trunking applications if <silenceSuppEnable> = "on" and <silenceTimer> is a large value.

The <suppPref> specifies the preferred silence suppression method that is preferred or already selected. It can take on the string values of "standard" and "custom". If its value is "standard", then a standard method (e.g., ITU-defined) is preferred to custom methods if such a standard is defined. Otherwise, a custom method may be used. If <suppPref> is set to "custom", then a custom method, if available, is preferred to the standard method.

The <sidUse> indicates whether SIDs (Silence Insertion Descriptors) are to be used, and whether they use fixed comfort noise or sampled background noise. It can take on the string values of "No SID", "Fixed Noise", "Sampled Noise".

If the value of <sidUse> is "Fixed Noise", then <fxnslevel> provides its level. It can take on integer values in the range 0-127, as follows:

<fxnslevel> value	Meaning
0-29	Reserved
30	-30 dBm0
31	-31 dBm0
. . .	. . .
77	-77 dBm0
78	-78 dBm0
79-126	reserved
127	Idle Code (no noise)

In addition to the decimal representation of <fxnslevel>, a hex representation, preceded by a "0x" prefix, is also allowed.

5.6.3.3 The ’ecan’ attribute

When present, the ’ecan’ attribute s is used to indicate the use or non-use of echo cancellation. There can be several ’ecan’ lines in an SDP description.

The format of the ’ecan’ media attribute line is as follows:

```
a=ecan:<directionFlag><ecanEnable><ecanType>
```

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <directionFlag> is always specified. Except for the <directionFlag>, the remaining parameters can be set to "-" to indicate that they are not specified, inapplicable or implied. However, there must be some specified parameters for the line to be useful in an SDP description.

If the ’ecan’ media attribute lines is not present, then means other than the SDP descriptor must be used to determine the applicability and nature of echo cancellation for a connection direction. Examples of such means are MIB provisioning, the local connection options structure in MGCP etc.

The <ecanEnable> parameter can take on values of "on" or "off". If it is "on", then echo cancellation is enabled. If it is "off", then echo cancellation is disabled.

The <ecanType> parameter can take on the string values "G165" and "G168" respectively.

When SDP is used with some media gateway control protocols such as MGCP and Megaco [26], there exist means outside SDP descriptions to specify the echo cancellation properties of a connection. Nevertheless, this media attribute line is included for completeness. As a result, the SDP can be used for describing echo cancellation in applications where alternate means for this are unavailable.

5.6.3.4 The ’gc’ attributes

When present, the ’gc’ attribute is used to indicate the use or non-use of gain control. There can be several ’gc’ lines in an SDP description.

The format of the ’gc’ media attribute line is as follows:

```
a=gc:<directionFlag><gcEnable><gcLvl>
```

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and backward). Conventions for the forward and backward directions are per section 2.3.

The <directionFlag> is always specified. Except for the <directionFlag>, the remaining parameters can be set to "-" to indicate that they are not specified, inapplicable or implied. However, there must be some specified parameters for the line to be useful in an SDP description.

If the ’gc’ media attribute lines is not present, then means other than the SDP descriptor must be used to determine the applicability and nature of gain control for a connection direction. Examples of such means are MIB provisioning, the local connection options structure in MGCP etc.

The <gcEnable> parameter can take on values of "on" or "off". If it is "on", then gain control is enabled. If it is "off", then gain control is disabled.

The <gcLvl> parameter is represented as the decimal or hex equivalent of a 16-bit binary field. A value of 0xFFFF implies automatic gain control. Otherwise, this number indicates the number of decibels of inserted loss. The upper bound, 65,535 dB (0xFFFE) of inserted loss, is a large number and is a carryover from Megaco [26]. In practical applications, the inserted loss is much lower.

When SDP is used with some media gateway control protocols such as MGCP and Megaco [26], there exist means outside SDP descriptions to specify the gain control properties of a connection. Nevertheless, this media attribute line is included for completeness. As a result, the SDP can be used for describing gain control in applications where alternate means for this are unavailable.

5.6.3.5 The ’profileDesc’ attribute

There is one ’profileDesc’ media attribute line for each AAL2 profile that is intended to be described. The ’profileDesc’ media attribute line is structured as follows:

```
a=profileDesc: <aal2transport> <profile>  <uuiCodeRange#1>
  <encodingName#1> <packetLength#1> <packetTime#1>
  <uuiCodeRange#2> <encodingName#2> <packetLength#2>
  <packetTime#2>... <uuiCodeRange#N> <encodingName#N>
  <packetLength#N> <packetTime#N>
```

Here, <aal2transport> can have those values of <transport> (Table 1) that pertain to AAL2. These are:

```
AAL2/ATMF
AAL2/ITU
AAL2/custom
AAL2/<corporateName>
AAL2/IEEE:<oui>
```

The parameter <profile> is identical to its definition for the ’m’ line (Section 5.5.4).

The profile elements (rows in the profile tables of ITU I.366.2 or AF-VTOA-0113) are represented as four-tuples following the <profile> parameter in the ’profileDesc’ media attribute line. If a member of one of these four-tuples is not specified or is implied, then it is set to "-".

The <uuiCodeRange> parameter is represented by D1-D2, where D1 and D2 are decimal integers in the range 0 through 15.

The <encodingName> parameter can take one of the values in column 2 of Table 2. Additionally, it can take on the following descriptor strings: "PCMG", "SIDG" and "SID729". These stand for generic PCM, generic SID and G.729 SID respectively.

The <packetLength> is a decimal integer representation of the AAL2 packet length in octets.

The <packetTime> is a decimal integer representation of the AAL2 packetization interval in microseconds.

For instance, the ’profileDesc’ media attribute line below defines the AAL2/custom 100 profile. This profile is reproduced in the Table 3 below. For a description of the parameters in this profile such as M and the sequence number interval, see ITU I.366.2 [13].

```
a=profileDesc:AAL2/custom 100 0-7 PCMG 40 5000 0-7 SIDG 1 5000 8-15
    G726-32 40 10000 8-15 SIDG 1 5000
```

If the <packetTime> parameter is to be omitted or implied, then the same profile can be represented as follows:

```
a=profileDesc:AAL2/custom 100 0-7 PCMG 40 - 0-7 SIDG 1 - 8-15
     G726-32 40 - 8-15 SIDG 1 -
```

If a gateway has a provisioned or hard coded definition of a profile, then any definition provided via the 'profileDesc' line overrides it. The exception to this rule is with regard to standard profiles such as ITU-defined profiles and ATMF-defined profiles. In general, these should not be defined via a 'profileDesc' media attribute line. If they are, then the definition needs to be consistent with the standard definition else the SDP session descriptor should be rejected with an appropriate error code.

Table 3: Example of a custom AAL2 profile

UUI Code point Range	Packet Length (octets)	Encoding per ITU I.366.2 2/99 version	Description of Algorithm	M	Packet Time (ms)	Seq.No. Interval (ms)
0-7	40	Figure B-1	PCM, G.711-64, generic	1	5	5
0-7	1	Figure I-1	Generic SID	1	5	5
8-15	40	Figure E-2	ADPCM, G.726-32	2	10	5
8-15	1	Figure I-1	Generic SID	1	5	5

5.6.3.6 The 'vsel' attribute

The 'vsel' attribute indicates a prioritized list of one or more 3-tuples for voice service. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the 'm' line information and should be consistent with it.

The ’vsel’ attribute refers to all directions of a connection. For a bidirectional connection, these are the forward and backward directions. For a unidirectional connection, this can be either the backward or forward direction.

The ’vsel’ attribute is not meant to be used with bidirectional connections that have asymmetric codec configurations described in a single SDP descriptor. For these, the ’onewaySel’ attribute (section 5.6.3.9) should be used. See section 5.6.3.9 for the requirement to not use the ’vsel’ and ’onewaySel’ attributes in the same SDP descriptor.

The ’vsel’ line is structured as follows:

```
a=vsel:<encodingName #1> <packetLength #1><packetTime #1>
          <encodingName #2> <packetLength #2><packetTime #2>
          ...
         <encodingName #N> <packetLength #N><packetTime #N>
```

where the <encodingName> parameter can take one of the values in column 2 of Table 2. The <packetLength> is a decimal integer representation of the packet length in octets. The <packetTime> is a decimal integer representation of the packetization interval in microseconds. The parameters <packetLength> and <packetTime> can be set to "-" when not needed. Also, the entire ’vsel’ media attribute line can be omitted when not needed.

For example,

```
a=vsel:G729 10 10000 G726-32 40 10000
```

indicates first preference of G.729 or G.729a (both are interoperable) as the voice encoding scheme. A packet length of 10 octets and a packetization interval of 10 ms are associated with this codec. G726-32 is the second preference stated in this line, with an associated packet length of 40 octets and a packetization interval of 10 ms. If the packet length and packetization interval are intended to be omitted, then this media attribute line becomes

```
a=vsel:G729 - - G726-32 - -
```

The media attribute line

```
a=vsel:G726-32 40 10000
```

indicates preference for or selection of 32 kbps ADPCM with a packet length of 40 octets and a packetization interval of 10 ms.

This media attribute line can be used in ATM as well as non-ATM contexts. Within the ATM context, it can be applied to the AAL1, AAL2 and AAL5 adaptations. The <packetLength> and <packetTime> are not meaningful in the AAL1 case and should be set to "-". In the AAL2 case, this line determines the use of some or all of the rows in a given profile table. If multiple 3-tuples are present, they can indicate a hierarchical assignment of some rows in that profile to voice service (e.g., row A preferred to row B etc.). If multiple profiles are present on the ’m’ line, the profile qualified by this attribute is the first profile. If a single profile that has been selected for a connection is indicated in the ’m’ line, the ’vsel’ attribute qualifies the use, for voice service, of codecs within that profile.

With most of the encoding names in Figure 2, the packet length and packetization period can be derived from each other. One of them can be set to "-" without a loss of information. There are some exceptions such as the IANA-registered encoding names G723, DVI4 and L16 for which this is not true. Therefore, there is a need to retain both the packet length and packetization period in the definition of the ’vsel’ line.

5.6.3.7 The ’dsel’ attribute

The ’dsel’ attribute indicates a prioritized list of one or more 3-tuples for voiceband data service. The <fxIncl> flag indicates whether this definition of voiceband data includes fax ("on" value) or not ("off" value). If <fxIncl> is "on", then the ’dsel’ line must be consistent with any ’fsel’ line in the session description. In this case, an error event is generated in the case of inconsistency. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

The ’dsel’ attribute refers to all directions of a connection. For a bidirectional connection, these are the forward and backward directions. For a unidirectional connection, this can be either the backward or forward direction.

The ’dsel’ attribute is not meant to be used with bidirectional connections that have asymmetric codec configurations described in a single SDP descriptor. For these, the ’onewaySel’ attribute (section 5.6.3.9) should be used. See section 5.6.3.9 for the requirement to not use the ’dsel’ and ’onewaySel’ attributes in the same SDP descriptor.

The ’dsel’ line is structured as follows:

```
a=dsel:<fxIncl> <encodingName #1> <packetLength #1><packetTime #1>
          <encodingName #2> <packetLength #2><packetTime #2>
          ...
         <encodingName #N> <packetLength #N><packetTime #N>
```

where the <encodingName> parameter can take one of the values in column 2 of Table 2. The <packetLength> and <packetTime> parameters are per their definition, above, for the ’vsel’ media attribute line. The parameters <packetLength> and <packetTime>) can be set to "-" when not needed. The <fxIncl> flag is presumed to be "off" if it is set to "-". Also, the entire ’dsel’ media attribute line can be omitted when not needed.

For example,

```
a=dsel:-  G726-32 20 5000 PCMU 40 5000
```

indicates that this line does not address facsimile, and that the first preference for the voiceband data codes is 32 kbps ADPCM, while the second preference is PCMU. The packet length and the packetization interval associated with G726-32 are 20 octets and 5 ms respectively. For PCMU, they are 40 octets and 5 ms respectively.

This media attribute line can be used in ATM as well as non-ATM contexts. Within the ATM context, it can be applied to the AAL1, AAL2 and AAL5 adaptations. The <packetLength> and <packetTime> are not meaningful in the AAL1 case and should be set to "-". In the AAL2 case, this line determines the use of some or all of the rows in a given profile table. If multiple 3-tuples are present, they can indicate a hierarchical assignment of some rows in that profile to voiceband data service (e.g., row A preferred to row B etc.) If multiple profiles are present on the ’m’ line, the profile qualified by this attribute is the first profile. If a single profile that has been selected for a connection is indicated in the ’m’ line, the ’ dsel’ attribute qualifies the use, for voiceband data service, of codecs within that profile.

With most of the encoding names in Figure 2, the packet length and packetization period can be derived from each other. One of them can be set to "-" without a loss of information. There are some exceptions such as the IANA-registered encoding names G723, DVI4 and L16 for which this is not true. Therefore, there is a need to retain both the packet length and packetization period in the definition of the ’dsel’ line.

5.6.3.8 The ’fsel’ attribute

The ’fsel’ attribute indicates a prioritized list of one or more 3-tuples for facsimile service. If an ’fsel’ line is present, any ’dsel’ line with <fxIncl> set to "on" in the session description must be consistent with it. In this case, an error event is generated in the case of inconsistency. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the ’m’ line information and should be consistent with it.

The ’fsel’ attribute refers to all directions of a connection. For a bidirectional connection, these are the forward and backward directions. For a unidirectional connection, this can be either the backward or forward direction.

The ’fsel’ attribute is not meant to be used with bidirectional connections that have asymmetric codec configurations described in a --single SDP descriptor. For these, the ’onewaySel’ attribute (section 5.6.3.9) should be used. See section 5.6.3.9 for the requirement to not use the ’fsel’ and ’onewaySel’ attributes in the same SDP descriptor.

The ’fsel’ line is structured as follows:

```
a=fsel:<encodingName #1> <packetLength #1><packetTime #1>
          <encodingName #2> <packetLength #2><packetTime #2>
          ...
         <encodingName #N> <packetLength #N><packetTime #N>
```

where the <encodingName> parameter can take one of the values in column 2 of Table 2. The <packetLength> and <packetTime> parameters are per their definition, above, for the ’vsel’ media attribute line. The parameters <packetLength> and <packetTime> can be set to "-" when not needed. Also, the entire ’fsel’ media attribute line can be omitted when not needed.

For example,

```
a=fsel:FXDMOD-3 - -
```

indicates demodulation and remodulation of ITU-T group 3 fax at the gateway.

```
a=fsel:PCMU 40 5000 G726-32 20 5000
```

indicates a first and second preference of Mu-law PCM and 32 kbps ADPCM as the facsimile encoding scheme. The packet length and the packetization interval associated with G726-32 are 20 octets and 5 ms respectively. For PCMU, they are 40 octets and 5 ms respectively.

This media attribute line can be used in ATM as well as non-ATM contexts. Within the ATM context, it can be applied to the AAL1, AAL2 and AAL5 adaptations. The <packetLength> and <packetTime> are not meaningful in the AAL1 case and should be set to "-". In the AAL2 case, this line determines the use of some or all of the rows in a given profile table. If multiple 3-tuples are present, they can indicate a hierarchical assignment of some rows in that profile to facsimile service (e.g., row A preferred to row B etc.). If multiple profiles are present on the ’m’ line, the profile qualified by this attribute is the first profile. If a single profile that has been selected for a connection is indicated in the ’m’ line, the ’fsel’ attribute qualifies the use, for facsimile service, of codecs within that profile.

With most of the encoding names in Figure 2, the packet length and packetization period can be derived from each other. One of them can be set to "-" without a loss of information. There are some exceptions such as the IANA-registered encoding names G723, DVI4 and L16 for which this is not true. Therefore, there is a need to retain both the packet length and packetization period in the definition of the ’fsel’ line.

5.6.3.9 The ’onewaySel’ attribute

The ’onewaySel’ (one way select) attribute can be used with connections that have asymmetric codec configurations. There can be several ’onewaySel’ lines in an SDP description. The ’onewaySel’ line is structured as follows:

```
a=onewaySel:<serviceType> <directionFlag>
          <encodingName #1> <packetLength #1><packetTime #1>
          <encodingName #2> <packetLength #2><packetTime #2>
          ...
          <encodingName #N> <packetLength #N><packetTime #N>
```

The <serviceType> parameter can be assigned the following string values: "v", "d", "f", "df" and "all". These indicate voice, voiceband data (fax not included), fax, voiceband data (fax included) and all services respectively.

The <directionFlag> can be assigned the following string values: "f", "b" and "fb". "f" and "b" indicate the forward and backward directions respectively. "fb" refers to both directions (forward and

backward) and shall not be used with the 'onewaySel' line. Conventions for the forward and backward directions are per section 2.3.

Following <directionFlag>, there is a prioritized list of one or more 3-tuples. Each 3-tuple indicates a codec, an optional packet length and an optional packetization period. This complements the 'm' line information and should be consistent with it.

Within each 3-tuple, the <encodingName> parameter can take one of the values in column 2 of Table 2. The <packetLength> is a decimal integer representation of the packet length in octets. The <packetTime> is a decimal integer representation of the packetization interval in microseconds.

The 'onewaySel' attribute must not be used in SDP descriptors that have one or more of the following attributes: 'vsel', 'dsel', 'fsel'. If it is present, then command containing the SDP description may be rejected. An alternate response to such an ill-formed SDP descriptor might the selective ignoring of some attributes, which must be coordinated via an application-wide policy.

The <serviceType>, <directionFlag> and <encodingName> parameters may not be set to "-". However, the parameters <packetLength> and <packetTime> can be set to "-" when not needed.

For example,

```
a=onewaySel:v f G729 10 10000
a=onewaySel:v b G726-32 40 10000
```

indicates that for voice service, the codec to be used in the forward direction is G.729 or G.729a (both are interoperable), and the codec to be used in the backward direction is G726-32. A packet length of 10 octets and a packetization interval of 10 ms are associated with the G.729/G.729a codec. A packet length of 40 octets and a packetization interval of 10 ms are associated with the G726-32 codec.

For example,

```
a=onewaySel:d f G726-32 20 5000
a=onewaySel:d b PCMU 40 5000
```

indicates that for voiceband service (fax not included), the codec to be used in the forward direction is G726-32), and the codec to be used in the backward direction is PCMU. A packet length of 20 octets

and a packetization interval of 5 ms are associated with the G726-32 codec. A packet length of 40 octets and a packetization interval of 5 ms are associated with the PCMU codec.

This media attribute line can be used in ATM as well as non-ATM contexts. Within the ATM context, it can be applied to the AAL1, AAL2 and AAL5 adaptations. The <packetLength> and <packetTime> are not meaningful in the AAL1 case and should be set to "-". In the AAL2 case, these lines determine the use of some or all of the rows in a given profile table. If multiple 3-tuples are present, they can indicate a hierarchical assignment of some rows in that profile to voice service (e.g., row A preferred to row B etc.). If multiple profiles are present on the ’m’ line, the profile qualified by this attribute is the first profile.

With most of the encoding names in Figure 2, the packet length and packetization period can be derived from each other. One of them can be set to "-" without a loss of information. There are some exceptions such as the IANA-registered encoding names G723, DVI4 and L16 for which this is not true. Therefore, there is a need to retain both the packet length and packetization period in the definition of the ’onewaySel’ line.

5.6.3.10 The ’codecconfig’ attribute

When present, the ’codecconfig’ attribute is used to represent the contents of the single codec information element (IE) defined in [57]. The contents of this IE are: a single-octet Organizational Identifier (OID) field, followed by a single-octet Codec Type field, followed by zero or more octets of a codec configuration bit-map. The semantics of the codec configuration bit-map are specific to the organization [57, 58]. The ’codecconfig’ attribute is represented as follows:

```
a=codecconfig:<q7655scc>
```

The <q7655scc> (Q.765.5 single codec IE contents) parameter is represented as a string of hex digits. The number of hex digits is even (range 4 -32). The "0x" prefix shall be omitted since this value is always hexadecimal. As with other hex values [Section 2.2], digits to the left are more significant than digits to the right. Leading zeros shall not be omitted.

An example of the use of this media attribute is:

```
a=codecconfig:01080C
```

The first octet indicates an Organizational Identifier of 0x01 (the ITU-T). Using ITU Q.765.5 [57], the second octet (0x08) indicates a codec type of G.726 (ADPCM). The last octet, 0x0C indicates that 16 kbps and 24 kbps rates are NOT supported, while the 32 kbps and 40 kbps rates ARE supported.

5.6.3.11 The 'isup_usi' attribute

When present, the 'isup_usi' attribute is used to represent the bearer capability information element defined in Section 4.5.5 of ITU Q.931 [59] (excluding the information element identifier and length). This information element is reiterated as the user service information element (IE) in Section 3.57 of ITU Q.763 [60]. The 'isup_usi' attribute is represented as follows:

```
a=isup_usi:<isupUsi>
```

The <isupUsi> parameter is represented as a string of hex digits. The number of hex digits is even (allowed range 4 -24). The "0x" prefix shall be omitted since this value is always hexadecimal. As with other hex values [Section 2.2], digits to the left are more significant than digits to the right. Leading zeros shall not be omitted.

5.6.3.12 The 'uiLayer1_Prot' attribute

When present, the 'uiLayer1_Prot' attribute is used to represent the 'User Information Layer 1 protocol' field within the bearer capability information element defined in Section 4.5.5 of [59], and reiterated as the user service information element (IE) in Section 3.57 of [60]. The 'User Information Layer 1 protocol' field consists of the five least significant bits of Octet 5 of this information element.

Within SDP, the 'uiLayer1_Prot' attribute is represented as follows:

```
a='uiLayer1_Prot':<uiLayer1Prot>
```

The <uiLayer1Prot> parameter is represented as a string of two hex digits. The "0x" prefix shall be omitted since this value is always hexadecimal. As with other hex values [Section 2.2], digits to the left are more significant than digits to the right. These hex digits are constructed from an octet with three leading '0' bits and last five bits equal to the 'User Information Layer 1 protocol' field described above. As specified in [59] and [26], bit 5 of this field is the most significant bit. The resulting values of the <uiLayer1Prot> parameter are as follows:

VALUE	MEANING
0x01	CCITT standardized rate adaption V.110 and X.30
0x02	Recommendation G.711 Mu-law
0x03	Recommendation G.711 A-law
0x04	Recommendation G.721 32 kbps ADPCM and Recommendation I.460
0x05	Recommendations H.221 and H.242
0x06	Recommendation H.223 and H.245
0x07	Non-ITU-T standardized rate adaption
0x08	ITU-T standardized rate adaption V.120
0x09	CCITT standardized rate adaption X.31 HDLC flag stuffing

5.6.4 Miscellaneous media attributes

The 'chain' media attribute line, which is used to chain consecutive SDP descriptions, cannot be classified as an ATM, AAL or service attribute. It is detailed in the following subsection.

5.6.4.1 The 'chain' attribute

The start of an SDP descriptor is marked by a 'v' line. In some applications, consecutive SDP descriptions are alternative descriptions of the same session. In others, these describe different layers of the same connection (e.g., IP, ATM, frame relay). This is useful when these connectivity at these layers are established at the same time (e.g., an IP-based session over an ATM SVC). To distinguish between the alternation and concatenation of SDP descriptions, a 'chain' attribute can be used in the case of concatenation.

When present, the 'chain' attribute binds an SDP description to the next or previous SDP description. The next or previous description is separated from the current one by a 'v' line. It is not necessary that this description also have a 'chain' media attribute line.

Chaining averts the need to set up a single SDP description for a session that is simultaneously created at multiple layers. It allows the SDP descriptors for different layers to remain simple and clean. Chaining is not needed in the Megaco context, where it is possible to create separate terminations for the different layers of a connection.

The 'chain' media attribute line has the following format:

```
a=chain:<chainPointer>
```

The <chainPointer> field can take on the following string values: "NEXT", "PREVIOUS" and "NULL". The value "NULL" is not equivalent to omitting the chain attribute from a description since it expressly

precludes the possibility of chaining. If the 'chain' attribute is absent in an SDP description, chaining can still be realized by the presence of a chain media attribute line in the previous or next description.

5.6.5 Use of the second media-level part in H.323 Annex C applications

Section 4 mentions that H.323 annex C applications have a second media level part for the ATM session description. This is used to convey information about the RTCP stream. Although the RTP stream is encapsulated in AAL5 with no intervening IP layer, the RTCP stream is sent to an IP address and RTCP port. This media-level part has the following format:

```
m= control <rtcpPortNum> H323c -
c= IN IP4 <rtcpIPaddr>
```

Consistency with RFC 2327 is maintained in the location and format of these lines. The <fmt list> in the 'm' line is set to "-". The 'c' line in the second media-level part pertains to RTCP only.

The <rtcpPortNum> and <rtcpIPaddr> subparameters indicate the port number and IP address on which the media gateway is prepared to receive RTCP packets.

Any of the subparameters on these lines can be set to "-" if they are known by other means.

The range and format of the <rtcpPortNum> and <rtcpIPaddr> subparameters is per [1]. The <rtcpPortNum> is a decimal number between 1024 and 65535. It is an odd number. If an even number in this range is specified, the next odd number is used. The <rtcpIPaddr> is expressed in the usual dotted decimal IP address representation, from 0.0.0.0 to 255.255.255.255.

5.6.6 Use of the eecid media attribute in call establishment procedures

This informative section supplements the definition of the eecid attribute (Section 5.6.1.1) by describing example procedures for its use. These procedures assume a bearer-signaling mechanism for connection set-up that is independent of service-level call control. These procedures are independent of the media gateway control protocol (MGCP, Megaco, SIP etc.), the protocol used between media gateway controllers (ITU Q.1901, SIP etc.) and the protocol used for bearer connection set-up (Q.2931, UNI, PNNI, AINI, IISP, Q.2630.1 etc.).

```
                    Inter-MGC
             +---------+  Protocol        +---------+
             |   MGC   |------------------|   MGC   |
             +---------+                  +---------+
                  |                            |
                  |Media Gateway               |Media Gateway
                  |Control Protocol            |Control Protocol
                  |                            |
              +------------+  (ATM Network)   +------------+
              |Originating |------------------|Terminating |
              |Media       |  Bearer Setup    |Media       |
              |Gateway     |  Protocol        |Gateway     |
              +------------+                  +------------+
```

In the diagram above, the originating media gateway originates the service-level call. The terminating media gateway terminates it. In the forward bearer connection set-up model, the originating media gateway initiates bearer connection set-up. In the backward bearer connection set-up model, the terminating gateway initiates bearer connection set-up.

Example use of the Backward Bearer Connection Set-up Model:

(1) The originating media gateway controller (OMGC) initiates service-level call establishment by sending the appropriate control message to the originating media gateway (OMG).

(2) The originating media gateway (OMG) provides its NSAP address and an eecid value to the OMGC, using the following SDP description:

```
v=0
o=- 2873397496 0 ATM NSAP
   47.0091.8100.0000.0060.3E64.FD01.0060.3E64.FD01.00
s=-
c=ATM NSAP
  47.0091.8100.0000.0060.3E64.FD01.0060.3E64.FD01.00
t=0 0
m=audio $ AAL2/ITU 8
a=eecid:B3D58E32
```

(3) The originating media gateway controller (OMGC) signals the terminating media gateway controller (TMGC) through the appropriate mechanism (ISUP with Q.1901 extensions, SIP etc.). It provides the TMGC with the NSAP address and the eecid provided by the OMG.

(4) The TMGC sends the appropriate control message to the TMG. This includes the session descriptor received from the OMG. This descriptor contains the NSAP address of the OMG and the EECID assigned by the OMG. Additionally, the TMGC instructs the TMG to set up an SVC to the OMG. It also requests the TMG to notify the TMGC when SVC set-up is complete. Depending on the control protocol used, this can be done through a variety of means. In the Megaco context, the request to set-up an SVC (not the notification request for the SVC set-up event) can be made through the following local descriptor:

```
v=0
o=- 2873397497 0 ATM - -
s=-
c=ATM - -
t=0 0
m=audio $ - -
a=bearerType:SVC on
```

The 'bearerType' attribute indicates that an SVC is to be used and that the <localInitiation> flag is on i.e., the SVC is to be set up by the TMG.

(5) The TMG acknowledges the control message from the TMGC. It returns the following SDP descriptor with the acknowledge:

```
v=0
o=- 2873397498 0 ATM NSAP
   47.0091.8100.0000.0040.2A74.EB03.0020.4421.2A04.00
s=-
c=ATM NSAP
  47.0091.8100.0000.0040.2A74.EB03.0020.4421.2A04.00
t=0 0
m=audio $ AAL2/ITU 8
```

The NSAP address information provided in this descriptor is not needed. It can be omitted (by setting it to "- -").

(6) The TMG sends an SVC set-up message to the OMG. Within the GIT information element, it includes eecid (B3D58E32) received from the OMG.

(7) The OMG uses the eecid to correlate the SVC set-up request with service-level control message received before from the OMGC.

(8) The OMG returns an SVC connect message to the TMG. On receiving this message, the TMG sends an event notification to the TMGC indicating successful SVC set-up.

Note that, for this example, the "v=", "o=", "s=" and "t=" lines can be omitted in the Megaco context.

Example use of the Forward Bearer Connection Set-up Model:

(1) The originating media gateway controller (OMGC) initiates service-level call establishment by sending the appropriate controlsmessage to the originating media gateway (OMG).

(2) The originating media gateway (OMG) provides its NSAP address to the OMGC, using the following SDP description:

```
v=0
o=- 2873397496 0 ATM NSAP
   47.0091.8100.0000.0060.3E64.FD01.0060.3E64.FD01.00
s=-
c=ATM NSAP
  47.0091.8100.0000.0060.3E64.FD01.0060.3E64.FD01.00
t=0 0
m=audio $ AAL2/ITU 8
```

The NSAP address information provided in this descriptor is not needed. It can be omitted (by setting it to "- -").

(3) The originating media gateway controller (OMGC) signals the terminating media gateway controller (TMGC) through the appropriate mechanism (ISUP with Q.1901 extensions, SIP etc.). Although this is not necessary, it can provide the TMGC with the NSAP address provided by the OMG.

(4) The TMGC sends the appropriate control message to the TMG. This includes the session descriptor received from the OMG. This descriptor contains the NSAP address of the OMG.

(5) The TMG acknowledges the control message from the TMGC. Along with the acknowledgement, it provides an SDP descriptor with a locally assigned eecid.

```
v=0
o=- 2873397714 0 ATM NSAP
   47.0091.8100.0000.0040.2A74.EB03.0020.4421.2A04.00
s=-
c=ATM NSAP
  47.0091.8100.0000.0040.2A74.EB03.0020.4421.2A04.00
t=0 0
m=audio $ AAL2/ITU 8
a=eecid:B3D58E32
```

(6) The terminating media gateway controller (TMGC) signals the originating media gateway controller (OMGC) through the appropriate mechanism (ISUP with Q.1901 extensions, SIP etc.). It provides the OMGC with the NSAP address and the eecid provided by the TMG.

(7) The OMGC sends the appropriate control message to the OMG. This includes the session descriptor received from the TMG. This descriptor contains the NSAP address of the TMG and the EECID assigned by the TMG. Additionally, the OMGC instructs the OMG to set up an SVC to the TMG. It also requests the OMG to notify the OMGC when SVC set-up is complete. Depending on the control protocol used, this can be done through a variety of means. In the Megaco context, the request to set-up an SVC (not the notification request for the SVC set-up event) can be made through the following local descriptor:

```
v=0
o=- 2873397874 0 ATM - -
s=-
c=ATM - -
t=0 0
m=audio $ - -
a=bearerType:SVC on
```

The ’bearerType’ attribute indicates that an SVC is to be used and that the <localInitiation> flag is on i.e., the SVC is to be set up by the TMG.

(8) The OMG acknowledges the control message from the OMGC.

(9) The OMG sends an SVC set-up message to the TMG. Within the GIT information element, it includes eecid (B3D58E32) received from the TMG.

(10) The TMG uses the eecid to correlate the SVC set-up request with the service-level control message received before from the TMGC.

(11) The TMG returns an SVC connect message to the OMG. On receiving this message, the OMG sends an event notification to the OMGC indicating successful SVC set-up.

Note that, for this example, the "v=", "o=", "s=" and "t=" lines can be omitted in the Megaco context.

6. List of Parameters with Representations

This section provides a list of the parameters used in this document, and the formats used to represent them in SDP descriptions. In general, a "-" value can be used for any field that is not specified, is inapplicable or is implied.

PARAMETER	MEANING	REPRESENTATION
<username>	User name	Constant "-"
<sessionID>	Session ID	Up to 32 decimal or hex digits
<version>	Version of SDP descriptor	"0" or 10 decimal digits
<networkType>	Network type	Constant "ATM" for ATM transport
<addressType>	Address type	String values: "NSAP", "E164", "GWID", "ALIAS"
<address>	Address	"NSAP": 40 hex digits, dotted "E164": up to 15 decimal digits "GWID": up to 32 characters "ALIAS": up to 32 characters
<sessionName>	Session name	Constant "-"
<startTime>	Session start time	"0" or 10 decimal digits
<stopTime>	Session stop time	Constant "0"
<vcci>	Virtual Circuit Connection Identifier	Decimal or hex equivalent of 16 bits
<ex_vcci>	Explicit representation of <vcci>	"VCCI-" prefixed to <vcci>
<bcg>	Bearer Connection Group	Decimal or hex equivalent of 8 bits

<ex_bcg>	Explicit representation of <bcg>	"BCG-" prefixed to <bcg>
<portId>	Port ID	Hex number of up to 32 digits
<ex_portId>	Explicit representation of <portId>	"PORT-" prefixed to <portId>
<vpi>	Virtual Path Identifier	Decimal or hex equivalent of 8 or 12 bits
<ex_vpi>	Explicit representation of <vpi>	"VPI-" prefixed to <vpi>
<vci>	Virtual Circui t Identifier	Decimal or hex equivalent of 16 bits
<ex_vci>	Explicit representation of <vci>	"VCI-" prefixed to <vci>
<vpci>	Virtual Path Connection Identifier	Decimal or hex equivalent of 16 bits
<ex_vpci>	Explicit representation of <vpci>	"VPCI-" prefixed to <vpci>
<cid>	Channel Identifier	Decimal or hex equivalent of 8 bits
<ex_cid>	Explicit representation of <cid>	"CID-" prefixed to <cid>
<payloadType>	Payload Type	Decimal integer 0-127
<transport>	Transport	Values listed in Table 1.
<profile>	Profile	Decimal integer 1-255

<eecid>	End-to-end Connection Identifier	Up to 8 hex digits
<aalType>	AAL type	String values: "AAL1","AAL1_SDT","AAL1_UDT", "AAL2", "AAL3/4", "AAL5", "USER_DEFINED_AAL"
<asc>	ATM service category defined by the ATMF	String values: "CBR", "nrt-VBR", "rt-VBR", "UBR", "ABR", "GFR"
<atc>	ATM transfer capability defined by the ITU	String values: "DBR","SBR","ABT/IT","ABT/DT", "ABR"
<subtype>	<asc>/<atc> subtype	Decimal integer 1-10
<qosClass>	QoS Class	Decimal integer 0-5
<bcob>	Broadband Bearer Class	Decimal or hex representation of 5-bit field
<eetim>	End-to-end timing required	String values: "on", "off".
<stc>	Susceptibility to clipping	Decimal equivalent of a 2-bit field
<upcc>	User plane connection configuration	Decimal equivalent of a 2-bit field
<directionFlag>	Direction Flag	String values: "f", "b", "fb"
<cdvType>	CDV type	String values: "PP", "2P"
<acdv>	Acceptable CDV	Decimal equivalent of 24-bit field
<ccdv>	Cumulative CDV	Decimal equivalent of 24-bit field

<eetd>	End-to-end transit delay	Decimal equivalent of 16-bit field
<cmtd>	Cumulative transit delay	Decimal equivalent of 16-bit field
<aclr>	Acceptable Cell Loss Ratio	Decimal equivalent of 8-bit field
<clpLvl>	CLP level	String values: "0", "0+1"
<pcr>	Peak Cell Rate	Decimal equivalent of a 24-bit field.
<scr>	Sustained Cell Rate	Decimal equivalent of a 24-bit field
<mbs>	Maximum Burst Size	Decimal equivalent of 16-bit field
<cdvt>	CDVT	Decimal equivalent of 24-bit field.
<mcr>	Minimum Cell Rate	Decimal equivalent of a 24-bit field
<mfs>	Maximum Frame Size	Decimal equivalent of a 16-bit field
<fd>	Frame Discard Allowed	String Values: "on", "off"
<te>	CLP tagging	String Values: "on", "off"
<nrm>	NRM	Decimal/hex equivalent of 3 bit field
<trm>	TRM	-ditto-
<cdf>	CDF	-ditto-
<adtf>	ADTF	Decimal/Hex equivalent of 10 bit field

<ficr>	Forward Initial Cell Rate	Decimal equivalent of 24-bit field
<bicr>	Backward Initial Cell Rate	Decimal equivalent of 24-bit field
<ftbe>	Forward Transient Buffer Exposure	Decimal equivalent of 24-bit field
<btbe>	Backward Transient Buffer Exposure	Decimal equivalent of 24-bit field
<crmrtt>	Cumulative RM round-trip time (Microseconds)	Decimal equivalent of 24-bit field
<frif>	Forward rate increase factor	Decimal integer 0 -15
<brif>	Backward rate increase factor	Decimal integer 0 -15
<frdf>	Forward rate decrease factor	Decimal integer 0 -15
<brdf>	Backward rate decrease factor	Decimal integer 0 -15
<bearerType>	Bearer Type	String Values: "PVC", "SVC", "CID"
<localInitiation>	Local Initiation	String values: "on", "off"
<sci>	Screening Indication	Decimal or hex equivalent of 4 bits.
<lsn>	Leaf Sequence Number	Decimal or hex equivalent of 32 bits.
<cdStd>	Coding standard for connection scope selection IE Definition: UNI 4.0 [5]	Decimal or hex equivalent of 2 bits.
<conScpTyp>	Type of connection scope Definition: UNI 4.0 [5]	Decimal or hex equivalent of 4 bits

<conScpSel>	Connection scope selection Definition: UNI 4.0 [5]	Decimal or hex equivalent of 8 bits
<cacheEnable>	Enable SVC caching	String values: "on", "off"
<cacheTimer>	Timer for cached SVC deletion	Decimal or hex equivalent of 32-bit field
<bearerSigIEType>	Bearer Signaling IE Type	2 hex digits
<bearerSigIELng>	Bearer Signaling IE Length	1-4 hex digits
<bearerSigIEVal>	Bearer Signaling IE Value	Even number of hex digits, 2-512
<appClass>	Application specification	String values: "itu_h323c","af83", "AAL5_SSCOP", "itu_i3661_unassured", "itu_i3661_assured", "itu_i3662", "itu_i3651", "itu_i3652", "itu_i3653", "itu_i3654", "FRF5", "FRF8","FRF11", "itu_h2221"
<oui>	Organizationally Unique Identifier	1 to 6 hex digits
<appId>	Application Identifier	1 to 8 digits
<cbrRate>	CBR Rate	Two hex digits.
<sbc>	Subchannel Count	T1: Decimal integer 1-24 or hex equivalent E1: Decimal integer 1-31 or hex equivalent
<clkrec>	Clock Recovery Method	String values: "NULL", "SRTS", "ADAPTIVE"
<fecEnable>	Forward Error Correction Enable	String values: "NULL", "LOSS_SENSITIVE" "DELAY_SENSITIVE"

<partialFill>	Partial Fill	Decimal integer 1-48 or hex equivalent
<structureEnable>	Structure Present	String values: "on", "off"
<blksz>	Block Size	Decimal or hexadecimal equivalent of 16 bits
<cpcs>	Maximum CPCS SDU size	AAL5: Decimal or hex equivalent of 16 bits AAL2: 45 or 64, decimal or hex representation
<cidLowerLimit>	AAL2 CID lower limit	Decimal integer 8-255 or hex equivalent
<cidUpperLimit>	AAL2 CID upper limit	Decimal integer 8-255 or hex equivalent
<timerCU>	Timer, combined use (microseconds)	Integer decimal; range determined by application. Use decimal equivalent of 32 bits.
<simplifiedCPS>	Simplified CPS [52]	String values: "on", "off"
<fSDUrate>	Forward SDU rate (bits per second)	Decimal equivalent of 24-bit field
<bSDUrate>	Backward SDU rate (bits per second)	Decimal equivalent of 24-bit field
<ted>	Transmission Error Detection Enable	String values: "on", "off"
<rastimer>	SSSAR reassembly (microseconds)	Integer decimal, Range determined by application. Use decimal equivalent of 32 bits.
<fsssar>	Maximum SSSAR-SDU size, forward direction	Decimal 1- 65568 or hex equivalent

<bsssar>	Maximum SSSAR-SDU size, backward direction	Decimal 1- 65568 or hex equivalent
<fsscopsdu>	Maximum SSCOP-SDU size, forward direction	Decimal 1- 65528 or hex equivalent
<bsscopsdu>	Maximum SSCOP-SDU size, backward direction	Decimal 1- 65528 or hex equivalent
<fsscopuu>	Maximum SSCOP-UU field size, forward direction	Decimal 1- 65524 or hex equivalent
<bsscopuu>	Maximum SSCOP-UU field size, backward direction	Decimal 1- 65524 or hex equivalent
<sap>	Service Access Point	String values: "AUDIO", "MULTIRATE"
<circuitMode>	Circuit Mode Enable	String values: "on", "off"
<frameMode>	Frame Mode Enable	String values: "on", "off"
<faxDemod>	Fax Demodulation Enable	String values: "on", "off"
<cas>	Enable CAS transport via Type 3 packets	String values: "on", "off"
<dtmf>	Enable DTMF transport via Type 3 packets	String values: "on", "off"
<mfall>	Enable MF transport via Type 3 packets	String values: "on", "off"
<mfr1>	Enable MF (R1) transport via Type 3 packets	String values: "on", "off"
<mfr2>	Enable MF (R2) transport via Type 3 packets	String values: "on", "off"

<PCMencoding>	PCM encoding	String values: "PCMA", "PCMU"
<fmaxFrame>	Maximum length of a frame mode data unit, forward direction	Decimal or hex equivalent of 16-bit field
<bmaxFrame>	Maximum length of a frame mode data unit, backward direction	-ditto-
<silenceSuppEnable>	Silence suppression Enable	String values: "on", "off"
<silenceTimer>	Kick-in timer for silence suppression	Decimal or hex representation of 16-bit field
<suppPref>	Preferred Silence Suppression Method	String values: "standard", "custom"
<sidUse>	SID Use Method	String values: "No SID", "Fixed Noise", "Sampled Noise"
<fxnslevel>	Fixed Noise Level	Decimal or hex representation of a 7-bit field
<ecanEnable>	Enable Echo Cancellation	String values: "on", "off"
<ecanType>	Type of Echo Cancellation	String values: "G165", "G168"
<gcEnable>	Enable Gain Control	String values: "on", "off"
<gcLvl>	Level of inserted Loss	Decimal or hex equivalent of 16-bit field
<aal2transport>	AAL2 transport	Values listed in Table 1 that begin with the string "AAL2"
<uuiCodeRange>	UUI code range	Decimal integer 0-15

<encodingName>	Encoding name	String values: "PCMG", "SIDG", "SID729", any value from column 2 of Table 2
<packetLength>	Packet length	Decimal integer 0-45
<packetTime>	Packetization Interval in microsec.	Decimal integer 1-65,536
<fxIncl>	Facsimile included	String values: "on", "off"
<serviceType>	Service type	String values: "v", "d", "f", "df", "all"
<q7655scc>	Contents of the Q.765.5 Single Codec IE	Even number of hex digits (4-32)
<isupUsi>	ISUP User Service Information	Even number of hex digits (4-24)
<uiLayer1Prot>	User Information Layer 1 Protocol	Two hex digits
<chainPointer>	Chain pointer	String values: "NEXT", "PREVIOUS", "NULL"
<rtcpPortNum>	RTCP port number for H.323 Annex C applications	Odd decimal in range 1,024 to 65,535. Preferred: Odd number in the range 49,152 to 65,535
<rtcpIPaddr>	IP address for receipt of RTCP packets	Dotted decimal, 7-15 chars

7. Examples of ATM session descriptions using SDP

An example of a complete AAL1 session description in SDP is:

```
v=0
o=- A3C47F21456789F0 0 ATM NSAP
   47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
s=-
c=ATM NSAP
    47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
t=0 0
m=audio $ AAL1/AVP 18 0 96
a=atmmap:96 X-G727-32
a=eecid:B3D58E32
```

An example of a complete AAL2 session description in SDP is:

```
v=0
o=- A3C47F21456789F0 0 ATM NSAP
47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
s=-
c=ATM NSAP
     47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
t=0 0
m=audio $ AAL2/ITU 8 AAL2/custom 100 AAL2/ITU 1
a=eecid:B3E32
```

The AAL2 session descriptor below is the same as the one above except that it states an explicit preference for a voice codec, a voiceband data codec and a voiceband fax codec. Further, it defines the profile AAL2/custom 100 rather than assume that the far-end is cognizant of the elements of this profile.

```
v=0
o=- A3C47F21456789F0 0 ATM NSAP
47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
s=-
c=ATM NSAP
47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
t=0 0
m=audio $ AAL2/ITU 8 AAL2/custom 100 AAL2/ITU 1
a=eecid:B3E32
a=profileDesc:AAL2/custom 100 0-7 PCMG 40 5000 0-7 SIDG 1
5000 8-15 G726-32 40 10000 8-15 SIDG 1 5000
a=vsel:G726-32 40 10000
a=dsel:off PCMU - -
a=fsel:G726-32 40 10000
```

An example of an SDP session descriptor for an AAL5 switched virtual circuit for delivering MPEG-2 video:

```
v=0
o=- A3C47F21456789F0 0 ATM NSAP
47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
s=-
c=ATM NSAP 47.0091.8100.0000.0060.3e64.fd01.0060.3e64.fd01.00
t=0 0
m=video $ AAL5/ITU 33
a=eecid:B3E32
a=aalType:AAL5
a=bearerType:SVC on
a=atmTrfcDesc:f 0+1 7816 - - - - - off -
a=atmTrfcDesc:b 0+1 0 - - - - - on -
a=cpsSDUsize:f 20680
a=aalApp:itu_h2221 - -
```

An example of an SDP session descriptor for an AAL5 permanent virtual circuit for delivering MPEG-2 video:

```
v=0
o=- A3C47F21456789F0 0 ATM - -
s=-
c=ATM - -
t=0 0
m=video PORT-$/VPI-0/VCI-$ AAL5/ITU 33
a=bearerType:PVC -
a=atmTrfcDesc:f 0+1 7816 - - - - - off -
a=atmTrfcDesc:b 0+1 0 - - - - - on -
a=cpsSDUsize:f 20680
a=aalApp:itu_h2221 - -
```

8. Security Considerations

8.1 Bearer Security

At present, standard means of encrypting ATM and AAL2 bearers are not conventionalized in the same manner as means of encrypting RTP payloads. Nor has the authentication of ATM or AAL2 bearer signaling.

The SDP encryption key line (k=) defined in RFC 2327 can be used to represent the encryption key and the method of obtaining the key. In the ATM and AAL2 contexts, the term ’bearer’ can include ’bearer signaling’ as well as ’bearer payloads’.

8.2 Security of the SDP description

The SDP session descriptions might originate in untrusted areas such as equipment owned by end-subscribers or located at end-subscriber premises. SDP relies on the security mechanisms of the encapsulating protocol or layers below the encapsulating protocol. Examples of encapsulating protocols are the Session Initiation Protocol (SIP), MGCP and Multimedia Gateway Control Protocol (MEGACO). No additional security mechanisms are needed. SIP, MGCP and MEGACO can use IPSec authentication as described in RFC 1826 [Ref. 27]. IPSec encryption can be optionally used with authentication to provide an additional, potentially more expensive level of security. IPSec security associations can be made between equipment located in untrusted areas and equipment located in trusted areas through configured shared secrets or the use of a certificate authority.

9. ATM SDP Grammar

This appendix provides an Augmented BNF (ABNF) grammar for the ATM conventions for SDP. ABNF is defined in rfc2234. This is not a complete ABNF description of SDP. Readers are referred to [1] for an ABNF description of the SDP base line protocol, and to rfc2848, rfc2543, rfc2045 and rfc2326 for application-specific conventions for SDP use. For case conventions, see section 2.4.

```
; Constant definitions

safe = alpha-numeric / "'" / "-" / "." / "/" / ":" / "?" / DQUOTE /
   "#" / "$" / "&" / "*" / ";" / "=" / "@" / "[" / "]" / "^" / "_" /
   "'" / "{" / "|" / "}" / "+" / "~"
DQUOTE = %x22 ; double quote
alpha-numeric = ALPHA / DIGIT
ALPHA = "a" / "b" / "c" / "d" / "e" / "f" / "g" / "h" / "i" / "j" /
        "k" / "l" / "m" / "n" / "o" / "p" / "q" / "r" / "s" / "t" /
        "u" / "v" / "w" / "x" / "y" / "z" /
        "A" / "B" / "C" / "D" / "E" / "F" / "G" / "H" / "I" / "J" /
        "K" / "L" / "M" / "N" / "O" / "P" / "Q" / "R" / "S" / "T" /
        "U" / "V" / "W" / "X" / "Y" / "Z"
DIGIT = "0" / POS-DIGIT
POS-DIGIT = "1" / "2" / "3" / "4" / "5" / "6" / "7" / "8" / "9"
hex-prefix = "0" ("x"  /  "X")
HEXDIG = DIGIT  /  "a" / "b" / "c" / "d" / "e" / "f" /
                      "A" / "B" / "C" / "D" / "E" / "F"
space = %d32
EOL = (CR / LF / CRLF) ; as per Megaco RFC
CR = %d13
LF = %d10
```

```
decimal-uchar =       DIGIT
                         / POS-DIGIT DIGIT
                         / ("1" 2*(DIGIT))
                         / ("2" ("0"/"1"/"2"/"3"/"4") DIGIT)
                         / ("2" "5" ("0"/"1"/"2"/"3"/"4"/"5"))

generic-U8  = (hex-prefix hex-U8) / decimal-uchar
generic-U12 = (hex-prefix hex-U12) / 1*4 (DIGIT)
generic-U16 = (hex-prefix hex-U16) / 1*5(DIGIT)
generic-U24 = (hex-prefix hex-U24) / 1*8(DIGIT)
generic-U32 = (hex-prefix hex-U32) / 1*10(DIGIT)
hex-U8  = 1*2(HEXDIG)
hex-U12 = 1*3(HEXDIG)
hex-U16 = 1*4(HEXDIG)
hex-U24 = 1*6(HEXDIG)
hex-U32 = 1*8(HEXDIG)
generic-U8-or-null  = generic-U8 / "-"
generic-U12-or-null = generic-U12 / "-"
generic-U16-or-null = generic-U16 / "-"
generic-U24-or-null = generic-U24 / "-"
generic-U32-or-null = generic-U32 / "-"
decimal-U8-or-null =  decimal-uchar / "-"
decimal-U12-or-null = 1*4(DIGIT) / "-"
decimal-U16-or-null = 1*5(DIGIT) / "-"
decimal-U24-or-null = 1*8 (DIGIT) / "-"
decimal-U32-or-null = 1*10(DIGIT) / "-"
on-off-or-null = "on" / "off" / "-"

; ABNF definition of SDP with ATM conventions

SDP-infoset    =  1*(announcement)announcement  =  proto-version
origin-field   session-name-field   information-field   uri-field
email-fields   phone-fields   connection-field bandwidth-fields
time-fields key-field attribute-fields media-descriptions

proto-version = ["v=" 1*4(DIGIT) EOL] ; use "v=0" for ATM SDP

origin-field = ["o=" username space sess-id space sess-version space
   net-type-addr EOL]

username = 1* safe ; for ATM use "-"

sess-id = (1*32 DIGIT) / (hex-prefix 1*32 HEXDIG)
sess-version = (1*10 DIGIT) / (hex-prefix 1*8 HEXDIG)

net-type-addr= nettype space addrtype-addr

netttype = "ATM" / "IN" / "TN" / "-" / "$"
```

```
 ; Other nettype values may be defined in the future in other documents
 ; Validity of  nettype and addrtype-addr combination to be checked at
 ;      application level, not protocol syntax level

addrtype-addr = atm-addrtype-addr / ip-addrtype-addr / tn-addrtype-addr
   ; ip-addrtype-addr per rfc2327
   ; tn-addrtype-addr per rfc2848

; ATM address definition

atm-addrtype-addr =  atm-nsap-addr / atm-e164-addr / atm-alias-addr

atm-nsap-addr = ("NSAP" / "-" / "$")  space (nsap-addr / "-" / "$")
atm-e164-addr = ("E164" / "-" / "$") space (e164-addr / "-" / "$")
atm-alias-addr = ("GWID" / "ALIAS" / "-" / "$") space (alias-addr /
                  "-" / "$")

nsap-addr = 2(HEXDIG) "." 9(4(HEXDIG) ".") 2(HEXDIG)

e164-addr = 1*15 (DIGIT)
alias-addr = 1*32(alpha-numeric / "-" / "." / "_")

session-name-field = ["s=" text EOL] ; for ATM use "s=-"
text = byte-string
byte-string = 1*(byte-string-char) ; definition per rfc2327
byte-string-char = %x01-09/ %x0B/ %x0C/ %x0E-FF ; all ASCII except
                   NUL, CR & LF
; Definitions of information-field, uri-field, email-fields,
; phone-fields per rfc2327.  These fields are omitted in
; ATM SDP descriptions.  If received, they are ignored in the ATM
; context

connection-field = ["c=" c-net-type-addr]

         ; connection-field required, not optional, in ATM

c-net-type-addr = nettype space c-addrtype-addr
c-addrtype-addr = atm-addrtype-addr / c-ip-addrtype-addr /
                  tn-addrtype-addr

   ; atm-addrtype-addr defined above

   ; c-ip-addrtype-addr per rfc2327
   ; difference in address usage between 'o' and 'c' lines per rfc2327

   ; tn-addrtype-addr per rfc2848

bandwidth-fields = *("b=" bwtype ":" bandwidth EOL)
```

```
bwtype = 1*(alpha-numeric)
bandwidth = 1*(DIGIT)

time-fields = *( "t=" start-time space stop-time
              *(EOL repeat-fields) EOL)
              [zone-adjustments EOL]
start-time = time / "0"
stop-time = time / "0" ; always "0" in ATM
time = POS-DIGIT 9*(DIGIT) ; same as rfc2327
 ; repeat-fields and zone-adjustments per rfc2327, not used in ATM

 ; Definition of optional key-field per rfc2327
 ;

attribute-fields = *("a=" attribute EOL)

 ; SDP descriptors for ATM do not have session-level media attribute
 ; lines.  If these are provided, they should be ignored.

media-descriptions = *(media-description)
media-description  = media-field information-field *(connection-field)
                     bandwidth-fields key-field attribute-fields

; Definitions of information-field per RFC 2327.  These fields are
; omitted in ATM SDP descriptions.  If received, they are ignored in
; the ATM context
;
; In ATM, the connection-field is used in media-description to indicate
; the IP address associated with the RTCP control protocol in H.323.C
; applications.  In this case,  the connection field is per the RFC 2327
; definition for IP v4-based connections.  Otherwise, it is not used in
; media-description.  If received as part of  media-description,
; it is ignored.
;
; Definition of optional bandwidth-fields as above.
: Definition of optional key-field as in RFC 2327

media-field = rfc2327-media-field / rfc2848-media-field /
              atm-media-field
    ; rfc2327-media-field and rfc2848-media-field defined in those rfc's
atm-media-field = "m=" media space vcId space transport-fmts EOL
   ; superset of rfc2327 definition

media = "audio" / "video" / "data" / "application" / "control" /
        1*(alpha-numeric)

vcId = "$" / "-" / ex-vcci / (ex-vcci "/" ex-cid) /
     (atm-type-addr-m  "/" ex-vcci) /
```

```
     (atm-type-addr-m "/" ex-vcci "/" ex-cid) /
     (ex-bcg "/" ex-vcci) / (ex-bcg "/" ex-vcci "/" ex-cid)
     (ex-portid "/" ex-vpi "/" ex-vci) /
     (ex-portid "/" ex-vpi "/" ex-vci "/" ex-cid) /
     (ex-bcg "/" ex-vpi "/" ex-vci) /
     (ex-bcg "/" ex-vpi "/" ex-vci "/" ex-cid) /
     (ex-vpci "/" ex-vci) /
     (ex-vpci "/" ex-vci "/" ex-cid) /
     (atm-type-addr-m  "/" ex-vpci "/" ex-vci) /
     (atm-type-addr-m  "/" ex-vpci "/" ex-vci "/" ex-cid)

atm-type-addr-m = atm-nsap-addr-m / atm-e164-addr-m / atm-alias-addr-m
atm-nsap-addr-m =  ["NSAP-"] (nsap-addr / "$")
atm-e164-addr-m =  ["E164-"] (e164-addr / "$")
atm-alias-addr-m = ["GWID-" / "ALIAS-"] (alias-addr / "$")
 ; The -m at the end indicates use in the media field
 ; Wildcarding rules different from ATM address on 'o' and 'c' lines

ex-vcci    = "VCCI-"  vcci
ex-cid     = "CID-"   cid
ex-bcg     = "BCG-"   bcg
ex-portid  = "PORT-"  portid
ex-vpi     = "VPI-"   vpi
ex-vci     = "VCI-"   vci
ex-vpci    = "VPCI-"  vpci

vcci   = generic-U16
cid    = generic-U8
bcg    = generic-U8
portid = 1*32 (HEXDIG)
vpi    = generic-U12
vci    = generic-U16
vpci   = generic-U16


transport-fmts = generic-transport-fmts / known-transport-fmts / "- -"
generic-transport-fmts = generic-transport 1*(space fmt)
generic-transport = 1*(alpha-numeric / "/")
fmt = 1*(alpha-numeric)

known-transport-fmts = aal1-transport space aal1-fmt-list /
                       aal2-transport space aal2-fmt-list
                       *(space aal2-transport space aal2-fmt-list) /
                       aal5-transport space aal5-fmt-list /
                       rtp-transport space rtp-fmt-list /
                       tn-proto space tn-fmt-list /
                       h323c-proto "-"
h323c-proto = "H323c"
```

```
    ; h323c-proto used for RTCP control ports in H.323 annex C
    ; applications.  tn-proto and tn-fmt-list per rfc2848

aal1-transport = "AAL1" "/" aal1-transport-list
aal1-transport-list = "ATMF" / "ITU" / "custom" / "IEEE:" oui /
                      corporate-name
corporate-name = 1*(safe)
aal2-transport = "AAL2" "/" aal2-transport-list
aal2-transport-list = aal1-transport-list
aal5-transport = "AAL5" "/" aal5-transport-list
aal5-transport-list = aal1-transport-list
rtp-transport = "RTP" "/" rtp-transport-list
rtp-transport-list = "AVP"

aal1-fmt-list = (payload-type *(space payload-type)) / "-"
payload-type = decimal-uchar
aal5-fmt-list = aal1-fmt-list
rtp-fmt-list = aal1-fmt-list
aal2-fmt-list = (profile *(space profile)) / "-"
profile = decimal-uchar
attribute-fields = *("a=" attribute EOL)
attribute = known-attribute / (generic-att-field ":" att-value) /
            generic-att-field
generic-att-field = 1*(alpha-numeric)
att-value = byte-string
known-attribute = atm-attribute / PINT-attribute / rfc2327-attribute
         ; PINT-attribute as defined in rfc2848
         ; rfc2327 attribute as defined in that rfc

atm-attribute =
      "eecid" ":" eecid /
      "aalType" ":" aalType /
      "capability" ":" (asc / atc) space subtype /
      "qosclass" ":" qosclass /
      "bcob" ":" bcob space eetim /
      "stc" ":" stc /
      "upcc" ":" upcc /
      "atmQOSparms" ":" directionFlag space cdvType
                      space acdv space ccdv space eetd space cmtd
                      space aclr /
      "atmTrfcDesc" ":" directionFlag space clpLvl
                      space pcr space scr space mbs space cdvt space
                      mcr space mfs space fd space te /
      "abrParms" ":" directionFlag  space nrm space trm space cdf
                    space adtf /
      "abrSetup" ":" ficr space bicr space ftbe space btbe space
             crmrtt space frif space brif space frdf space brdf /
      "bearertype" ":" bearerType space localInitiation  /
```

```
"lij" ":" sci space lsn /
"anycast" ":" atmGroupAddress space cdStd space
           conScpTyp space conScpSel /
"cache" ":" cacheEnable space cacheTimer /
"bearerSigIE" ":" bearerSigIEType space
         bearerSigIELng space bearerSigIEVal /
"aalApp" ":" appClass space oui space appId /
"cbrRate" ":" cbrRate /
"sbc" ":" sbc /
"clkrec" ":" clkrec /
"fec" ":" fecEnable /
"prtfl" ":" partialFill /
"structure" ":" structureEnable space blksz /
"cpsSDUsize" ":" directionFlag space cpcs /
"aal2CPS" ":" cidLowerLimit space cidUpperLimit space
         timerCU space simplifiedCPS /
"aal2CPSSDUrate" ":" fSDUrate space bSDUrate /
"aal2sscs3661unassured" ":" ted space rastimer space fsssar
          space bsssar /
"aal2sscs3661assured" ":" rastimer space fsssar space bsssar
     space fsscopsdu space bsscopsdu space fsscopuu
     space bsscopuu  /
"aal2sscs3662" ":" sap space circuitMode space frameMode
     space faxDemod space cas space dtmf space mfall space mfr1
     space mfr2 space PCMencoding space fmaxFrame
     space bmaxFrame /
"aal5sscop" ":" fsscopsdu space bsscopsdu space fsscopuu
       space bsscopuu  /
"atmmap" ":" payload-type space encoding-name /
"silenceSupp" ":" silenceSuppEnable space silenceTimer
         space suppPref space sidUse space fxnslevel /
"ecan" ":" directionFlag space ecanEnable space ecanType /
"gc" ":" directionFlag space gcEnable space gcLvl /
"profileDesc" ":" aal2-transport space profile space
   1*(profile-row) /
"vsel" ":" 1*(encoding-name space packet-length space
                              packet-time space) /
"dsel" ":" fxIncl space
           1*(encoding-name space packet-length space
                              packet-time space) /
"fsel" ":" 1*(encoding-name space packet-length space
                              packet-time space) /
"onewaySel" ":" serviceType space directionFlag space
           1*(encoding-name space packet-length space
                              packet-time space) /

"codecconfig" ":" q7655scc /
"isup_usi" ":" isupUsi /
```

```
      "uiLayer1_Prot" ":" uiLayer1Prot /
      "chain" ":" chainPointer

eecid =  8 (HEXDIG)
aalType = "AAL1" / "AAL2" / "AAL3/4" / "AAL5" / "USER_DEFINED_AAL"
asc = "CBR" / "nrt-VBR" / "rt-VBR" / "UBR" / "ABR" / "GFR"
atc = "DBR" / "SBR" / "ABT/IT" / "ABT/DT" / "ABR"
subtype = decimal-U8-or-null
qosclass = decimal-U8-or-null
bcob = generic-U8
eetim = on-off-or-null
stc = decimal-uchar
upcc = decimal-uchar
directionFlag = "f" / "b" / "fb"
cdvType = "PP" / "2P" / "-"
acdv = decimal-U32-or-null
ccdv = decimal-U32-or-null
eetd = decimal-U16-or-null
cmtd = decimal-U16-or-null
aclr = decimal-U8-or-null
clpLvl = "0" / "0+1" / "-"
pcr = decimal-U24-or-null
scr = decimal-U24-or-null
mbs = decimal-U16-or-null
cdvt = decimal-U24-or-null
mcr = decimal-U24-or-null
mfs = decimal-U16-or-null
fd = on-off-or-null
te = on-off-or-null
nrm = generic-U8-or-null
trm = generic-U8-or-null
cdf = generic-U8-or-null
adtf = generic-U16-or-null
ficr = decimal-U24-or-null
bicr = decimal-U24-or-null
ftbe = decimal-U24-or-null
btbe = decimal-U24-or-null
crmrtt = decimal-U24-or-null
frif = 1*2 (DIGIT)
brif = 1*2 (DIGIT)
frdf = 1*2 (DIGIT)
brdf = 1*2 (DIGIT)
bearerType =  "PVC" / "SVC" / "CID"
localInitiation = on-off-or-null
sci = generic-U8-or-null
lsn = generic-U32-or-null
atmGroupAddress = atm-type-addr
cdStd = generic-U8-or-null
```

```
conScpTyp = generic-U8-or-null
conScpSel = generic-U8-or-null
cacheEnable = on-off-or-null
cacheTimer = generic-U32-or-null
bearerSigIEType = 2 * (HEXDIG)
bearerSigIELng = 1*4 (HEXDIG)
bearerSigIEVal = 2*512 (HEXDIG)
appClass =  "-" /
          "itu_h323c" / "af83" / "AAL5_SSCOP" / "itu_i3661_unassured" /
          "itu_ i3661_assured"/ "itu_i3662"/ "itu_i3651" /
          "itu_i3652" / "itu_i3653" / "itu_i3654" / "FRF11" / "FRF5" /
          "FRF8" / "itu_h2221"
oui = "-" / 1*6 (HEXDIG)
appId = "-" / 1*8 (HEXDIG)
cbrRate = 2 (HEXDIG)
sbc = generic-U8
clkrec = "NULL" / "SRTS" / "ADAPTIVE"
fecEnable = "NULL" / "LOSS_SENSITIVE"  / "DELAY_SENSITIVE"
partialFill = generic-U8
structureEnable = on-off-or-null
blksz = generic-U16-or-null
cpcs = generic-U16
cidLowerLimit = generic-U8-or-null
cidUpperLimit = generic-U8-or-null
timerCU = decimal-U32-or-null
simplifiedCPS = on-off-or-null
fSDUrate = decimal-U24-or-null
bSDUrate = decimal-U24-or-null
ted = on-off-or-null
rastimer = decimal-U32-or-null
fsssar = generic-U24-or-null
bsssar = generic-U24-or-null
fsscopsdu = generic-U16-or-null
bsscopsdu = generic-U16-or-null
fsscopuu = generic-U16-or-null
bsscopuu = generic-U16-or-null
sap = "AUDIO" / "MULTIRATE" / "-"
circuitMode = on-off-or-null
frameMode = on-off-or-null
faxDemod = on-off-or-null
cas = on-off-or-null
dtmf = on-off-or-null
mfall = on-off-or-null
mfr1 = on-off-or-null
mfr2 = on-off-or-null
PCMencoding = "PCMA" / "PCMU" / "-"
fmaxframe = generic-U16-or-null
bmaxframe = generic-U16-or-null
```

```
silenceSuppEnable = on-off-or-null
silenceTimer = generic-U16-or-null
suppPref = "standard" / "custom" / "-"
sidUse = "No SID" / "Fixed Noise" / "Sampled Noise" / "-"
fxnslevel = generic-U8-or-null
ecanEnable = on-off-or-null
ecanType = "G165" / "G168" / "-"
gcEnable = on-off-or-null
gcLvl = generic-U16-or-null

profile-row  = uuiCodeRange space encoding-name space packet-length
                   space packet-time space
uuiCodeRange = decimal-uchar "-" decimal-uchar / "-"
encoding-name = "-" /
                "PCMG" / "SIDG" / "SID729" /
                "PCMU" / "G726-32" / "G723" / "PCMA" / "G722" / "G728" /
                "G729" / "X-G729a" / "X-G729b" / "X-G729ab" /
                "X-G726-16" / "X-G726-24" / "X-G726-40" / "X-G7231-H" /
                "X-G7231-L" / "X-G7231a-H" / "X-G7231a-L" /
                "X-G727-16" / "X-G727-24" / "X-G727-32" /
                "X-CCD" / "X-CCD-CAS" / "GSM" / "GSM-HR" / "GSM-EFR" /
                "GSM-EHR" / "X-FXDMOD-3" / "1016" / "DVI4" / "L16" /
                "LPC" / "MPA" / "QCELP" / "H263" / "H263-1998" /
                "JPEG" / "H261" / "MPV" / "MP2T" / "nv" / "RED" /
                "CelB" / "L8" / "VDVI" / "MP1S" / "MP2P" / "BT656" /
                "FR-AMR" / "HR-AMR" / "UMTS-AMR" / "AMR"
packet-length = decimal-U8-or-null
packet-time = decimal-U16-or-null
fxIncl = on-off-or-null
serviceType = "v" / "d" / "f" / "df" / "all"
q7655scc = 4*32 (HEXDIG)
isupUsi = 4*24 (HEXDIG)
uiLayer1Prot = 2 (HEXDIG)

chainPointer = "NEXT" / "PREVIOUS" / "NULL"
```

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