          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.

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.

Table of Contents

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

+---+
| | Controlling Document for |
| Transport | 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	Corporate document or
AAL2/custom	application-specific interoperability
AAL5/custom	statement.
+-----------------------+---+
AAL1/<corporateName>	
AAL2/<corporateName>	
AAL5/<corporateName>	
AAL1/IEEE:<oui>	Corporate document
AAL2/IEEE:<oui>	
AAL5/IEEE:<oui>	
+-----------------------+---+
| 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 T1S1, 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   |     3 bits           |
|           | forward Resource Management cell|                    |
+-----------+-------------------------------+----------------------+
| <trm>     | Maximum time between          |     3 bits           |
|           | forward Resource Management cells|                   |
+-----------+-------------------------------+----------------------+
| <cdf>     | Cutoff Decrease Factor        |     3 bits           |
+-----------+-------------------------------+----------------------+
| <adtf>    | Allowed Cell Rate Decrease    |     10 bits          |
|           | Time Factor                   |                      |
+-----------+-------------------------------+----------------------+
```

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     | Decimal equivalent   |
|           | (Cells per second)            | of 24-bit field      |
+-----------+-------------------------------+----------------------+
| <bicr>    | Backward Initial Cell Rate    | Decimal equivalent   |
|           | (Cells per second)            | of 24-bit field      |
+-----------+-------------------------------+----------------------+
| <ftbe>    | Forward transient buffer      | Decimal equivalent   |
|           | exposure (Cells)              | of 24-bit field      |
+-----------+-------------------------------+----------------------+
| <btbe>    | Backward transient buffer     | Decimal equivalent   |
|           | exposure (Cells)              | of 24-bit field      |
+-----------+-------------------------------+----------------------+
| <crmrtt>  | Cumulative RM round-trip time | Decimal equivalent   |
|           | (Microseconds)                | of 24-bit field      |
+-----------+-------------------------------+----------------------+
| <frif>    | Forward rate increase factor  | Decimal integer      |
|           | (used to derive cell count)   | 0 -15                |
+-----------+-------------------------------+----------------------+
| <brif>    | Backward rate increase factor | Decimal integer      |
|           | (used to derive cell count)   | 0 -15                |
+-----------+-------------------------------+----------------------+
| <frdf>    | Forward rate decrease factor  | Decimal integer      |
|           | (used to derive cell count)   | 0 -15                |
+-----------+-------------------------------+----------------------+
| <brdf>    | Backward rate decrease factor | Decimal integer      |
|           | (used to derive cell count)   | 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    |                  MEANING                       |
|  (hex)    |                                                |
+-----------+-----------------------------------------------+
|    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   1- 65,568
            forward direction

<bsssar>   Maximum SSSAR-SDU size   1- 65,568
            backward direction

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   1- 65,568
            forward direction

```
    <bsssar>    Maximum SSSAR-SDU size           1- 65,568
                backward direction

    <fsscopsdu> Maximum SSCOP-SDU size           1- 65,528
                forward direction

    <bsscopsdu> Maximum SSCOP-SDU size           1- 65,528
                backward direction

    <fsscopuu>  Maximum SSCOP-UU field           1- 65,524
                size, forward direction

    <bsscopuu>  Maximum SSCOP-UU field           1- 65,524
                size, backward direction
```

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     |
         +-----------+                    +-----------+
```
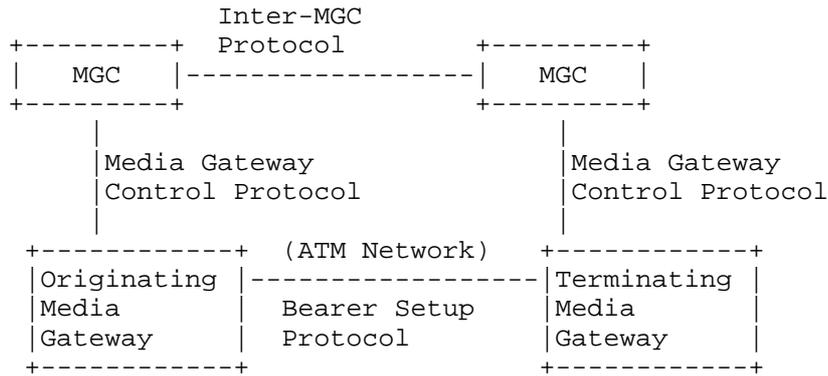
   In the diagram above, the originating media gateway originates the
   service-level call. The terminating media gateway terminates it. In
   the forward bearer connection set-up model, the originating media
   gateway initiates bearer connection set-up. In the backward bearer
   connection set-up model, 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   "BCG-" prefixed to <bcg>
                   representation
                   of <bcg>

<portId>   Port ID   Hex number of up to 32 digits

<ex_portId>   Explicit   "PORT-" prefixed to <portId>
                   representation
                   of <portId>

<vpi>   Virtual Path   Decimal or hex equivalent
                   Identifier   of 8 or 12 bits

<ex_vpi>   Explicit   "VPI-" prefixed to <vpi>
                   representation
                   of <vpi>

<vci>   Virtual Circui t   Decimal or hex equivalent
                    Identifier   of 16 bits

<ex_vci>   Explicit   "VCI-" prefixed to <vci>
                   representation
                   of <vci>

<vpci>   Virtual Path   Decimal or hex equivalent
                   Connection   of 16 bits
                   Identifier

<ex_vpci>   Explicit   "VPCI-" prefixed to <vpci>
                   representation
                   of <vpci>

<cid>   Channel   Decimal or hex equivalent
                   Identifier   of 8 bits

<ex_cid>   Explicit   "CID-" prefixed to <cid>
                   representation
                   of <cid>

<payloadType>   Payload   Decimal integer 0-127
                   Type

<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   Decimal equivalent
                    delay   of 16-bit field

<cmtd>   Cumulative transit   Decimal equivalent
                    delay   of 16-bit field

<aclr>   Acceptable   Decimal equivalent
                    Cell Loss Ratio   of 8-bit field

<clpLvl>   CLP level   String values:
                                          "0", "0+1"

<pcr>   Peak   Decimal
                    Cell Rate   equivalent of a 24-bit field.

<scr>   Sustained   Decimal
                    Cell Rate   equivalent of a 24-bit field

<mbs>   Maximum   Decimal
                    Burst Size   equivalent of 16-bit field

<cdvt>   CDVT   Decimal equivalent of 24-bit
                                          field.

<mcr>   Minimum   Decimal
                    Cell Rate   equivalent of a 24-bit field

<mfs>   Maximum   Decimal
                    Frame Size   equivalent of a 16-bit field

<fd>   Frame Discard   String Values:
                    Allowed   "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      Decimal equivalent of
                     Cell Rate            24-bit field

<bicr>               Backward Initial     Decimal equivalent of
                     Cell Rate            24-bit field

<ftbe>               Forward Transient    Decimal equivalent of
                     Buffer Exposure      24-bit field

<btbe>               Backward Transient   Decimal equivalent of
                     Buffer Exposure      24-bit field

<crmrtt>             Cumulative RM        Decimal equivalent of
                     round-trip time      24-bit field
                     (Microseconds)

<frif>               Forward rate         Decimal integer
                     increase factor      0 -15

<brif>               Backward rate        Decimal integer
                     increase factor      0 -15

<frdf>               Forward rate         Decimal integer
                     decrease factor      0 -15

<brdf>               Backward rate        Decimal integer
                     decrease factor      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      Decimal or hex
                     connection scope         equivalent of 2 bits.
                     selection IE
                     Definition: UNI 4.0 [5]

<conScpTyp>          Type of connection scope   Decimal or hex
                     Definition: UNI 4.0 [5]    equivalent of 4 bits
```

```
<conScpSel>          Connection scope selection   Decimal or hex
                     Definition: UNI 4.0 [5]      equivalent of 8 bits

<cacheEnable>        Enable SVC caching           String values: "on",
                                                  "off"

<cacheTimer>         Timer for cached SVC         Decimal or hex equivalent
                     deletion                     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                  String values:
                     specification               "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             1 to  6 hex digits
                     Unique Identifier

<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               String values:
                     Method                       "NULL", "SRTS",
                                                  "ADAPTIVE"

<fecEnable>          Forward Error                String values:
                     Correction Enable            "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               AAL5: Decimal or hex
                      CPCS SDU size         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   Integer decimal; range
                      (microseconds)        determined by application.
                                            Use decimal equivalent of
                                            32 bits.

<simplifiedCPS>       Simplified CPS [52]   String values:
                                            "on", "off"

<fSDUrate>            Forward SDU rate      Decimal equivalent of
                      (bits per second)     24-bit field

<bSDUrate>            Backward SDU rate     Decimal equivalent of
                      (bits per second)     24-bit field

<ted>                 Transmission Error    String values:
                      Detection Enable      "on", "off"

<rastimer>            SSSAR reassembly      Integer decimal,
                      (microseconds)        Range determined by
                                            application.  Use decimal
                                            equivalent of 32 bits.

<fsssar>              Maximum SSSAR-SDU     Decimal 1- 65568
                      size, forward         or hex equivalent
                      direction
```

```
<bsssar>              Maximum SSSAR-SDU     Decimal 1- 65568
                      size, backward        or hex equivalent
                      direction

<fsscopsdu>           Maximum SSCOP-SDU     Decimal 1- 65528
                      size, forward         or hex equivalent
                      direction

<bsscopsdu>           Maximum SSCOP-SDU     Decimal 1- 65528
                      size, backward        or hex equivalent
                      direction

<fsscopuu>            Maximum SSCOP-UU      Decimal 1- 65524
                      field size, forward   or hex equivalent
                      direction

<bsscopuu>            Maximum SSCOP-UU      Decimal 1- 65524
                      field size, backward  or hex equivalent
                      direction

<sap>                 Service Access        String values:
                      Point                 "AUDIO", "MULTIRATE"

<circuitMode>         Circuit Mode          String values:
                      Enable                "on", "off"

<frameMode>           Frame Mode            String values:
                      Enable                "on", "off"

<faxDemod>            Fax Demodulation      String values:
                      Enable                "on", "off"

<cas>                 Enable CAS transport  String values:
                      via Type 3 packets    "on", "off"

<dtmf>                Enable DTMF transport  String values:
                      via Type 3 packets    "on", "off"

<mfall>               Enable MF transport   String values:
                      via Type 3 packets    "on", "off"

<mfr1>                Enable MF (R1)        String values:
                      transport via          "on", "off"
                      Type 3 packets

<mfr2>                Enable MF (R2)        String values:
                      transport via          "on", "off"
                      Type 3 packets
```

```
<PCMencoding>        PCM encoding            String values:
                                             "PCMA", "PCMU"


<fmaxFrame>          Maximum length of a     Decimal or hex
                     frame mode data unit,   equivalent of
                     forward direction       16-bit field


<bmaxFrame>          Maximum length of a     -ditto-
                     frame mode data unit,
                     backward direction


<silenceSuppEnable>  Silence suppression     String values:
                     Enable                  "on", "off"


<silenceTimer>       Kick-in timer           Decimal or hex representation
                     for silence             of 16-bit field
                     suppression


<suppPref>           Preferred Silence       String values:
                     Suppression Method      "standard", "custom"


<sidUse>             SID Use                 String values:
                     Method                  "No SID", "Fixed Noise",
                                             "Sampled Noise"


<fxnslevel>          Fixed Noise             Decimal or hex representation
                     Level                   of a 7-bit field


<ecanEnable>         Enable Echo             String values:
                     Cancellation            "on", "off"


<ecanType>           Type of Echo            String values:
                     Cancellation            "G165", "G168"


<gcEnable>           Enable Gain             String values:
                     Control                 "on", "off"


<gcLvl>              Level of inserted       Decimal or hex equivalent
                     Loss                    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"
```

References

   [1] Handley, M. and V. Jacobson, "SDP: Session Description
        Protocol", RFC 2327, April 1998.

   [2] Schulzrinne, H., Casner, S., Frederick, R. and V. Jacobson,
        "RTP: A Transport Protocol for Real-Time Applications", RFC
        1889, January 1996.

        RFC 1889 will be obsoleted, in a substantially backwards
        compatible manner, by a work in progress that will become an
        RFC.

   [3] Schulzrinne, H., "RTP Profile for Audio and Video Conferences
        with Minimal Control", RFC 1890, January 1996.

        RFC 1890 will be obsoleted, in a fully backwards compatible
        manner, by a work in progress that will become an RFC.

   [4] ATMF UNI 3.1 Specification, af-uni-0010.002. Of special
        interest for this document is Section 5.4.5.5, ATM Adaptation
        Layer Parameters.

   [5] ATMF UNI 4.0 Signaling Specification, af-sig-0061.000.

   [6] ATMF Traffic Management Specification, Version 4.1, af-tm-
        0121.000.

   [7] ATMF Circuit Emulation Service (CES) Interoperability
        Specification, version 2.0, af-vtoa-0078.000, Jan. 97.

   [8] ATMF Voice and Telephony over ATM - ATM Trunking using AAL1 for
        Narrowband Services, version 1.0, af-vtoa-0089.000, July 1997.

   [9] ATMF Specifications of (DBCES) Dynamic Bandwidth Utilization -
        in 64kbps Timeslot Trunking over ATM - using CES, af-vtoa-
        0085.000, July 1997.

   [10] ITU-T I.363.1, B-ISDN ATM Adaptation Layer Specification: Type 1
        AAL, August 1996.

   [11] ITU-T I.363.2, B-ISDN ATM Adaptation Layer Specification: Type 2
        AAL, Sept. 1997.

   [12] ITU-T I.366.1, Segmentation and Reassembly Service Specific
        Convergence Sublayer for AAL Type 2, June 1998.

   [13] ITU-T I.366.2, AAL Type 2 Reassembly Service Specific
        Convergence Sublayer for Trunking, Feb. 99.

   [14] Petrack, S., "RTP payloads for Telephone Signal Events", Work in
        Progress.

   [15] ITU-T Q.2931, B-ISDN Application Protocol for Access Signaling.

   [16] Amendment 1, 2, 3 and 4 to ITU-T Q.2931, B-ISDN Application
        Protocol for Access Signaling.

   [17] Handley, M., Perkins C. and E. Whelan, "Session Announcement
        Protocol", RFC 2974, October 2000.

   [18] Handley, M., Schulzrinne, H., Schooler, E. and J. Rosenberg,
        "Session Initiation Protocol (SIP)", RFC 2543, March 1999.

   [19] Almquist, P., "Type of Service in the Internet Protocol Suite",
        July 1992.

   [20] Nichols, K., Blake, S., Baker, F. and D. Black, "Definition of
        the Differentiated Services Field (DS Field) in the IPv4 and
        IPv6 Headers", December 1998.

   [21] ITU-T I.363.5, B-ISDN ATM Adaptation Layer Specification: Type 5
        AAL, Aug. 1996.

   [22] ATMF PNNI 1.0, af-pnni-0055.000, March 1996.

   [23] Schulzrinne, H., Casner, S., Frederick, R. and V. Jacobson,
        "RTP: A Transport Protocol for Real-Time Applications", Work in
        Progress.

   [24] Schulzrinne, H. and S. Casner, "RTP Profile for Audio and Video
        Conferences with Minimal Control", Work in Progress.

   [25] Arango, M., Dugan, A., Elliott, I., Huitema, C. and S. Pickett,
        "Media Gateway Control Protocol (MGCP)", RFC 2705, October 1999.

   [26] Cuervo, F., Greene, N., Rayhan, A., Huitema, C., Rosen, B. and
        J. Segers, "Megaco Protocol Version 1.0", RFC 3015, November
        2000.

   [27] Atkinson, R., "IP Authentication Header", RFC 1826, August 1995.

   [28] ITU I.371, Traffic Control and Congestion Control in the BISDN.

   [29] ITU E.191, BISDN Numbering and Addressing.

   [30] ATM Forum Addressing: Reference Guide, af-ra-0106.000.

   [31] http://www.iana.org/assignments/rtp-parameters for a list of
        codecs with static payload types.

   [32] ITU Q.2941-2, Digital Subscriber Signalling System No. 2 (DSS
        2): Generic identifier transport extensions.

   [33] ITU Q.2961, Digital subscriber signalling system no.2 (DSS 2) -
        additional traffic parameters. Also, Amendment 2 to Q.2961.

   [34] ITU Q. 2965.1, Digital subscriber signalling system no.2 (DSS 2)
        - Support of Quality of Service classes.

[35] ITU Q. 2965.2, Digital subscriber signalling system no.2 (DSS 2)
     - Signalling of individual Quality of Service parameters.

[36] ITU Q.1901, Bearer Independent Call Control Protocol.

[37] ITU Q.2630.1, AAL type 2 signaling protocol - capability set 1.

[38] ITU I.363.5, B-ISDN ATM Adaptation Layer specification: Type 5
     AAL.

[39] I.365.1,Frame relaying service specific convergence sublayer
     (FR-SSCS).

[40] I.365.2, B-ISDN ATM adaptation layer sublayers: service specific
     coordination function to provide the connection oriented network
     service.

[41] I.365.3, B-ISDN ATM adaptation layer sublayers: service specific
     coordination function to provide the connection-oriented
     transport service.

[42] I.365.4, B-ISDN ATM adaptation layer sublayers: Service specific
     convergence sublayer for HDLC applications.

[43] Q.2110, B-ISDN ATM adaptation layer - service specific
     connection oriented protocol (SSCOP).

[44] af-vtoa-0113.000, ATM trunking using AAL2 for narrowband
     services.

[45] H.323-2, Packet-based multimedia communications systems.

[46] af-vtoa-0083.000, Voice and Telephony Over ATM to the Desktop.

[47] I.356, BISDN ATM layer cell transfer performance.

[48] ITU Q.2957, Digital Subscriber Signaling System No. 2, User to
     user signaling.

[49] Mills, D., "Network Time Protocol (Version 3) Specification,
     Implementation and Analysis", RFC 1305, March 1992.

[50] TIA/EIA/IS-J-STD-025-A, Lawfully Authorized Electronic
     Surveillance, May 2000.

[51] ITU-T H.222.1, Multimedia multiplex and synchronization for
     audiovisual communication in ATM environments.

   [52] af-vmoa-0145.000, Voice and Multimedia over ATM, Loop Emulation
        Service using AAL2.

   [53] FRF.5, Frame Relay/ATM PVC Network Interworking Implementation
        Agreement.

   [54] FRF.8.1, Frame Relay/ATM PVC Service Interworking Implementation
        Agreement.

   [55] FRF.11, Voice over Frame Relay Implementation Agreement.

   [56] Crocker, D. and P. Overell, "Augmented BNF for Syntax
        Specifications: ABNF", RFC 2234, November 1997.

   [57] ITU Q.765.5, Application Transport Mechanism - Bearer
        Independent Call Control.

   [58] http://www.3gpp.org/ftp/Specs for specifications related to
        3GPP, including AMR codecs.

   [59] ITU Q.931, Digital Subscriber Signaling System No. 1: Network
        Layer.

   [60] ITU Q.763, SS7 - ISUP formats and codes.

   [61] http://www.atmforum.com/atmforum/specs/specs.html, ATM Forum,
        Well-known addresses and assigned codes.

   [62] Bradner, S., "Keywords for use in RFCs to indicate requirement
        levels", BCP 14, RFC 2119, March 1997.

Acknowledgements

Authors' Addresses

   Rajesh Kumar
   Cisco Systems, Inc.
   M/S SJC01/3
   170 West Tasman Drive
   San Jose, CA 95134-1706

   Phone: 1-800-250-4800
   EMail: rkumar@cisco.com

   Mohamed Mostafa
   Cisco Systems, Inc.
   M/S SJC01/3
   170 West Tasman Drive
   San Jose, CA 95134-1706

   Phone: 1-800-250-4800
   EMail: mmostafa@cisco.com