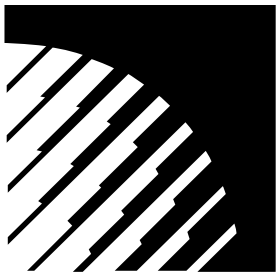

The ATM Forum

Technical Committee

Low Speed Circuit Emulation Service (LSCES)

AF-VTOA-0119.000

May, 1999

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PREFACE

This specification uses three levels for indicating the degree of compliance necessary for specific functions, procedures, or coding. They are indicated by the use of key words as follows:

- **Requirements:** "Shall" indicates a required function, procedures or coding necessary for compliance. In some cases "shall" used in text indicates a conditional requirement, since the operation described is dependent on whether or not an objective or option is chosen.

- **Objective:** "Should" indicates an objective which is not required for compliance, but which is considered desirable.

- **Option**: "May" indicates an optional operation without implying a desirability of one operation over another. That is, it identifies an operation that is allowed while still maintaining compliance.

1.0 Introduction

There is a user demand for carrying certain types of constant bit rate (CBR) or "circuit" traffic over Asynchronous Transfer Mode (ATM) networks. As ATM is essentially a packet- rather than circuit-oriented transmission technology, it must emulate circuit characteristics in order to provide good support for CBR traffic.

Interfaces that support low rates, such as EIA-449 and V.35, have been implemented in numerous networks to support such applications as Voice Order Wires (VOWs), Video Teleconferencing (VTC), low speed multiplexers, WAN interfaces, encrypted data, and telemetry. Data rates typically range from 75 bit/s to 2.048 Mbit/s. Transmission distances here are relatively limited, and an additional option for increasing the range is realized by extending these interfaces over an ATM network.

1.1 Purpose of document

This document - referred to as the Low Speed Circuit Emulation Service Interoperability Specification (LSCES-IS) - specifies the ATM Forum's interoperability agreements for supporting unstructured CBR traffic at user-defined rates over ATM networks that comply with the Forum's other interoperability agreements. This document is targeted to support low speed applications (less than 64 kbit/s), but can also support higher rates. This document supports interfaces of both DTE and DCE.

Note that all of the specific interfaces identified within this document need not be supported in order to be compliant with this specification. Although no specific type of interface is required for compliance, support for any one or more of these will be considered as implementing a Low Speed Circuit Emulation Service. However, if support for any of the specified interfaces identified within this specification is provided, this support must then be provided in a manner consistent with this specification to be considered compliant. For example, a compliant CES implementation may choose to implement a EIA-449 interface without implementing the EIA/TIA-530-A or V.35 interfaces. This implementation would then be considered compliant for the EIA-449 interface, provided that it is implemented in a manner consistent with their specification within this document.

1.2 Scope of document

The LSCES-IS specifies point-to-point unstructured circuit emulation service using AAL1. The use of both PVCs and SVCs are specified in this document.

1.3 Abbreviations

The following abbreviations as used in this specification:

AAL1	ATM Adaptation Layer type 1
CBR	Constant Bit Rate
CDV	Cell Delay Variation
CES	Circuit Emulation Service
DCD	Data Carrier Detect
DCE	Data Circuit-Terminating Equipment
DTE	Data Terminal Equipment
IWF	Inter-Working Function
LSB	Least Significant Bit
MSB	Most Significant Bit
OAM	Operation, Administration, and Maintenance
PRS	Primary Reference Source
PVC	Permanent Virtual Circuit
SRTS	Synchronous Residual Time Stamp
SVC	Switched Virtual Circuit

1.4 Reference model and terms

Figure 1 provides a reference model for dedicated circuit emulation for low speed circuits.

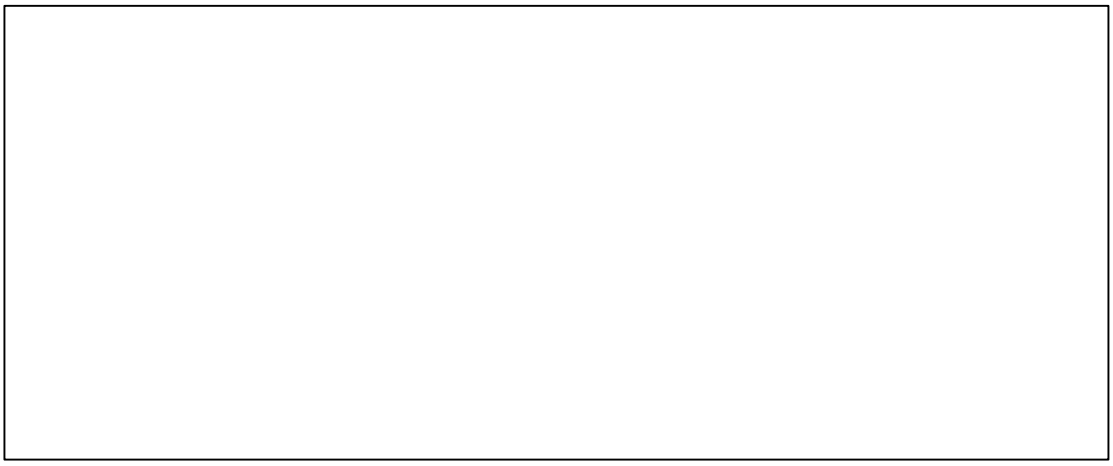

Figure 1. Reference Configuration for Low Speed CES

1.5 References

1.5.1 Normative

ATM Forum/AF- VTOA-0078.000 “Circuit Emulation Service Interoperability Specification Version 2.0,” January, 1997.

ATM Forum/AF-BICI-0013.001 “Broadband Inter-Carrier Interface Specification 1.1”, Sept 1994

ATM Forum/AF-UNI-0010.002 “ATM User Network Interface Specification 3.1”, Sept 1994

ATM Forum/AF-TM-0056.000 “Traffic Management Specification Version 4.0”, April 1996

ATM Forum/AF-SIG-0061.000 “ATM User-Network-Interface (UNI) Signalling Specification Version 4.0”, July 1996

ATM Forum/ af-ra-0106.000 “ATM Forum Addressing: Reference Guide”, final ballot February, 1999

ITU-T Recommendation V.35 “Data Transmission at 48 Kilobits per Second Using 60-108 kHz Group Band Circuits”, 1976.
Note: This specification has been withdrawn from the ITU set of recommendations. However, copies of this recommendation can still be obtained from the ITU.

EIA-449, General Purpose 37-position and 9-position interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Interchange”, published Nov. 1977 and reaffirmed Jan. 1985.

ITU-T Recommendation H.14 “Characteristics of Group Links for the Transmission of Wide-Spectrum Signals”, 1984.

TIA/EIA-530-A “High Speed 25-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment, Including Alternative 26-Position Connector,” June, 1992.

TIA/EIA-422-B “Electrical Characteristics of Balanced Voltage Digital Interface Circuits,” May, 1994.

EIA-423-A “Electrical Characteristics of Unbalanced Voltage Digital Interface Circuits, December, 1978.

TIA/EIA-334-B “Signal Quality at Interface Between Data Terminal Equipment and Synchronous Data Circuit-Terminating Equipment for Serial Data Transmission,” May, 1994.

ITU-T Recommendation V.28 “Electrical Characteristics for Unbalanced Double Current Interchange Circuits”, 1993.

ITU-T Recommendation I.363.1 “B-ISDN ATM Adaptation Layer specification: Type 1 AAL”, 1996

ITU-T Recommendation Q.2931 “Broadband Integrated Services Digital Network (B-ISDN) – Digital Subscriber Signalling System No. 2 (DSS 2) – User-Network-Interface (UNI) Layer 3 Specification For Basic Call/Connection Control”, 1995

1.5.2 Informative

ITU-T V.120 Support by an ISDN of Data Terminal Equipment with V-series Type Interfaces with Provision for Statistical Multiplexing.

2.0 Low Speed CES Interfaces

A large number of applications utilize EIA-449, V.35, and EIA/TIA-530-A interfaces today, making use of a wide range of data rates. Within this section is a description of the point-to-point interface shown in the reference configuration.

2.1 Service description

The Dedicated Low Speed CES interface is designed to emulate a point-to-point EIA-449, EIA/TIA-530-A, or V.35 circuit. The interface is targeted for low speed applications (less than 64 kbit/s), but can support rates up to 2.048 Mbit/s. The service is accessed using the appropriate interface for that type of circuit (e.g. the EIA-449 uses a 37 pin "D" type connector). The service defined here is clear channel, and transparently carries the data stream.

The IWF service side shall support, at a minimum, the rates of 1200, 2400, 4800, and 9600 bit/s. Any other rates between 75 bit/s and 2.048 Mbit/s may also be supported. The purpose of a minimal set of rates is to provide a user with some basic expectation of what rates a compliant interface will support.

Figure 2 shows the Low Speed CES interface from a layering perspective. For this service, the CES interworking function has two physical layers, one for the CBR circuit to be emulated (e.g. EIA-449) and one for the ATM interface. Linking the CBR physical layer with the AAL 1 layer is a "mapping function". In Low Speed CES, the mapping function simply maps every bit between the AAL 1 layer and the CBR interface. From an ATM perspective, everything in the shaded diagram represents an "AAL User Entity".

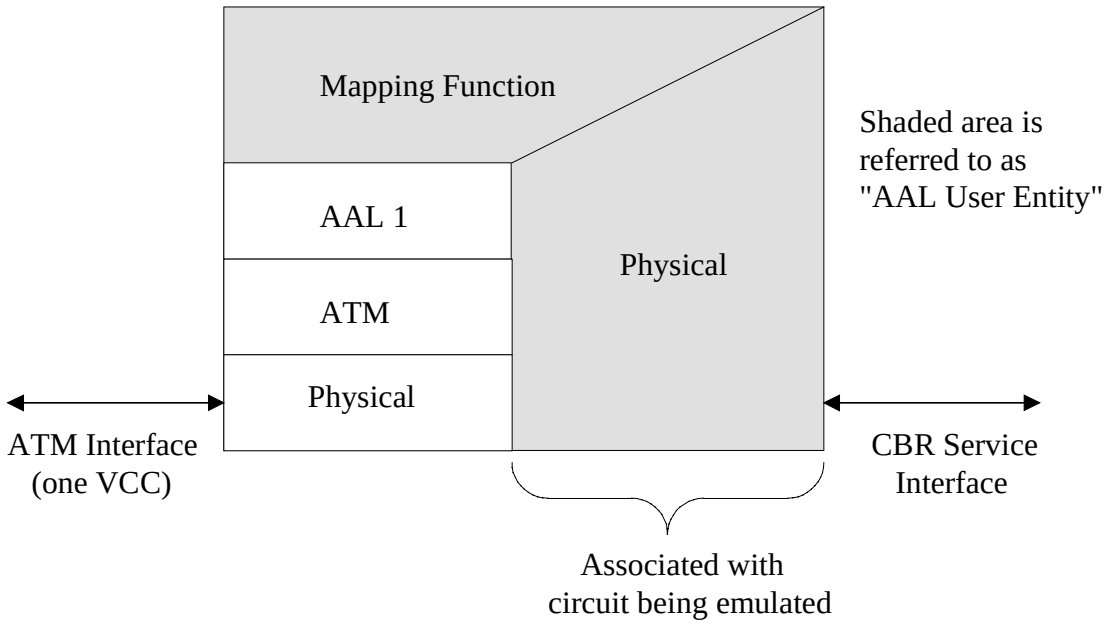

Figure 2: Low Speed CES Interworking Function -- Layering Perspective

2.1.1 Framing

There is no requirement for framing, as the Low Speed CE Service carries any arbitrary data stream.

2.1.2 Clocking

The Low Speed CES IWF has two modes for timing user equipment attached to the Service Interface:

1. Synchronous Mode, in which timing is supplied to attached equipment via the IWF Service Interface, and may be traceable to a Primary Reference Source.
2. Asynchronous Mode, in which a) timing information is transported using SRTS or b) timing is recovered using adaptive timing.

Use of SRTS shall be done in accordance with ITU I.363.1.

For EIA-449 and EIA/TIA-530-A circuits, the Transmit Signal Element Timing clocks (both transmit and receive) shall not deviate more than +/- .01% from the nominal value, based on TIA/EIA-334-B.

For V.35 circuits, the Transmit Signal Element Timing clocks (both transmit and receive) shall not deviate more than +/- 1 bit/s from its nominal value.

This specification does not preclude the provision of synchronous circuit timing to the external equipment via a separate physical interface. The specification of such a separate timing interface is beyond the scope of this specification.

2.1.3 Jitter and Wander

Jitter and wander may be present at the output of the emulated circuit, introduced, for example, by imperfections in clock recovery at the output of the CES IWF.

EIA-449 or EIA/TIA-530-A interfaces on the Low Speed CES interworking function shall meet EIA-334-B for signal quality.

V.35 interfaces on the Low Speed CES interworking function shall meet ITU-T H.14 for signal quality.

2.1.4 Loss of Signal (LOS) Alarms at the IWF service interface.

This alarm would indicate that an IWF was no longer able to send data to the ATM network. The condition is shown in figure 3 below. If the IWF is configured as a DTE, then the detect LOS alarm indicates that one of the following conditions had occurred: loss of data signal, loss of clock signal, Data Set Ready is no longer set, or Clear to Send is no longer set. If the IWF is configured as a DCE, then the detect LOS alarm indicates that one of the following conditions had occurred: loss of data signal, loss of clock signal, Data Terminal Ready is no longer set, or Request to Send is no longer set.

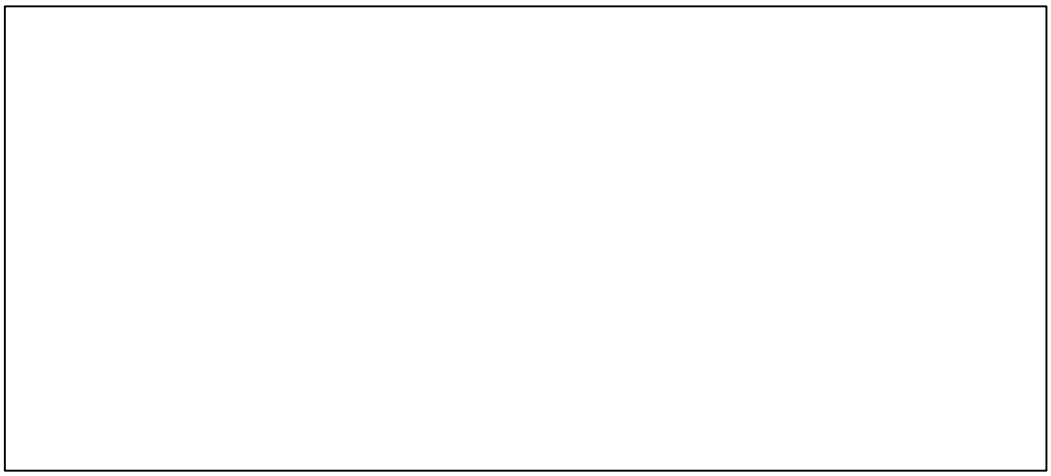

Figure 3. Loss of Signal (LOS) alarm condition

The IWF shall detect Loss of Signal at the IWF service interface. How Loss of Signal is detected is implementation dependent. Upon detection of LOS, the IWF shall send cells containing all-ones.

2.1.5 End-to-End Delay

End-to-end delay requirements are application specific. End-to-end delay requirements are beyond the scope of this specification. For this specification, end-to-end delay will depend significantly on the CBR data rate selected, and could become quite long at low rates.

2.1.6 Electrical

The electrical requirements for the EIA-449 and EIA/TIA-530-A interfaces shall be in accordance with TIA/EIA-422-B and EIA-423-A.

The electrical requirements for the V.35 interface shall be in accordance with the following:

Unbalanced V.35 Electrical Signals:

The V.35 unbalanced electrical signals shall comply with ITU-T V.28, *Electrical Characteristics for Unbalanced Double-Current Interchange Circuits.*

Balanced V.35 Electrical Signals:

The V.35 balanced electrical signals shall comply with Appendix 2 of ITU-T V.35.

2.2 AAL 1 Requirements

2.2.1 Data Transfer Service Type

This service shall use no AAL convergence sublayer overhead, as defined in ITU-T I.363.1.

2.2.2 Cell Utilization

In accordance with ITU I.363.1, the IWF shall fill the entire 47-octet cell payload with data, unless the IWFs are configured to partially fill ATM cells. Partial cell fill shall be done according to ITU-T I.363.1, section 2.5.2.5, for the case where there is no AAL convergence sublayer overhead (i.e. P format cells are not used).

2.3 AAL User Entity Requirements

2.3.1 Cell Coding

Unstructured Data Transfer does not rely on any particular data format. Bits received from the service interface are packed into cells without regard to framing. Note that no particular alignment between any octets that may exist in the data stream and octets in an ATM cell can be assumed with Unstructured Data Transfer.

Correct bit ordering shall be maintained. Considering the 376 contiguous bits that will be packed into the SDU, the first bit received on the service interface is placed in the MSB of the first octet of the SDU, and placement proceeds in order until the last bit is placed in the LSB of the last valid octet of the cell. If partial cell fill is used, the remaining octets of the cell shall be filled with dummy octets.

2.3.2 Loss/Error Response

The IWF should maintain “bit count integrity”; i.e., the number of bits coming into the IWF providing the unstructured service should equal the number of bits leaving the reassembling IWF. Failure to maintain bit count integrity may cause end-user equipment to experience a buffer over-run or under-run.

2.3.3 Lost and Mis-inserted Cells

The re-assembly unit may detect lost and mis-inserted cells by processing sequence numbers in the AAL1 headers.

If lost cells are detected, dummy cells consisting of 47 octets of all ones shall be inserted when bit count integrity can be maintained. Sequence number processing shall be done in accordance with I.363.1. Depending on implementation, there will be a point at which too many cells will have been lost to maintain bit count integrity.

Mis-inserted cells are expected to be rare. The re-assembly unit may maintain bit count integrity where possible by dropping cells that the AAL1 header processor detects as mis-inserted.

2.3.4 Buffer Overflow/Underflow

Under some circumstances, such as a failure in the ATM network carrying the emulated circuit, the flow of cells to the re-assemble unit will stop for an extended period.

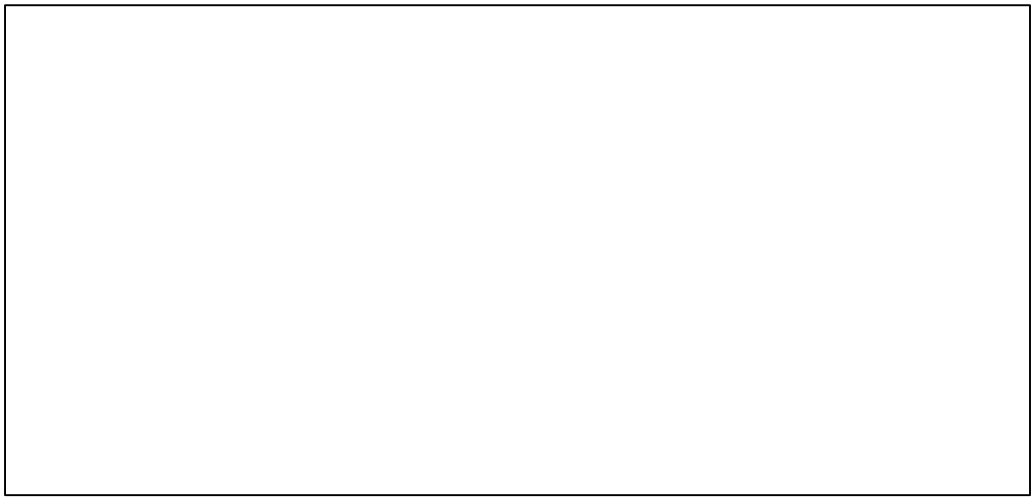

Figure 4. Virtual Channel Fault Indication

After an integration period of 5 +/- 0.5 seconds, a persistent buffer starvation condition shall trigger a Loss-of-Cells fault indication. If the service side of the IWF is configured as a DTE, then the Request to Send (RTS) lead shall be set low and data from DCE shall be dropped. If the IWF is configured as a DCE, then the Data Carrier Detect (DCD) lead shall be set low and no data transmitted toward the DTE.

The re-assembly buffer can suffer an overflow condition due to a clocking error. The IWF shall drop an implementation-dependent number of bits from the reassembled stream in the case of a buffer overflow.

2.4 Physical Interfaces

2.4.1 ATM Interfaces

The ATM interfaces should be any ATM interface defined by the ATM Forum or by the ITU-T I.432.x series of UNI recommendations. The ATM physical interface has two characteristics that are relevant when supporting this CES:

Bandwidth

The ATM interface shall be capable of providing adequate bandwidth to carry the unstructured traffic after segmentation.

Timing

The ATM interface can be used to convey timing traceable to a Primary Reference Source from the ATM network to the CES Interworking Function, where external connection to network timing is not supported.

2.4.2 Service Interfaces

The service interfaces supported by this CES IWF are EIA-449, EIA/TIA-530-A and V.35. The service interface of the IWF shall support the leads shown in table 1.

Table 1. Service Interface Leads

Service Signals	Leads
Signal Ground	SG
Transmitted Data	TD
Received Data	RD
Request to Send	RTS
Clear to Send	CTS
Data Set Ready	DSR
Data Terminal Ready	DTR
Transmit Signal Element Timing (DTE source)	TSET (DTE)
Transmit Signal Element Timing (DCE source)	TSET (DCE)
Receive Signal Element Timing (DCE source)	RSET
Local Loopback	LL
Data Carrier Detect	DCD

Support for leads not shown in Table 1 is beyond the scope of this specification

3.0 ATM Virtual Channel Requirements

The requirements described in this section must be met by the ATM network that provides an end-to-end ATM connection, i.e., from the IWF ATM Interface on the left to the IWF ATM Interface on the right in Figure 1.

Quality of Service Class 1 for circuit emulation from the UNI Specification Version 3.1 Appendix A (AF-UNI-0010.002) or Traffic Management 4.0 (AF-TM-0056.000) section B.3.1 shall be used.

3.1 Traffic Parameters and Tolerances

Traffic policing may be performed on cells generated by the CES Interworking Function and transported by the ATM network.

The CDV Tolerance parameter of the UPC should take into account any cell delay variation caused by the introduction of OAM cells. The CDV Tolerance should also account for any CDV that occurs in the intervening multiplexing and switching devices between the Interworking Function and the UPC device.

The following section gives the Peak Cell Rate (PCR) for the Low Speed CES Interworking Function. The case when partial cell fill is used is also given.

In all cases, if the OAM traffic is to be included in the PCR per AF-UNI-0010.002 section 3.6.3.2.3.7 or AF-TM-0056.000, section 4.4.1, then the OAM traffic parameter cells needs to be added to the above or specified separately.

3.1.1 Low Speed CES Cell Rate (no partial cell fill)

The PCR on CLP=0+1 required for AAL1 transport of user data is dependent on the data rate and shall be based on the formula below:

For V.35: PCR > (User data rate (bit/s)+1) / (47 AAL1 octets/cell x 8 bits/octet)

For EIA-449 and EIA/TIA-530-A:

PCR > (User data rate (bit/s))/ (47 AAL1 octets/cell x 8 bits/octet) +

.0001 x (User data rate (bit/s))/ (47 AAL1 octets/cell x 8 bits/octet)

Adequate bandwidth should be made available to support F5 end-to-end OAM cells on these VCCs.

3.1.2 Low Speed CES Cell Rate (partial cell fill)

The PCR on CLP=0+1 required for AAL1 transport of user data with partial cell fill is dependent on the data rate and shall be based on the formula below:

K is the number of AAL1-user octets filled.

For V.35: PCR>(User data rate (bits/s)+1) / (K AAL1 octets/cell x 8 bits/octet)

For EIA-449 and EIA/TIA-530-A:

PCR > (User data rate (bit/s))/ (K AAL1 octets/cell x 8 bits/octet) +

.0001 x (User data rate (bit/s))/ (K AAL1 octets/cell x 8 bits/octet)

Adequate bandwidth should be made available to support F5 end-to-end OAM cells on these VCCs.

3.2 Impairments

Cell Transfer Delay

Overall delay is often critical for Circuit Emulation applications, particularly those involving voice. Delay introduced by the ATM network interconnecting CES IWFs is composed of two components:

Maximum Delay gives the largest expected cell delay between entrance and exit of the ATM network.

Cell Delay Variation (CDV) gives the uncertainty in the delay that might be experienced by any particular cell.

Low Speed Circuit Emulation Service equipment must have re-assembly buffers large enough to accommodate the largest CDV present on a virtual channel to prevent underflow or overflow, with resulting buffer reset events.

The number of intervening switches, and their queue management, and line speeds have a significant impact on the distribution of CDV that must be handled by the re-assembly buffer in the destination IWF. The BICI 1.1 specification (af-bici-0013.001), Section 5.1.2 gives an approximation of how CDV accumulates across multiple nodes. Implementers are advised to design the re-assembly buffer in excess of these values, possibly making the size of the re-assembly buffer configurable to optimize the jitter versus absolute delay trade-off in various configurations.

The amount of CDV that the re-assembly process can accommodate is configurable. This entry allows the network provider to configure the maximum cell arrival jitter that the re-assembly process will tolerate in the cell stream without producing errors on the CBR Service Interface. This parameter may be set to a small value if the connection will produce minimal CDV and a large value if the connection will produce large CDV.

4.0 Signaling

This section specifies ATM UNI 3.1 (AF-UNI-0010.002) and UNI 4.0 Signaling (AF-SIG-0061.000) signaling between the IWFs that support Low Speed CES. There is no mapping specified between signaling that pertains to traditional EIA-449/EIA/TIA-530-A/V.35 and ATM UNI 3.1/4.0 signaling.

In cases where there is no difference between UNI Signaling 4.0 (AF-SIG-0061.000) and ITU Q.2931, the ITU-T recommendation is referenced in the UNI 4.0 specification and will be referenced here also.

The call/connection control procedures of UNI 3.1/4.0 apply. The following section details the content of the setup message. CES signaling places no explicit constraints on other signaling messages.

As this interface is designed to interoperate with the unstructured DS-1 and E1 interfaces in the ATM Forum CES 2.0 specification (AF-VTOA-0078.000), the Low Speed CES interface should accept calls initiated by such an interface if such rates are supported in a Low Speed CES implementation.

Note that UNI 3.1/4.0 SVC support is optional for the CES IWF. The following sections are applicable only when such SVC support is provided.

Addresses and Identifiers for CES Switched Virtual Channels (SVCs)

All Low Speed CES SVCs are point-to-point. As with all SVCs, the endpoints must be identified during call setup with an ATM address; these may be of any of the formats specified in ATM Forum af-ra-0106.000

4.2 SETUP Message Contents

Section 5.3.1.7 in the UNI 3.1 Specification and section 3.1.7 of Q.2931 lists the mandatory information elements in the SETUP message. This CES specification places constraints on the values of certain fields in the following mandatory information elements:

1. ATM Traffic Descriptor
2. Broadband bearer capability
3. QoS Parameter

The following sections describe those constraints.

The following information elements (which in general are optional) shall be present for Low Speed CES at rates of DS-1 and E1

1. The AAL Parameters Information Element
2. The Broadband Low Layer Information Element

The required contents of these information elements are discussed in the following sections.

The other information elements identified in UNI 3.1 Section 5.3.1.7 and section 3.1.7 of Q.2931 as optional remain optional for Low Speed CES SVCs; this CES specification places no constraints on the values of the fields in these optional information elements.

Note that in the following sections the fixed information element header fields and field identifiers have been omitted from this specification; these should be inserted in the appropriate place in the information element.

Note also that the service side data rate and timing configuration are not signaled. The rate and timing will need to be configured into the IWF.

ATM Traffic Descriptor

For SVCs, the following two fields in this information element must be specified:

1. Forward peak cell rate CLP=0+1
2. Backward peak cell rate CLP=0+1

The values for these fields should be calculated as specified in Section 3.1. The Best Effort Indicator and the Traffic Management Options Identifier must be omitted. The other fields should be omitted as well.

4.2.2 Broadband Bearer Capability

The following table specifies the values for the fields in this information element.

Table 4-1: Broadband Bearer Capability IE Field Values for Low Speed CES SVCs

Field	Value
Bearer Class	‘1000 0’ BCOB-X
Traffic Type	‘001’ Constant bit rate
Timing Requirements	‘01’ End-to-end timing required
Susceptibility to clipping	‘00’ Not susceptible to clipping
User Plane Connection Configuration	‘00’ Point-to-point

4.2.3 Quality of Service Parameter

The following table specifies the values for the fields in this information element.

Table 4-2: QoS Parameter IE Field Values for Low Speed CES SVCs

Field	Value
QoS Class Forward	'0000 0001' QoS Class 1
QoS Class Backward	'0000 0001' QoS Class 1

The Coding Standard field in this Information Element shall be coded as "11" when operating over ATM Forum compliant networks. However, when interfacing to an ITU conformant network that is not ATM Forum compliant, the Coding Standard shall be coded "00" and the QoS Class Forward and QoS Class Backward are each coded "0000 0000", meaning QoS Class 0 — Unspecified QoS Class.

4.2.4 ATM Adaptation Layer Parameters

This information element is used for unstructured DS1 and E1 only. The following table specifies the field values for these rates. If the called party does not accept these parameters, it should release the call with cause 93 (AAL Parameters not Supported).

Table 4-3: AAL Parameters IE Field Values DS1 and E1 Low Speed CES SVCs

Field	Value
AAL Type	'0000 0001' AAL Type 1
Subtype	'0000 0010' Circuit Transport
CBR rate	'0000 0100' 1544 kbit/s (DS1) '0001 0000' 2048 kbit/s (E1)
Source Clock Frequency Recovery Method	'0000 0000' Null (synchronous circuit transport)
	'0000 0001' SRTS method (asynchronous circuit transport)
	'0000 0010' Adaptive method (asynchronous circuit transport)

4.2.5 Broadband Low Layer Information

This information element identifies that the signaling entities are ATM Forum CES AAL User Entities as specified in the ATM Forum CES 2.0 Specification. This information element is for DS1 and E1 use only**.**

Table 4-4: Broadband Low Layer Information IE Field Values for DS1/E1 Low Speed CES SVCs

Field	Value
User Information Layer 3 Protocol (octet 7)	'01011' ISO/IEC TR 9577
ISO/IEC TR 9577 Initial Protocol Identifier (IPI) (octet 7a, 7b)	IPI is coded '1000 0000' to indicate IEEE 802.1 SNAP identifier. Hence, octets 7a and 7b are coded as '0100 0000' and '0000 0000', respectively.
Organizational Unique Identifier (OUI) (octets 8.1-8.3)	x'00 A0 3E' ATM Forum OUI
Protocol Identifier (PID) (octets 8.4-8.5)	x'00 00' Unstructured Service

5.0 Call Initiation Procedures

This section specifies optional procedures for the automatic initiation of an SVC between two Low Speed CES entities. Within this section, “shall” and “should” apply only if the optional procedures are supported.

5.1 Overview of SVC Procedures

These procedures support automatic setup of an SVC between two circuit emulation processes. Using these procedures, the connection endpoints are provisioned via management action, identifying each endpoint by assigning them unique ATM addresses. Once provisioned, these procedures allow the endpoints to establish the connection, without further network management or user intervention.

A process supporting SVCs may be provisioned to support 2 modes:

- passive, in which it only awaits incoming calls and does not initiate outgoing calls, and
- active, in which it makes call attempts periodically whenever a call is not in progress. In this mode, it is also possible to configure the process to cease call attempts after a configured number of failed attempts. This mode would also include the case where a call is initiated based on some condition. For example, a call may be initiated when the RTS signaling lead is set high.

This specification gives the flexibility to the operator to either have both ends retry calls until successful, or have calls initiated only by a single end.

Note that since the parameters of this type of connection are established administratively, separate from the processes that establish the connection itself; negotiation of end to end parameters is not possible. For example, traffic parameters will not be negotiable. If the switching network can not support any of the configured parameters, the call establishment will fail.

5.2 Call Collision

If a circuit emulation process receives a valid incoming call while it has an outgoing call in progress, it should compare the value of the source and destination ATM addresses in the incoming call. If the source address is smaller than the destination address, the incoming call should be accepted, and the outgoing call cleared. Otherwise, the incoming call should be cleared.

5.3 Call Retry

Strict adherence to a precise retry interval is to be avoided. Rather, the implementation should apply some random differential from this value on each retry. In addition, it may be

desirable to increase the retry interval on each retry in order to implement a back-off scheme when successive retries continue to fail.