Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Type of Number (octet 5)

Bits 7 6 5	Meaning
0 0 0	Unknown
0 0 1	International number

Addressing/Numbering Plan Identification (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 1	ISDN/telephony numbering plan (Recommendation E.164) (Note 1)
0 0 1 0	ATM Endsystem Address (Note 2)

Note 1 - If the E.164 numbering plan is used, "Type of Number" shall be coded as "International Number"

Note 2 -If the ATM Endsystem Address format is used, "Type of Number" shall be coded as "Unknown"

Presentation indicator (octet 5a)

Bits 7 6	Meaning
0 0	Presentation allowed
0 1	Presentation restricted
1 0	Number not available
1 1	Reserved

Note- At the originating user-network interface, the presentation indicator is used for indicating the intention of the calling user for the presentation of the calling party number to the called user. This may also be requested on a subscription basis. If octet 5a is omitted, and the network does not support subscription information for the calling party number information restrictions, the value "00 - presentation allowed" is assumed.

Screening indicator (octet 5a)

Bits 2 1	Meaning
0 0	User-provided, not screened
0 1	User-provided, verified and passed
1 0	User-provided, verified and failed
1 1	Network provided

Note - If octet 5a is omitted, "00 - User provided, not screened" is assumed.

Address (octet 6, etc.)

If the coding "international number/ISDN/telephony numbering plan (Recommendation E.164)" is used, the address is coded as IA5 characters according to the format specified in the numbering plan. If the coding "unknown/ATM Endsystem Address" is used, the address is coded as described in ISO 8348, Addendum 2, using the preferred binary encoding.

5.4.5.14 Calling Party Subaddress

The purpose of the Calling party subaddress information element is to identify a subaddress associated with the origin of a call. It is used in this Implementation Agreement only to convey an ATM address in the ATM Endsystem Address format across a public network which supports only E.164 addresses. The ATM Endsystem Address is based on the ISO NSAP format but it is not an ISO NSAP. Support of this information element by the network is mandatory.

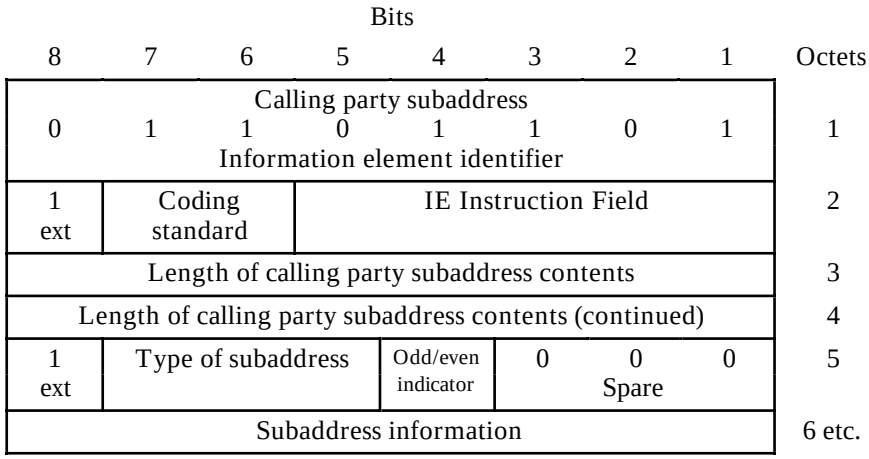

Figure 5-37 Calling Party Subaddress Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Type of Subaddress (octet 5)

Bits 7 6 5	Meaning
0 0 0	NSAP (X.213/ISO 8348 AD2)
0 0 1	ATM Endsystem Address

Odd/even Indicator (octet 5)

The Odd/even indicator is not used in this Implementation Agreement.

Subaddress information (octet 6)

The NSAP X.213/ISO8348AD2 address shall be formatted as specified by octet 6 which contains the Authority and Format Identifier (AFI). The encoding is made according to the "preferred binary encoding" as defined in X.213/ISO 8348 AD2. For the definition of this type of subaddress, see Recommendation I.334.

The ATM Endsystem Address shall be formatted as specified by octet 6 which contains the Authority and Format Identifier (AFI) and is formatted as defined in Section 5.1.3.1 of this Implementation Agreement. The encoding is made according to the "preferred binary encoding" as defined in X.213/ISO 8348. The ATM Endsystem Address uses the code point defined as "User specified, ATM Endsystem Address" in ITU-T Recommendation Q.2931.

5.4.5.15 Cause

The Cause information element describes the reason for generating certain messages, provides diagnostic information in the event of procedural errors, and indicates the location of the cause originator. The Cause information element and diagnostic may be repeated in a message.

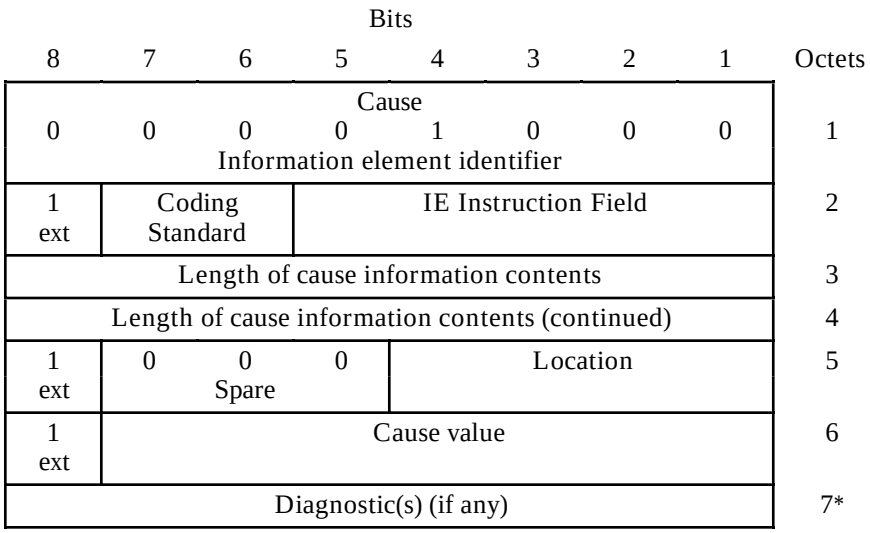

Figure 5-38 Cause Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized
1 1	Standard defined for the network (either public or private) present on the network side of the interface.

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Location (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 0	user
0 0 0 1	private network serving the local user
0 0 1 0	public network serving the local user
0 0 1 1	transit network
0 1 0 0	public network serving the remote user
0 1 0 1	private network serving the remote user
0 1 1 1	international network
1 0 1 0	network beyond interworking point

Cause value (octet 6) (Note 1)

Bits 7 6 5 4 3 2 1	Number	Meaning	Diagnostics
0 0 0 0 0 0 1	1	unallocated (unassigned) number	Note 2
0 0 0 0 0 1 0	2	no route to specified transit network	-
0 0 0 0 0 1 1	3	no route to destination	Note 2
0 0 1 0 0 0 0	16	normal call clearing	-
0 0 1 0 0 0 1	17	user busy	-
0 0 1 0 0 1 0	18	no user responding	-
0 0 1 0 1 0 1	21	call rejected	Note 3
0 0 1 0 1 1 0	22	number changed	New destination (Note 4)
0 0 1 0 1 1 1	23	user rejects all calls with calling line identification restriction (CLIR) (Note 5)	-
0 0 1 1 0 1 1	27	destination out of order	-
0 0 1 1 1 0 0	28	invalid number format (address incomplete)	-
0 0 1 1 1 1 0	30	response to STATUS ENQUIRY	-
0 0 1 1 1 1 1	31	normal, unspecified	-
0 1 0 0 0 1 1	35	requested VPCI/VCI not available	-
0 1 0 0 1 0 0	36	VPCI/VCI assignment failure	-
0 1 0 0 1 0 1	37	user cell rate not available	Note 8
0 1 0 0 1 1 0	38	network out of order (*)	-
0 1 0 1 0 0 1	41	temporary failure	-
0 1 0 1 0 1 1	43	access information discarded	Note 6, Note 7
0 1 0 1 1 0 1	45	no VPCI/VCI available	-
0 1 0 1 1 1 1	47	resource unavailable, unspecified	-
0 1 1 0 0 0 1	49	Quality of Service unavailable	Note 2
0 1 1 1 0 0 1	57	bearer capability not authorized	-
0 1 1 1 0 1 0	58	bearer capability not presently available	-
0 1 1 1 1 1 1	63	Service or option not available, unspecified	-
1 0 0 0 0 0 1	65	bearer capability not implemented	-
1 0 0 1 0 0 1	73	unsupported combination of traffic parameters	-
1 0 0 1 1 1 0	78	AAL parameters cannot be supported	-
1 0 1 0 0 0 1	81	invalid call reference value	-
1 0 1 0 0 1 0	82	identified channel does not exist	Note 9
1 0 1 1 0 0 0	88	incompatible destination	Note 6
1 0 1 1 0 0 1	89	invalid endpoint reference	-
1 0 1 1 0 1 1	91	invalid transit network selection	-
1 0 1 1 1 0 0	92	too many pending add party requests	-
1 1 0 0 0 0 0	96	mandatory information element is missing	Note 6, Note 7
1 1 0 0 0 0 1	97	message type non-existent or not implemented	Note 10
1 1 0 0 0 1 1	99	information element non-existent or not implemented	Note 6, Note 7
1 1 0 0 1 0 0	100	invalid information element contents	Note 6, Note 7
1 1 0 0 1 0 1	101	message not compatible with call state	Note 10
1 1 0 0 1 1 0	102	recovery on timer expiry	Timer Number (Note 11)
1 1 0 1 0 0 0	104	incorrect message length	-
1 1 0 1 1 1 1	111	protocol error, unspecified	-

(*) Not used in this Implementation Agreement

The use of diagnostics and the coding format of diagnostics varies among the different cause values. The diagnostics column of the table above indicates whether diagnostics are applicable and the coding format of the diagnostics field.

Note 1 - The cause value can be viewed as being comprised of two fields, a class (bits 5 through 7) indicating the general nature of the event, and a value within the class (bits 1 through 4). Classes are:

Bits 7 6 5	Meaning
0 0 0	normal event
0 0 1	normal event
0 1 0	resource unavailable
0 1 1	service or option not available
1 0 0	service or option not implemented
1 0 1	invalid message
1 1 0	protocol error
1 1 1	interworking event/error

Note 2 - The following coding is used:

Bits								
8	7	6	5	4	3	2	1	Octet
1	Spare			P-U	N-A	Condition		7
ext	0	0	0					

P-U (octet 7)

Bit 4	Meaning
0	Network service - Provider
1	Network service - User

N-A (octet 7)

Bit 3	Meaning
0	Normal
1	Abnormal

Condition (octet 7)

Bits 2 1	Meaning
0 0	Unknown
0 1	Permanent
1 0	Transient

Note 3 - The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octets
1 ext	Rejection reason					Condition		7
User specific diagnostic								7.1* (Note i)
Information element identifier								7.1* (Note ii)

Note i - This octet may be present only if octet 7 indicates user specific diagnostic.

Note ii - This octet may be present only if octet 7 indicates information element missing or information element contents are not sufficient.

Rejection reason (octet 7)

Bits 7 6 5 4 3	Meaning
0 0 0 0 0	User specific
0 0 0 0 1	Information element missing
0 0 0 1 0	Information element contents are not sufficient

Condition (octet 7)

Bits 2 1	Meaning
0 0	Unknown
0 1	Permanent
1 0	Transient

User specific diagnostic (octet 7.1)

Coded according to the user specification, subject to the maximum length of the Cause information element.

Information element identifier (octet 7.1)

Bits 8-1 encoded with the information element identifier of the missing or insufficient information element.

Note 4 - New destination is formatted as the called party number information element, including information element identifier. Transit network selection may also be included.

Note 5 - This cause value is used with coding standard “1 1”, Standard defined for the network (either public or private) present on the network side of the interface.

Note 6 - The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octet
Information element identifier								7

Note 7 - Multiple information identifiers may be included.

Note 8 - The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octet
ATM user cell rate subfield identifier								7

Octet 7 may be repeated to identify multpile ATM traffic descriptor subfield identifiers.

Note 9 - The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octets
VPCI								7
VPCI (continued)								7.1
VCI								7.2
VCI (continued)								7.3

Note 10 - The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octets
Message type								7

Note 11 - The timer number is coded in IA5 characters, e.g., T308 is coded as “3” “0” “8”. The following is used in each octet:

Bit 8: Spare “0”
Bit 7 - 1: IA5 character

The following coding is used:

Bits 8	7	6	5	4	3	2	1	Octets
0 Spare	IA5 character							7
0 Spare	IA5 character							7.1
0 Spare	IA5 character							7.2

5.4.5.16 Connection Identifier

The Connection identifier information element identifies the local ATM connection resources on the interface.

Bits 8	7	6	5	4	3	2	1	Octets
Connection identifier 0 1 0 1 1 0 1 0 Information element identifier								1
1 ext	Coding standard		IE Instruction Field					2
Length of connection identifier contents								3
Length of connection identifier contents (continued)								4
1 ext	0 0 Spare		VP Associated Signalling	Preferred/Exclusive				5
Virtual Path Connection Identifier								6
Virtual Path Connection Identifier (continued)								7
Virtual Channel Identifier								8
Virtual Channel Identifier (continued)								9

Figure 5-39 Connection Identifier Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

VP Associated Signalling (octet 5)

Bits 5 4	Meaning
0 1	Explicit indication of VPCI

Preferred/Exclusive (octet 5) (Note)

Bits 3 2 1	Meaning
0 0 0	Exclusive VPCI; Exclusive VCI

Note - The network always assigns the VPCI and VCI in this Implementation Agreement.

Virtual Path Connection Identifier (octets 6 and 7)

A two octet binary number assigned to the ATM connection representing the identifier of the Virtual Path Connection.

For this Implementation Agreement, the VPCI value is numerically equivalent to the VPI value assigned for the call. The VPI value is coded in bits 8-1 of Octet 7. Bits 8-1 of Octet 6 are coded to all "0's".

Virtual Channel Identifier (octets 8 and 9)

A two octet binary number assigned to the ATM connection representing the identifier of the Virtual Channel Connection.

VCI Value	
0-15	Reserved by ITU-T
16-31	Reserved by ATM Forum
32-65535	Available for assignment by these procedures. Some values in this range may not be available for use (e.g., permanent connections)

5.4.5.17 End-to-End Transit Delay

Not supported in this Implementation Agreement.

5.4.5.18 Quality of Service Parameter

The purpose of the Quality of Service parameter information element is to request and indicate the Quality of Service Class for a connection.

If information about the requested Quality of Service Class is not available for the network at the terminating interface (e.g. because an intermediate network did not transfer the Quality of Service parameter information element), the network will generate the default value ("unspecified QoS class") for the Quality of Service parameter information element for the transfer to the called user.

Bits 8	7	6	5	4	3	2	1	Octets
Quality of Service parameter								
0	1	0	1	1	1	0	0	1
Information element identifier								
1 ext	Coding standard		IE Instruction Field					2
Length of quality of service parameter contents								3
Length of quality of service parameter contents (continued)								4
QoS Class Forward								5
QoS Class Backward								6

Figure 5-40 Quality of Service parameter Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized
1 1	Standard defined for the network (either public or private) present on the network side of the interface

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

QoS Class Forward (octet 6)

Bits 8765	Bits 4321	Meaning
0000	0000	QoS class 0 - Unspecified QoS class (Note 1, 4)
0000	0001	QoS class 1 (Note 2)
0000	0010	QoS class 2 (Note 2)
0000	0011	QoS class 3 (Note 2)
0000	0100	QoS class 4 (Note 2)
1111	1111	Reserved by ITU-T for future indication of parameterized QoS (Note 3)

QoS Class Backward (octet 6)

Bits 8765	Bits 4321	Meaning
0000	0000	QoS class 0 - Unspecified QoS class (Note 1, 4)
0000	0001	QoS class 1 (Note 2)
0000	0010	QoS class 2 (Note 2)
0000	0011	QoS class 3 (Note 2)
0000	0100	QoS class 4 (Note 2)
1111	1111	Reserved by ITU-T for future indication of parameterized QoS (Note 3)

Note 1 - This code point is taken from the coding standard value 00. The meaning of this code point applies only for coding standard value 00. For coding standard value 11, this code point is reserved by the ATM Forum. If this class is indicated, the network does not guarantee any specific Quality of Service.

Note 2 The meanings of these codepoints apply only for the coding standard value 11. For coding standard value 00 these code points are reserved by ITU-T. The ATM Forum asserts the right to assign all values for coding standard value 11. However, these values will be assigned in ascending sequence.

Note 3 - This code point has been reserved by ITU-T for use when individual QoS parameters are defined. The individual parameters would then be contained in octets 7 and higher.

Note 4 - For some public networks, only the Coding Standard value 00 may be allowed at the public UNI.

5.4.5.19 Broadband Repeat Indicator

The purpose of the Broadband repeat indicator information element is to indicate how repeated information elements shall be interpreted, when included in a message. The Broadband repeat indicator information element is included before the first occurrence of the information element which will be repeated in a message.

Note - Use of the Broadband repeat indicator information element in conjunction with an information element that occurs only once in a message shall not of itself constitute an error.

Bits 8	7	6	5	4	3	2	1	Octets
Broadband repeat indicator 0	1	1	0	0	0	1	1	1 Information element identifier
1 ext	Coding Standard		IE Instruction Field					2
Length of broadband repeat indicator contents								3
Length of broadband repeat indicator contents (continued)								4
1 ext	0	0 Spare	0	Broadband repeat indication				5

Figure 5-41 Broadband Repeat Indicator Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Broadband repeat indication (octet 5)

Bits 4 3 2 1	Meaning
0 0 1 0	Prioritized list for selecting one possibility

5.4.5.20 Restart Indicator

The purpose of the Restart indicator information element is to identify the class of the facility to be restarted.

Bits 8	7	6	5	4	3	2	1	Octets
Restart indicator								
0	1	1	1	1	0	0	1	1
Information element identifier								
1 ext	Coding Standard		IE Instruction Field					2
Length of restart indicator contents								3
Length of restart indicator contents (continued)								4
1 ext	0	0	0	0	Class			5
	Spare							

Figure 5-42 Restart Indicator Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Class (octet 5)

Bits 3 2 1	Meaning
0 0 0	Indicated virtual channel (Note 1)
0 1 0	All virtual channels controlled by the Layer 3 entity which sends the RESTART message (Note 2)

Note 1 - The Connection identifier information element must be included and indicates the virtual channel to be restarted.

Note 2 - The Connection identifier information element is not included. All virtual channels controlled by the point-to-point signalling channel are to be restarted.

5.4.5.21 Broadband Sending Complete

The purpose of the Broadband sending complete information element is to optionally indicate completion of the called party number. It is provided in this Implementation Agreement to provide for compatibility with certain public networks. It is optional for user equipment to send, and shall be ignored by network equipment when received. It is optional for the network to send the Broadband sending complete information element in the SETUP message.

Bits 8	7	6	5	4	3	2	1	Octets
Broadband Sending Complete 0	1	1	0	0	0	1	0	1
Information element identifier								
1 ext	Coding Standard		IE Instruction Field					2
Length of broadband sending complete contents								3
Length of broadband sending complete contents (continued)								4
1 ext	Broadband sending complete indication 0	1	0	0	0	0	1	5

Figure 5-43 Broadband Sending Complete Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Broadband Sending Complete Indication (octet 5)

Bits 7 6 5 4 3 2 1	Meaning
0 1 0 0 0 0 1	Sending complete

5.4.5.22 Transit Network Selection

The purpose of the Transit network selection information element is to identify one requested transit network.

Bits 8	7	6	5	4	3	2	1	Octets
Transit network selection								
0	1	1	1	1	0	0	0	1
Information element identifier								
1 ext	Coding Standard		IE Instruction Field					2
Length of transit network selection contents								3
Length of transit network selection contents (continued)								4
1 ext	Type of network identification			Network identification plan				5
0	Network identification (IA5 characters)							6 etc.

Figure 5-44 Transit Network Selection Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Type of Network Identification (octet 5)

Bits 7 6 5	Meaning
0 1 0	National network identification

Network Identification Plan (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 1	Carrier Identification Code (Note)

Note - For use in the US, Carrier Identification Codes are assigned by the North American Numbering Plan Administrator to Interexchange Carriers and International Carriers. CICs are coded in IA5 characters corresponding to the digits "0" - "9". See Annex D. This text addresses only the needs of the US telecommunications environment.

Network identification (octet 6)

These IA5 characters are organized according to the network identification plan specified in octet 5.

5.4.6 Information Elements for Interworking with 64 kbit/s Based ISDN

Not supported in this Implementation Agreement.

5.4.7 Information Elements for Supplementary Services

Not supported in this Implementation Agreement.

5.4.8 ATM Forum Specified Information Elements

5.4.8.1 Endpoint Reference

The purpose of the Endpoint reference information element is to identify the individual endpoints of a point-to-multipoint connection. The Endpoint Reference Identifier Value 0 is always used to identify the first party of a point-to-multipoint call. A non-zero value is always used to identify subsequent parties of a point-to-multipoint call.

Bits								
8	7	6	5	4	3	2	1	Octets
Endpoint reference 0	1	0	1	0	1	0	0 Information element identifier	1
1 ext	Coding Standard	IE Instruction Field						2
Length of endpoint reference contents								3
Length of endpoint reference contents (continued)								4
Endpoint Reference Type								5
0 Endpoint Reference Flag	Endpoint Reference Identifier Value							6
Endpoint Reference Identifier Value (continued)								6.1

Figure 5-45 Endpoint Reference Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Endpoint reference type (octet 5)

Bits 8 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0 0	Locally defined integer

Endpoint reference flag (octet 6)

Bits 8	Meaning
0	The message is sent from the side that originates the endpoint reference
1	The message is sent to the side that originates the endpoint reference

Endpoint Reference Identifier Value (octet 6, 6.1)

The endpoint Reference Identifier is a 15-bit integer (coded in binary) assigned by the root to uniquely identify an endpoint.

5.4.8.2 Endpoint State

The purpose of the Endpoint state information element is to indicate the state of an endpoint of a point-to-multipoint connection.

Bits 8	7	6	5	4	3	2	1	Octets
Endpoint state								
0	1	0	1	0	1	0	1	1
Information element identifier								
1 ext	Coding Standard		IE Instruction Field					2
Length of endpoint state contents								3
Length of endpoint state contents (continued)								4
0	0	Endpoint Reference Party-state						5
Spare								

Figure 5-46 Endpoint State Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized

IE Instruction Field (octet 2)

Bits 5 4 3 2 1	Meaning
0 0 0 0 0	IE instruction field not significant

Endpoint Reference Party-state (octet 5)

Bits 6 5 4 3 2 1	Meaning
0 0 0 0 0 0	Null
0 0 0 0 0 1	Add Party Initiated
0 0 0 1 1 0	Add Party Received
0 0 1 0 1 1	Drop Party Initiated
0 0 1 1 0 0	Drop Party Received
0 0 1 0 1 0	Active

5.5 Call/Connection Control Procedures For ATM Point-to-Point Calls

This section describes procedures for point-to-point calls only. Section 5.6 contains additional procedures for point-to-multipoint calls as well as changes to the point-to-point procedures needed to support point-to-multipoint calls.

ITU - T draft Recommendation Q.2931 [29] procedures are used to establish ATM connections over a permanent signalling virtual channel connection (VCC). The Signalling virtual channel uses VPI=0, VCI=5.

For a call/connection to be established it must satisfy the following general criteria determined by the network and end systems:

Basic service support;

VC availability;

Physical and virtual network resource availability to provide quality of service requested;

End system resource availability to provide quality of service requested;

End to end compatibility.

The call states referred to in this section cover the states perceived by the network, states perceived by the user and states which are common to both user and network.

On any given interface, one entity always assumes the role of user and the other entity always assumes the role of network.

5.5.1 Call/Connection establishment at the originating interface

Before these procedures are invoked, an assured mode signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the Signalling AAL (SAAL) using an AAL-DATA-REQUEST primitive. For more information on the Signalling AAL, see §5.9.

5.5.1.1 Call/Connection request

The calling party initiates call establishment by transferring a SETUP message on the signalling virtual channel across the interface and starting timer T303. Following the transmission of the SETUP message, the call is considered by the calling party to be in the Call Initiated state. The message shall always contain a call reference, selected according to the procedures given in §5.4.3.

The SETUP message shall contain all the information required by the network to process the call. In particular, the called party address information is contained in the Called party number information element possibly supplemented by the Called party subaddress information element. The ATM traffic descriptor, Broadband bearer capability, and Quality of service parameter information elements are mandatory in the SETUP message. The Broadband sending complete information element may optionally be included by the user for compatibility with ITU - T draft Recommendation Q.2931 [29]; however, if it is received by the network, it shall be ignored.

If no response to the SETUP message is received by the user before the first expiry of timer T303, the SETUP message may be retransmitted and timer T303 restarted. If the user does not receive any response to the SETUP message after the final expiry of timer T303, the user shall internally clear the call.

5.5.1.2 Connection Identifier (VPCI/VCI) Allocation/Selection

5.5.1.2.1 Connection Identifier Allocation/Selection - Origination

In the SETUP message, the user shall not include the Connection identifier information element. If the Connection identifier information element is included by the user in the SETUP message, the network shall treat it as an unexpected recognized information element (see §5.5.6.8.3)

The network selects any available VPCI and VCI.

The selected VPCI/VCI value is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (i.e., CALL PROCEEDING message).

If the network is not able to allocate a VCI in any VPCI, a RELEASE COMPLETE message with cause #45, "*No VPCI/VCI available* ," is sent by the network.

5.5.1.2.2 Use of VPCIs

The Connection identifier information element is used in signalling messages to identify the corresponding user information flow. The Connection identifier information element contains the Virtual Path Connection Identifier (VPCI) and the Virtual Channel Identifier (VCI). The VPCI is used instead of the Virtual Path Identifier (VPI) since Virtual Path Cross Connects may be used in the access and multiple interfaces could be controlled by the signalling virtual channel.

Both the user and the network must understand the relationship between the VPCI used in the signalling protocol and the actual VPI used for the user information flow. VPCIs only have significance with regard to a given signalling virtual channel.

For this Implementation Agreement, the signalling virtual channel controls only a single interface, and the VPI and VPCI have the same numerical value.

5.5.1.2.3 VPCI and VCI Ranges

The range of valid VCI values is indicated below:

VCI Value	
0-15	Reserved by ITU-T
16-31	Reserved by ATM Forum
32-65535	Identifier of the Virtual Channel (Note)

Note - Some values in the range may not be available for use (e.g., some values may be used for permanent connections). The upper bound on the VCI range (i.e., 65535) may be further restricted by the number of active VCI bits. In addition, a need might arise to reserve more than 32 VCI values.

The range of valid VPCI values is as indicated below:

VPCI Value	
0-255	Identifier of the Virtual Path (Note)

Note - Some values in the range may not be available for use (e.g., some values may be used for permanent virtual path connections). The upper bound on the VPCI range (i.e., 255) may be further restricted by the number of active VPI bits.

5.5.1.3 QoS and Traffic parameters selection procedures

The user shall indicate the requested QoS class in the Quality of Service information element. The user shall indicate the requested ATM traffic descriptor in the ATM traffic descriptor information element.

If the network is able to provide the requested ATM traffic descriptor and QoS class, the network shall progress the call.

If the network is not able to provide the requested QoS class, the network shall reject the call, returning a RELEASE COMPLETE message with cause #49, *"Quality of Service unavailable"*.

If the network is not able to provide the requested ATM traffic descriptor, the network shall reject the call, returning a RELEASE COMPLETE message with cause #51, "*User cell rate unavailable*".

If the network detects that the ATM traffic descriptor information element contains a non-supported set of traffic parameters (see §3.6 for more information), the network shall return a RELEASE COMPLETE message with cause #73, *"Unsupported combination of traffic parameters."*

5.5.1.4 Invalid Call/Connection control information

Upon receiving the SETUP message, the network determines that the call information received from the user is invalid (e.g., invalid number), then the network shall initiate call clearing in accordance with §5.5.4 with a cause such as the following:

#1 "*unassigned (unallocated) number*";
#3 "*no route to destination*";
#22 "*number changed*";
#28 "*invalid number format (address incomplete)*".

5.5.1.5 Call/Connection proceeding

If the network can determine that access to the requested service is authorized and available, the network may send a CALL PROCEEDING message to the user to acknowledge the SETUP message and to indicate that the call is being processed, and enter the Outgoing Call Proceeding state. When the user receives the CALL PROCEEDING message, the user shall stop timer T303, start timer T310, and enter the Outgoing Call Proceeding state. If the network chooses not to send the CALL PROCEEDING message, the network shall remain in the Call Initiated state.

If the network determines that a requested service is not authorized or is not available, the network shall initiate call clearing in accordance with §5.5.4 with one of the following causes:

#38 *"network out of order"*;
#57 *"bearer capability not authorized";*
#58 *"bearer capability not presently available";*
#63 *"service or option not available, unspecified";* or
#65 *"bearer service not implemented"*.

If the user has received a CALL PROCEEDING message, but does not receive a CONNECT or RELEASE message prior to the expiration of timer T310, then the user shall initiate clearing procedures towards the network with cause #102, "*Recovery on timer expiry*".

5.5.1.6 Call/Connection confirmation indication

Not supported in this Implementation Agreement.

5.5.1.7 Call/Connection acceptance

Upon receiving an indication that the call has been accepted, the network shall: send a CONNECT message across the user-network interface to the calling user and enter the Active state.

This message indicates to the calling user that a connection has been established through the network.

On receipt of the CONNECT message, the calling user shall: stop timer T303 or T310; send a CONNECT ACKNOWLEDGE message; and enter the Active state. The network shall not take any action on receipt of a CONNECT ACKNOWLEDGE message when it perceives the call to be in the Active state.

At this point an end-to-end connection is established.

5.5.1.8 Call/Connection rejection

Upon receiving an indication that the network or the called user is unable to accept the call, the network shall initiate clearing at the originating user-network interface as described in §5.5.4, using the cause provided by the terminating network or the called user.

5.5.1.9 Transit network selection

When the Transit network selection information element is present, the call shall be processed according to Annex D. Some networks may not support transit network selection.

5.5.1.10 Extensions for symmetric call operation

An extension to allow the optional sending of a CALL PROCEEDING message is supported in §5.5.1.5.

5.5.2 Call/Connection establishment at the destination interface - Point-to-Point Access Configuration Call Offering

Before these procedures are invoked, an assured mode signalling AAL connection must be established between the user and the network. All layer 3 messages shall be sent to the Signalling AAL using an AAL-DATA-REQUEST primitive. The Signalling AAL is described in §5.9.

5.5.2.1 Incoming Call/Connection request

The network will indicate the arrival of a call at the user-network interface by transferring a SETUP message across the interface. The network shall start timer T303 and enter the Call Present state. The message shall always contain a call reference, selected according to the

procedures given in §5.4.3. This message is sent by the network only if resources for the call are available; otherwise, the call is cleared toward the calling user.

The SETUP message shall contain all the information required by the called user to process the call.

Upon receipt of a SETUP message, the user shall enter the Call Present state.

If no response to the SETUP message is received by the network before the first expiry of timer T303, the SETUP message may be retransmitted and timer T303 restarted.

5.5.2.2 Address and Compatibility Check

The procedures to perform compatibility checking are implementation dependent. See §5.5.2 of ITU-T draft Recommendation Q.2931 [29] for more information.

5.5.2.3 Connection identifier (VPCI/VCI) allocation/selection — destination

The network shall allocate a VPCI/VCI value and include this value in the SETUP message.

The user receiving the SETUP message accepts the indicated VPCI/VCI for the call.

If the indicated VCI is not available within the indicated VPCI, a RELEASE COMPLETE message with cause #35, *"Requested VPCI/VCI not available"*, is sent by the user.

If the VPCI and VCI values in the first response message are not the VPCI and VCI values offered by the network, a RELEASE message with cause #36, *"VPCI/VCI assignment failure"*, is sent to the called user by the network.

If connection identifier selection fails, the network shall initiate clearing towards the calling party using cause #41, *"temporary failure"*.

5.5.2.4 QoS and Traffic parameter selection procedures

The network shall indicate the QoS class in the Quality of service information element.

If the user is not able to provide the requested QoS class, the user shall reject the call, returning a RELEASE COMPLETE message with cause #49, *"Quality of Service unavailable"*.

The network shall indicate the ATM traffic descriptor in the ATM traffic descriptor information element.

If the user is not able to support the indicated ATM traffic descriptor, the user shall reject the call, returning a RELEASE COMPLETE message with cause #47, *"Resource unavailable, unspecified"*.

5.5.2.5 Call/Connection confirmation

5.5.2.5.1 Response to SETUP

5.5.2.5.1.1 Procedures when the User is an ATM endpoint

When the user receives a SETUP message and wishes to accept the incoming call/connection, the user responds with either a CALL PROCEEDING or CONNECT message (see Note), and enters the Incoming Call Proceeding or Connect Request state, respectively.

Note - The CALL PROCEEDING message may be sent by the user which cannot respond to a SETUP message with a CONNECT or RELEASE COMPLETE message before expiration of timer T303.

An incompatible user shall respond by sending a RELEASE COMPLETE message with cause #88, "*incompatible destination*", and enter the Null state. The network processes this RELEASE COMPLETE message in accordance with §5.5.2.5.3.

A busy user which satisfies the compatibility requirements indicated in the SETUP message shall normally respond with a RELEASE COMPLETE message with cause #17, "*user busy*". The network processes this RELEASE COMPLETE message in accordance with §5.5.2.5.3.

If the user wishes to refuse the call, a RELEASE COMPLETE message shall be sent with the cause #21, "*call rejected*", and the user returns to the Null state. The network processes this RELEASE COMPLETE message in accordance with §5.5.2.5.3.

If the user rejects all incoming calls that don't provide the calling number, the user shall return a RELEASE COMPLETE message with network-specific cause #23, "*User rejects all calls with calling line identification restriction (CLIR)*", and enter the Null state. The network processes this RELEASE COMPLETE message in accordance with §5.5.2.5.3.

5.5.2.5.1.2 Procedures when the User is not an ATM endpoint

If the user is able to provide the requested ATM traffic descriptor and the QoS, the user shall progress the call.

5.5.2.5.2 Receipt of CALL PROCEEDING

Upon receipt of the CALL PROCEEDING message from a user, the network shall: stop timer T303; start timer T310; and enter the Incoming Call Proceeding state.

5.5.2.5.3 Called user clearing during incoming call establishment

If a RELEASE COMPLETE or RELEASE message is received before a CONNECT message has been received, the network shall: stop timer T303 or T310; continue to clear the call to the called user as described in §5.5.4.3; and clear the call to the calling user with the cause received in the RELEASE COMPLETE or RELEASE message.

5.5.2.5.4 Call failure

If the network does not receive any response to the SETUP after the final expiry of timer T303, the network shall enter the Null state and initiate clearing procedures towards the calling user with cause #18, "*no user responding*".

If the network has received a CALL PROCEEDING message, but does not receive a CONNECT or RELEASE message prior to the expiration of timer T310, then the network shall: initiate clearing procedures toward the calling user with cause #18, "no user responding", and initiate clearing procedures towards the called user with cause #102, "recovery on timer expiry".

5.5.2.6 Call/Connection acceptance

An ATM endpoint indicates acceptance of an incoming call by sending a CONNECT message to the network. Upon sending the CONNECT message, the user (ATM endpoint) shall: start timer T313 and enter the Connect Request state.

A user that is not an ATM endpoint shall accept an incoming call by sending a CONNECT message to the network after receiving an indication that the call has been accepted from the ATM endpoint. After sending the CONNECT message the user shall: start timer T313 and enter the Connect Request state.

5.5.2.7 Active indication

On receipt of the CONNECT message, the network shall: stop timers T303 or T310 and enter the Connect request state. When the network awards the call/connection, it shall send a CONNECT ACKNOWLEDGE message to the user; initiate procedures to send a CONNECT message towards the calling user; and enter the Active state.

The CONNECT ACKNOWLEDGE message indicates completion of the ATM connection for that interface. There is no guarantee of an end-to-end connection until a CONNECT message is received at the calling user. Upon receipt of the CONNECT ACKNOWLEDGE message the called user shall: stop timer T313 and enter the Active state.

When timer T313 expires prior to receipt of a CONNECT ACKNOWLEDGE message, the called user shall initiate clearing with cause #102, "recovery on timer expiry" in accordance with §5.5.4.3.

5.5.3 Call/Connection establishment at the destination — Point-to-multipoint access arrangement call offering

Not supported in this Implementation Agreement.

5.5.4 Call/Connection clearing

5.5.4.1 Terminology

The following terms are used in this Implementation Agreement in the description of clearing procedures:

- A virtual channel is *connected* when the virtual channel is part of an ATM virtual channel connection established according to this Implementation Agreement.
- A virtual channel is *disconnected* when the virtual channel is no longer part of an ATM virtual channel connection, but is not yet available for use in a new virtual channel connection.
- A virtual channel is *released* when the virtual channel is not part of an ATM virtual channel connection and is available for use in a new virtual channel connection. Similarly, a call reference that is *released* is available for reuse.

5.5.4.2 Exception conditions

Under normal conditions, call clearing is usually initiated when the user or the network sends a RELEASE message and follows the procedures defined in §§5.5.4.3 and 5.5.4.4 respectively. The only exception to the above rule is in response to a SETUP message, the user or network can reject a call/connection (e.g., because of the unavailability of a suitable virtual channel) by: responding with a RELEASE COMPLETE message provided no other response has previously been sent; releasing the call reference; and entering the Null state.

5.5.4.3 Clearing initiated by the user

Apart from the exceptions identified in §§5.5.4.2 and 5.5.6, the user shall initiate clearing by: sending a RELEASE message; starting timer T308; disconnecting the virtual channel; and entering the Release Request state.

The network shall enter the Release Request state upon receipt of a RELEASE message. This message then prompts the network to disconnect the virtual channel, and to initiate procedures for clearing the network connection to the remote user. Once the virtual channel used for the call has been disconnected, the network shall: send a RELEASE COMPLETE message to the user; release both the call reference and virtual channel (i.e., connection identifier); and enter the Null state.

Note - The RELEASE COMPLETE message has only local significance and does not imply an acknowledgment of clearing from the remote user.

On receipt of the RELEASE COMPLETE message the user shall: stop timer T308; release the virtual channel; release the call reference; and return to the Null state.

If timer T308 expires for the first time, the user shall: retransmit a RELEASE message to the network with the cause number originally contained in the first RELEASE message; restart timer T308 and remain in the Release Request state. In addition, the user may indicate a second Cause information element with cause #102, "*recovery on timer expiry*". If no RELEASE

COMPLETE message is received from the network before timer T308 expires a second time, the user shall: release the call reference; and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

When user initiates normal call/connection clearing, cause #16 “normal call clearing” is used in the first clearing message.

5.5.4.4 Clearing initiated by the network

Apart from the exception conditions identified in §§5.5.4.2 and 5.5.6, the network shall initiate clearing by: sending a RELEASE message; starting timer T308; disconnecting the virtual channel; and entering the Release Indication state.

The user shall enter the Release Indication state upon receipt of a RELEASE message. Once the virtual channel used for the call has been disconnected, the user shall: send a RELEASE COMPLETE message to the network; release both its call reference and the virtual channel; and return to the Null state.

On receipt of the RELEASE COMPLETE message, the network shall: stop timer T308; release both the virtual channel and call reference; and return to the Null state.

If timer T308 expires for the first time, the network shall retransmit the RELEASE message to the user with the cause number originally contained in the first RELEASE message; start timer T308 and remain in the Release Indication state. In addition, the network may indicate a second Cause information element with cause #102, “*recovery on timer expiry*”. If no RELEASE COMPLETE message is received from the user before timer T308 expires a second time, the network shall: release the call reference and return to the Null state. Equipment shall perform implementation dependent recovery, such as initiating restart procedures.

5.5.4.5 Clear collision

Clear collision can occur when both sides simultaneously transfer RELEASE messages related to the same call reference value. If the user receives a RELEASE message while in the Release Request state, the user shall: stop timer T308; release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message). If the network receives a RELEASE message while in the Release Indication state, the network shall: stop timer T308; release the call reference and virtual channel; and enter the Null state (without sending or receiving a RELEASE COMPLETE message).

5.5.5 Restart procedure

The user and the network shall implement these procedures.

The restart procedure is used to return a virtual channel or all virtual channels controlled by the signalling virtual channel to the Null state. The procedure is usually invoked when the other side of the interface does not respond to other call control messages or a failure has occurred (e.g., following the expiry of timer T308 due to the absence of response to a clearing message). It may also be initiated as a result of local failure, maintenance action or mis-operation.

Note - The call reference flag of the global call reference applies to restart procedures. In the case when both sides of the interface initiate simultaneous restart requests, they shall be handled independently. In the case when the same virtual channel(s) are specified, they shall not be considered free for reuse until all the relevant restart procedures are completed.

5.5.5.1 Sending RESTART

A RESTART message is sent by the network or user equipment in order to return virtual channels to the idle condition. The Restart indicator information element shall be present in the RESTART message to indicate whether an *indicated virtual channel* or *allvirtual channels controlled by the layer 3 entity* are to be restarted. If the Restart indicator information element is coded as "indicated virtual channel", then the Connection identifier information element shall be present to indicate which virtual channel is to be returned to the idle condition. If the Restart indicator information element is coded as "allvirtual channels controlled by the layer 3 entity which sends the RESTART message", then the Connection identifier information element shall not be included.

Upon transmitting the RESTART message the sender enters the Restart Request state, starts timerT316, and waits for a RESTART ACKNOWLEDGE message. Also, no further RESTART messages shall be sent until a RESTART ACKNOWLEDGE is received or timer T316 expires. Receipt of a RESTART ACKNOWLEDGE message stops timer T316 and indicates that the virtual channel(s) and associated resources (e.g., call reference value(s)) can be freed for reuse. The Null state shall be entered after the virtual channel and call reference value are released .

If a RESTART ACKNOWLEDGE message is not received prior to the expiry of timer T316 one or more subsequent RESTART messages may be sent until a RESTART ACKNOWLEDGE message is returned. While timer T316 is running, no calls shall be placed or accepted over the virtual channel(s) by the originator of the RESTART message. The number of consecutive unsuccessful restart attempts has a default limit of two. When this limit is reached, the originator of the RESTART message shall make no further restart attempts and shall enter the Null state (REST 0). An indication will be provided to the appropriate maintenance entity. The virtual channel(s) is considered to be in an out-of-service condition until maintenance action has been taken.

If a RESTART ACKNOWLEDGE message is received indicating a different set of virtual channels from the set indicated in the RESTART message, the RESTART ACKNOWLEDGE message shall be discarded.

The RESTART and RESTART ACKNOWLEDGE message shall contain the global call reference value (all zeros) to which the Restart Request state is associated. These messages are transferred using the AAL-DATA-REQUEST primitive.

The remote parties are cleared using cause #41, "*temporary failure*".

5.5.5.2 Receipt of RESTART

Upon receiving a RESTART message the recipient shall enter the Restart state associated to the global call reference and start timer T317; it shall then initiate the appropriate internal actions to return the specified virtual channels to the idle condition and release all call references associated with the specified virtual channels. Upon completion of internal clearing, timer T317 shall be stopped and a RESTART ACKNOWLEDGE message transmitted to the originator, and the Null state (REST 0) entered.

If timer T317 expires prior to completion of internal clearing, an indication shall be sent to the maintenance entity (i.e., a primitive should be transmitted to the system management entity) and the Null state (REST 0) shall be entered.

The remote parties are cleared using cause #41, "*temporary failure*".

Even if all the specified virtual channels are in the idle condition, the receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

If the Restart indicator information element is coded as "allvirtual channels controlled by the layer 3 entity which sends the RESTART message", then all calls on all interfaces associated with the signalling virtual channel shall be cleared.

If the Restart indicator information element is coded as "allvirtual channels controlled by the layer 3 entity which sends the RESTART message" and a Connection identifier information element is included, the Connection identifier information element is treated as described in §5.5.6.8.3.

If the Restart indicator information element is coded as "indicated virtual channel" and the Connection identifier information element is not included, then the procedures in §5.5.6.7.1 shall be followed.

If the Restart indicator information element is coded as "indicated virtual channel" and the Connection identifier information element contains an unrecognized VPCI, then the procedures in §5.5.6.7.2 shall be followed.

If permanent virtual connections established by management procedures are implicitly specified (by specifying "all virtual channels controlled by the layer 3 entity which sends the RESTART message") no action shall be taken on these virtual channels, but a RESTART ACKNOWLEDGE message shall be returned containing the appropriate indications (i.e., "all virtual channels controlled by the layer 3 entity which sends the RESTART message").

If a permanent virtual connection established by management procedures or a reserved VPCI/VCI (e.g., the point-to-point signalling virtual channel) is explicitly specified (by including a Connection identifier information element in the RESTART message), no action

shall be taken on the virtual channel and a STATUS message should be returned with cause #82, "*identified channel does not exist*", indicating in the diagnostics field the virtual channel that could not be handled.

The following entities are released as a result of the Restart Procedures:

- virtual channels established by Q.2931 procedures,
- all resources associated with the released virtual channel (e.g., call reference value)

The following entities are not released as a result of the Restart Procedures:

- permanent connections established by a network management system
- reserved virtual channels (e.g., point-to-point signalling virtual channel)

If the RESTART message is received in the Restart state, then the procedures in §5.5.6.4 shall be followed.

5.5.6 Handling of error conditions

All messages which use the protocol discriminator *Q.2931 user-network call control message* must pass the checks described in §§5.5.6.1 through 5.5.6.8.

Detailed error handling procedures are implementation dependent and may vary from network to network. However, capabilities facilitating the orderly treatment of error conditions are provided for in this section and shall be provided in each implementation.

Sections 5.5.6.1 through 5.5.6.8 are listed in order of precedence.

5.5.6.1 Protocol discrimination error

When a message is received with a protocol discriminator coded other than *Q.2931 user-network call control message*, that message shall be ignored. "Ignore" means to do nothing, as if the message had never been received.

5.5.6.2 Message too short

When a message is received that is too short to contain a complete Message length information element, that message shall be ignored.

5.5.6.3 Call reference error

5.5.6.3.1 Invalid call reference format

If the call reference information element octet 1, bits 5 through 8 do not equal 0000, then the message shall be ignored.

If the call reference information element octet 1, bits 1 through 4 indicate a length other than 3 octets (see §5.4.3), then the message shall be ignored.

5.5.6.3.2 Call reference procedural errors

a) Whenever any message except SETUP, RELEASE COMPLETE, STATUS ENQUIRY, or STATUS is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the receiver shall initiate clearing by sending a RELEASE COMPLETE message with cause #81, "*invalid call reference value*", specifying the call reference in the received message and shall remain in the Null state.

b) When a RELEASE COMPLETE message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, no action should be taken.

c) When a SETUP message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, and with a call reference flag incorrectly set to "1", this message shall be ignored.

d) When a SETUP message is received specifying a call reference which is recognized as relating to an active call or to a call in progress, this SETUP message shall be ignored.

e) When any message except RESTART, RESTART ACKNOWLEDGE, or STATUS is received using the global call reference, no action should be taken on this message and a STATUS message using the global call reference with a call state indicating the current state associated with the global call reference and cause #81, "*invalid call reference*", shall be returned.

f) When a STATUS message is received specifying a call reference which is not recognized as relating to an active call or to a call in progress, the procedures of §5.5.6.12 shall apply.

g) When a STATUS ENQUIRY message is received which is not recognized as relating to an active call or a call in progress, the procedures of §5.5.6.11 shall apply.

5.5.6.4 Message type or message sequence errors

Whenever an unexpected message (including messages that are standardized by the ITU-T but which are not included in this specification), except RELEASE, RELEASE COMPLETE, or an unrecognized message is received in any state other than the Null state, a STATUS message shall be returned with one of the following causes:

#97 "*message type non-existent or not implemented*"; or,

#101 "*message not compatible with call state*".

However, two exceptions to this procedure exist. The first exception is when the network or the user receives an unexpected RELEASE message in response to a SETUP message. In this case no STATUS or STATUS ENQUIRY message is sent. Whenever the network receives an unexpected RELEASE message, the network shall: release the virtual channel; clear the network connection and the call to the remote user with the cause in the RELEASE message

sent by the user or, if not included, cause #31, "*normal, unspecified*"; return a RELEASE COMPLETE message to the user; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE message, the user shall: release the virtual channel; return a RELEASE COMPLETE message to the network; release the call reference; stop all timers; and enter the Null state.

The second exception is when the network or user receives an unexpected RELEASE COMPLETE message. Whenever the network receives an unexpected RELEASE COMPLETE message, the network shall: disconnect and release the virtual channel; clear the network connection and the call to the remote user with the cause indicated by the user or, if not included, cause #111, "*protocol error, unspecified*"; release the call reference; stop all timers; and enter the Null state. Whenever the user receives an unexpected RELEASE COMPLETE message, the user shall: disconnect and release the virtual channel; release the call reference; stop all timers; and enter the Null state.

5.5.6.5 Message length error

If the message length indicated in the Message length information element is inconsistent with the length of the message received, the message shall be handled normally as far as possible and, if necessary, the error handling procedures of §5.5.6.6 shall be followed.

5.5.6.6 General information element errors

5.5.6.6.1 Information element sequence

The first four information elements (Protocol discriminator, Call reference, Message type, and Message length) shall appear in the order specified in §5.4.1. Variable length information elements may appear in any order within a message except for the cases described in §5.4.5.1.

5.5.6.6.2 Duplicated information elements

If an information element is repeated in a message in which repetition of the information element is not permitted, only the contents of information element appearing first shall be handled and all subsequent repetitions of the information element shall be ignored. When repetition of information elements is permitted, only the contents of permitted information elements shall be handled. If the limit on repetition of information elements is exceeded, the contents of information elements appearing first up to the limit of repetitions shall be handled and all subsequent repetitions of the information element shall be ignored.

5.5.6.6.3 Coding standard error

If the user or the network receives an information element with the coding standard field indicating a coding standard that is not supported by the receiver, this information element shall be treated as an information element with a content error. Depending on the information element, the procedures as described in § 5.5.6.7.2 or § 5.5.6.8.2 shall be followed.

5.5.6.7 Mandatory information element error

5.5.6.7.1 Mandatory information element missing

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements missing, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause #96, "*mandatory information element is missing*".

When a SETUP message is received which has one or more mandatory information elements missing, a RELEASE COMPLETE message with cause #96, "*mandatory information element is missing*" shall be returned.

When a RELEASE message is received with the Cause information element missing, the actions taken shall be the same as if a RELEASE message with cause #31, "*normal, unspecified*", was received (see §5.5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause #96, "*mandatory information element is missing*".

When a RELEASE COMPLETE message is received with a Cause information element missing, it will be assumed that a RELEASE COMPLETE message was received with cause #31, "*normal, unspecified*".

5.5.6.7.2 Mandatory information element content error

When a message other than SETUP, RELEASE, or RELEASE COMPLETE is received which has one or more mandatory information elements with invalid content, no action should be taken on the message and no state change should occur. A STATUS message is then returned with cause #100, "*invalid information element contents*".

When a SETUP message is received which has one or more mandatory information elements with invalid content, a RELEASE COMPLETE message with cause #100, "*invalid information element contents*", shall be returned.

When a RELEASE message is received with invalid content of the Cause information element, the actions taken shall be the same as if a RELEASE message with cause #31, "*normal, unspecified*" was received (see §5.5.4), with the exception that the RELEASE COMPLETE message sent on the local interface contains cause #100, "*invalid information element contents*".

When a RELEASE COMPLETE message is received with invalid content of the Cause information element, it will be assumed that a RELEASE COMPLETE message was received with cause #31, "*normal, unspecified*".

Information elements with a length exceeding the maximum length (given in §5.3) will be treated as information elements with content error.

Note - As an option of user equipment, cause values, location codes, and diagnostics which are not understood by the user equipment may be passed on to another entity (e.g., user) instead of treating the cause value as if it were cause #31, "*normal, unspecified*", and sending cause #100, "*invalid information element contents*", with the RELEASE COMPLETE message. This option is intended to aid user equipment to be compatible to future additions of cause values, location codes and diagnostics to the Implementation Agreement.

5.5.6.8 Non-mandatory information element errors

The following sections identify actions on information elements not recognized as mandatory.

5.5.6.8.1 Unrecognized information element

When a message is received that has one or more unrecognized information elements, then the receiving entity shall proceed as follows:

Action shall be taken on the message and those information elements which are recognized and have valid content. When the received message is other than RELEASE or RELEASE COMPLETE, a STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause #99, "*information element non-existent or not implemented*", and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized. Subsequent actions are determined by the sender of the unrecognized information elements.

If a clearing message contains one or more unrecognized information elements, the error is reported to the local user in the following manner:

a) When a RELEASE message is received which has one or more unrecognized information elements, a RELEASE COMPLETE message with cause #99, "*information element non-existent or not implemented*", shall be returned. The Cause information element diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized.

b) When a RELEASE COMPLETE message is received which has one or more unrecognized information elements, no action shall be taken on the unrecognized information.

Note - The diagnostic(s) of cause #99, "*information element non-existent or not implemented*", facilitates the decision in selecting an appropriate recovery procedure at the reception of a STATUS message. Therefore, it is recommended to provide cause #99, "*information element non-existent or not implemented*", with diagnostic(s) if a layer 3 entity expects the peer to take an appropriate action at the receipt of a STATUS message, although inclusion of diagnostic(s) is optional.

5.5.6.8.2 Non-mandatory information element content error

When a message is received which has one or more non-mandatory information elements with invalid content, action shall be taken on the message and those information elements which are recognized and have valid content. A STATUS message may be returned containing one Cause information element. The STATUS message indicates the call state of the receiver after taking action on the message. The Cause information element shall contain cause #100, "*invalid information element contents*", and the diagnostic field, if present, shall contain the information element identifier for each information element which has invalid contents.

Information elements with a length exceeding the maximum length (given in §5.3) will be treated as an information element with content error. But for access information elements (i.e., Calling party subaddress, Called party subaddress, Broadband low layer information, AAL parameters, and Broadband high layer information information elements), cause #43, "*access information discarded*", is used instead of cause #100, "*invalid information element contents*".

Note - As an option of user equipment, cause values, location codes, and diagnostics which are not understood by the user equipment may be accepted and passed on to another entity (e.g., user) instead of ignoring the Cause information element contents and optionally sending a STATUS message with cause #100, "*invalid information element contents*". This option is intended to aid user equipment to be compatible to future additions of cause values, location codes and diagnostics to the Implementation Agreement.

5.5.6.8.3 Unexpected recognized information element

When a message is received with a recognized information element that is not defined to be contained in that message, the receiving entity shall (except as noted below) treat the information element as an unrecognized information element and follow the procedures defined in §5.5.6.8.1.

Note - Some implementations may choose to process unexpected recognized information elements when the procedure for processing the information element is independent of the message in which it is received.

5.5.6.9 Signalling AAL reset

Whenever indication of a Signalling AAL reset is received from the Q.SAAL layer (see §5.9) by means of the AAL-ESTABLISH-INDICATION primitive, the following procedures apply:

a) For calls in the clearing phase (states N11, N12, U11, and U12), no action shall be taken.

b) Calls in the establishment phase (states N1, N3, N6, N8, N9, U1, U3, U6, U8, and U9), shall be maintained. Optionally the status enquiry procedure may be invoked.

c) Calls in the active state shall be maintained according to the procedures in §5.5.6.11.

5.5.6.10 Signalling AAL failure

Whenever the network layer entity is notified by its Signalling AAL entity via the AAL-RELEASE-INDICATION primitive that there is a Signalling AAL malfunction, the following procedure shall apply:

a) Any calls not in the Active state shall be cleared.
b) If any call is in the Active state a timer T309 shall be started. If timer T309 is already running, it shall not be restarted.

Signalling AAL re-establishment shall be requested by sending an AAL-ESTABLISH-REQUEST primitive.

When informed of Signalling AAL re-establishment by means of the AAL-ESTABLISH-CONFIRM primitive, the following procedure shall apply:

- Stop timer T309; and

- Perform the Status Enquiry procedure according to §5.5.6.11.

If timer T309 expires prior to Signalling AAL re-establishment, the network shall: clear the network connection and call to the remote user with cause #27, "*destination out of order*"; disconnect and release the virtual channel; release the call reference; and enter the Null state.

If timer T309 expires prior to Signalling AAL re-establishment, the user shall: clear the attached connection (if any) with cause #27, "*destination out of order*"; disconnect and release the virtual channel; release the call reference; and enter the Null state.

5.5.6.11 Status enquiry procedure

To check the correctness of a call state at a peer entity, a STATUS ENQUIRY message may be sent requesting the call state. This may, in particular, apply to procedural error conditions described in 5.5.6.9 and 5.5.6.10.

In addition whenever indication is received from the Signalling AAL that a disruption has occurred at the data link layer, a STATUS ENQUIRY message shall be sent to check the correctness of the call state at the peer entity.

Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for call state information shall exist. Therefore, if timer T322 is already running, it shall not be restarted. If a clearing message is received before timer T322 expires, timer T322 shall be stopped and call clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiver shall respond with a STATUS message, reporting the current call state (the current state of an active call or a call in

progress, or the Null state if the call reference does not relate to an active call or a call in progress) and cause #30, "*response to status enquiry*". Receipt of the STATUS ENQUIRY message does not result in a state change.

The sending or receipt of the STATUS message in such a situation will not directly affect the call state of either the sender or receiver. The side having received the STATUS message shall inspect the Cause information element. If a STATUS message is received that contains cause #30, "*response to STATUS ENQUIRY*", timer T322 shall be stopped and the appropriate action taken, based on the information in that STATUS message, relative to the current state of the receiver.

If timer T322 expires, and no STATUS message was received, the STATUS ENQUIRY message may be retransmitted one or more times until a response is received. The number of times the STATUS ENQUIRY message is retransmitted is an implementation dependent value. The call shall be cleared to the local interface with cause #41, "*temporary failure*", if the STATUS ENQUIRY is retransmitted the maximum number of times. If appropriate, the network shall also clear the network connection, using cause #41, "*temporary failure*".

5.5.6.12 Receiving a STATUS message

On receipt of a STATUS message reporting an incompatible state, the receiving entity shall:

a) clear the call by sending the appropriate clearing message with cause #101, "*message not compatible with call state*"; or,

b) take other actions which attempt to recover from a mismatch and which are an implementation option.

Except for the following rules, the determination of which states are incompatible is left as an implementation decision:

a) If a STATUS message indicating any call state except the Null state is received in the Null state, then the receiving entity shall send a RELEASE COMPLETE message with cause #101, "*message not compatible with call state*"; and remain in the Null state.

b) If a STATUS message indicating any call state except the Null state is received in the Release Request or Release Indication state, no action shall be taken.

c) If a STATUS message, indicating the Null state, is received in any state except the Null state, the receiver shall release all resources and move into the Null state.

When in the Null state, the receiver of a STATUS message indicating the Null state shall take no action other than to discard the message and shall remain in the Null state.

A STATUS message may be received indicating a compatible call state but containing one of the following causes:

#96 *"mandatory information element is missing";*

#97 *"message type non-existent or not implemented"*;

#99 *"information element non-existent or not implemented"*; or

#100 *"invalid information element contents"*.

#101 *"Message not compatible with call state"*.

In this case, the actions to be taken are an implementation option. If other procedures are not defined, the receiver shall clear the call with the appropriate procedure defined in §5.5.4, using the cause specified in the received STATUS message.

On receipt of a STATUS message specifying the global call reference and reporting an incompatible state in the Restart Request or Restart state, layer management shall be informed and take no further action on this message.

When in the null state, then on receipt of a STATUS message with the global call reference, no action shall be taken.

Note- Further actions as a result of higher layer activity (e.g., system or layer management) are implementation dependent (including the retransmission of RESTART).

Except for the above case, the error handling procedures when receiving a STATUS message specifying the global call reference are an implementation option.

5.5.7 Forward Compatibility Procedures

Not supported in this Implementation Agreement

5.6 Call/Connection Control Procedures for Point-to-Multipoint Calls

This section describes procedures for point-to-multipoint calls. The signalling channel used is the same as the one assigned for point-to-point connections. This signalling specification supports point-to-multipoint calls where information is multicasted unidirectionally from one calling user to a set of called users. The calling user is also referred to as the Root; the called users are also referred to as Leaves. In this document the Root initiates the joining of all parties to the call. Point-to-multipoint calls are initiated with a SETUP message which contains an Endpoint reference information element and a Broadband bearer capability information element indicating point-to-multipoint in the user plane connection configuration field.

At an interface involved in a point-to-multipoint call there will be two types of states associated with this call:

1) States on both sides of the interface which coincide with the subset of Q.2931 states defined in §5.2, i.e., the states of the Q.2931 protocol handlers on both sides of the UNI and identified by their respective Call reference.

These states will henceforward be called the *link-states* of the point-to-multipoint call at that interface.

2) States for each party in the call which are known at the interface; These parties are identified by their Endpoint reference.

   These states will henceforward be called the *party-states* of the party associated with the call.

Note: In each network there will be:

For each point-to-multipoint call, one incoming link-state (on the link from the root) and one outgoing link-state for each branch leading to one or more leaves (i.e., parties) participating in the call. The network may remap the call reference such that different call reference values may be associated with the incoming and outgoing links, where all pertain to different links of the same point-to-multipoint call.

For each party associated with the point-to-multipoint call, one incoming party-state and one outgoing party-state is maintained for each leaf reached through the network. Additionally, an endpoint reference value is associated with each reachable party, where this value may be remapped by the network such that a different value is used on the incoming link from that used on the outgoing link heading towards the associated party.

The party-states which may exist on the user side or the network side of the user network interface are:

Null:
The party does not exist, no Endpoint Reference value has been allocated.

Add Party Initiated :
A SETUP or an ADD PARTY message has been sent to the other side of the interface for this party for the call.

Add Party Received:
A SETUP or an ADD PARTY message has been received from the other side of the interface for this party for the call.

Drop Party Initiated:
A DROP PARTY message has been sent for this party of the call.

Drop Party Received:
A DROP PARTY message has been received for this party of the call.

Active:

On the user side of the UNI, when the user has received a CONNECT, CONNECT ACKNOWLEDGE or ADD PARTY ACKNOWLEDGE message identifying this party, or sent an ADD PARTY ACKNOWELDGE.

On the network side of the UNI, when the network has sent a CONNECT, CONNECT ACKNOWLEDGE or ADD PARTY ACKNOWLEDGE message identifying this party, or when the network has received an ADD PARTY ACKNOWLEDGE message identifying this party.

These states apply to both sides of the interface.

In the Root, party-states of each party are maintained along with the link-state for the outgoing link. A Leaf terminal which expects to never terminate more than one party of a point-to-multipoint call need only maintain the link-states.

Note - For a more detailed description of the underlying architecture see Appendix C of this specification.

5.6.1 Adding a party at the originating interface

5.6.1.1 Set up of the first party

The set up of the first party of a point-to-multipoint call is always initiated by the Root (terminal) and follows the procedures of Q.2931 for call set-up as described in §5.5 for point-to-point calls; in particular only messages of the basic Q.2931 and no messages specific to point-to-multipoint control, such as ADD PARTY will be used. The link-states for the call change according to the call state changes as described in §5.5.

The following additions apply:

The SETUP message sent by the Root (terminal) must contain the Endpoint Reference value set to zero for the first party and with the Broadband bearer capability information element indicating point-to-multipoint in the user plane connection configuration field.

The party-state changes from Null to Add Party Initiated at the Root (terminal) after the SETUP message has been sent to the network. Upon reception of the SETUP message, the party-state at the network side of the interface changes from Null to Add Party Received. The party-state changes to Active when:

- at the network side of the Root UNI after CONNECT has been sent to the user side of the Root UNI

- at the user side of the root UNI after CONNECT has been received from the network side of the Root UNI

No party-state change occurs when:

- the user sends or receives a CALL PROCEEDING message.
- the network sends a CALL PROCEEDING message.
- the network receives a CALL PROCEEDING or CONNECT ACKNOWLEDGE message.
- the user sends a CONNECT message.

If the SETUP contains a non-zero backward user cell rate parameter the network shall reject the SETUP request with cause #73, "*Unsupported combination of traffic parameters*".

If the SETUP contains an Endpoint reference information element and the Broadband bearer capability information element does not indicate point-to-multipoint in the user plane connection configuration field, the network shall reject the SETUP request with cause #100, "*invalid information element contents*", and include both the Endpoint reference information element and the Broadband bearer capability information element identifiers in the diagnostic field.

If the SETUP contains a Broadband bearer capability information element indicating point-to-multipoint in the user plane connection configuration field and does not contain an Endpoint reference information element, the network shall reject the SETUP request with cause #96, "*mandatory information element is missing*", and include the Endpoint reference information element identifier in the diagnostic field.

5.6.1.2 Adding a Party

The calling party (Root) initiates the addition of a party by transferring an ADD PARTY message on the assigned signalling VCC across the interface. The user shall send an ADD PARTY message only if the link is in the Active link-state.

After sending the ADD PARTY message, the user starts timer T399. The ADD PARTY message must have the same call reference value as specified in the initial setup of the call to which the party is to be added. The message shall always contain an endpoint reference value as described in §5.4.8.1. Following the transmission of the ADD PARTY message, the party-state is considered by the calling party to be in the Add Party Initiated party-state.

The connection identifier (VPCI/VCI) used for the new party is the same as for the original call and is not indicated in the ADD PARTY message.

The QoS, Bearer capability and ATM traffic descriptor for the new party shall be the same as for the original call and are not indicated in the ADD PARTY message.

If the Connection identifier, QoS parameter, Broadband bearer capability, or ATM traffic descriptor information elements are included in the ADD PARTY message, these information elements shall be ignored and a status message sent as described in §5.6.5.

If the network rejects an Add Party request an ADD PARTY REJECT message shall be sent to the user. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state, then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"Normal, unspecified"*. The cause used in the ADD PARTY REJECT message is specified below:

If the network is not able to provide the requested QoS class, the network shall reject the add request with cause #49, *"Quality of Service unavailable"*.

If the network is not able to provide the user cell rate of the original connection, the network shall reject the add party request with cause #51, "*User cell rate not available*". The diagnostics field of the cause information element should indicate those parameters that exceed the capacity of the network.

If a user receives a RELEASE message for a call which has one or more parties which have not progressed past the Add Party Initiated party-state, as an option the User may transmit one of the ADD PARTY messages as a SETUP message with a new call reference value and the same information element values as the previous call. After the user receives the CONNECT message for this SETUP message, the remaining ADD PARTY messages will be retransmitted by the user using the new call reference value.

If the user does not use this option, the user shall clear all the parties associated with this call on this link.

5.6.1.3 Invalid Call/Connection Control Information or Service Request in the ADD PARTY message

Upon receiving the ADD PARTY message the network enters the Add Party Received party-state. If the network determines that the call information received from the user is invalid (e.g., invalid number), then the network will send an ADD PARTY REJECT message. The cause used in rejection is specified below.

#1 *"unassigned (unallocated) number"*;

#3 *"no route to destination"*;

#22 *"number changed"*;

#28 *"invalid number format (incomplete number)"*.

Similarly, if the network determines that a requested service is not authorized, not implemented or is not available, the network will send an ADD PARTY REJECT message with one of the following causes:

#47 *"resource unavailable, unspecified"*;

#58 *"bearer capability not presently available"*.

After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"normal unspecified"*.

5.6.1.4 Add Party Received

If the network can determine that access to the requested service is authorized and available, the network shall progress the call.

5.6.1.5 Add Party Connected

Upon receiving an indication that the add has been accepted, the network shall: send an ADD PARTY ACKNOWLEDGE message across the user-network interface to the calling (Root) user and enter the Active party-state for that party.

This message indicates to the calling user (Root) that an additional party has been added to the original connection.

On receipt of the ADD PARTY ACKNOWLEDGE message, the calling user shall enter the Active party-state, and stop timer T399.

If timer T399 expires, the user shall internally clear the party.

5.6.1.6 Add Party Rejection

Upon receiving an indication that the network or the called user is unable to accept the call, the network shall send an ADD PARTY REJECT at the originating user-network interface, using the cause provided by the terminating network or the called user, and enter the Null party-state for that party. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the release message is #31, *"Normal unspecified."*

5.6.2 Add party establishment at the destination interface

For a party in a call, the call reference and endpoint reference information elements, in those messages that contain these information elements and are exchanged across the user-network interface, shall contain the same call reference and endpoint reference values specified in the SETUP or ADD PARTY messages delivered by the network.

5.6.2.1 Incoming add party request

The network will indicate the arrival of an add party request at the user-network interface by transferring a SETUP or ADD PARTY message across the interface.

The network shall transfer a SETUP message with a new Call Reference value across the UNI if the link-state is either Null or in a clearing state. For the first party of a point-to-multipoint connection, the endpoint reference value used must remain equal to zero.

When a SETUP message is used the point-to-point procedure of §5.2 shall be used except that the Endpoint reference information element must be included in the message and the party-states are tracked.

The network shall transfer an ADD PARTY message across the UNI, start timer T399, and enter the Add Party Initiated party-state only if the link is in the Active link-state. Information such as bandwidth, bearer capability and QoS shall be the same as those contained in the original SETUP message, although these are not contained within the ADD PARTY message. The ADD PARTY message shall contain all the additional information required by the called user to process the call. This message is sent by the network only if resources are available; otherwise the add request is cleared toward the calling user.

Upon receipt of an ADD PARTY message, the user shall enter the Add Party Received party-state.

If there is one and only one party in the Add Party Initiated party-state and the link is not yet in the Active link-state, additional add party requests shall be queued by the network until the link either becomes active or is cleared. At this point the queued add party requests are treated as if they had just arrived. If the network is unable to queue any additional add party requests, the network shall return an ADD PARTY REJECT message to the calling user with cause #92, "*Too many pending add party requests*", and enter the Null party-state.

If the Network receives a RELEASE message for a call which has one or more parties which have not progressed past the Add Party Initiated party-state, the Network shall transmit one of the ADD PARTY messages as a SETUP message with a new call reference value and the same information element values as the previous call. The network node will clear the call reference and initiate party dropping procedures towards the calling user for the party previously in the Active party-state. After the network receives the CONNECT message for this SETUP message, the remaining ADD PARTY messages will be retransmitted by the network using the new call reference value.

5.6.2.2 Address and compatibility check

Not supported in this Implementation Agreement.

The procedures to perform the compaiibility checking are implementation dependent. (See §5.2.2, Q.2931 [29] for more information.)

5.6.2.3 Connection identifier (VPCI/VCI) allocation/selection — destination

The VPCI/VCI is the same as the connection that already exists on the interface. The VPCI/VCI is not included in the ADD PARTY message.

5.6.2.4 QoS and Traffic parameter selection procedures

With an ADD PARTY message, the QoS and bandwidth must be the same as the existing connection and are not explicitly indicated in the ADD PARTY message.

If the user is not able to support the requested ATM traffic descriptor or QoS class, the user shall reject the Add Party request, returning an ADD PARTY REJECT message with cause #47, "*Resources unavailable, unspecified*" or cause #49, "*Quality of Service unavailable*", respectively.

If the user is able to support the indicated ATM traffic descriptor and QoS, the procedures in §5.6.2.5 shall be followed.

5.6.2.5 Call/Connection confirmation

5.6.2.5.1 Response to ADD PARTY

5.6.2.5.1.1 Procedures when the user is an ATM endpoint

When the user receives an ADD PARTY message and wishes to accept the call/connection, the user responds with an ADD PARTY ACKNOWLEDGE message, and enters the Active party-state.

If a user rejects an Add Party request it will use an ADD PARTY REJECT message and enter the Null party-state. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, "*Normal unspecified.*" The cause used in the ADD PARTY REJECT message is specified below.

An incompatible user shall respond with cause #88, "*incompatible destination.*" The diagnostics field of the cause information element should indicate the incompatible parameter.

A busy user which satisfies the compatibility requirements indicated in the ADD PARTY message shall normally respond with cause #17, "*user busy*".

If the user wishes to refuse the call, cause #21, "*call rejected,*" shall be used.

If the user rejects all incoming calls that do not provide the calling party number, the user shall use cause #23, "*User rejects all calls with Calling Line Identification Restriction (CLIR)*".

5.6.2.5.1.2 Procedures when the user is not an ATM endpoint

Upon receiving an indication that the add has been accepted by the ATM endpoint, the user (e.g., private ATM switch) shall: send an ADD PARTY ACKNOWLEDGE message across the user-network interface toward the calling user (Root) and enter the Active party-state.

5.6.2.5.2 Called user rejection of incoming call establishment

If an ADD PARTY REJECT is received before an ADD PARTY ACKNOWLEDGE message has been received, and there are other parties of the call on the interface in the Add Party Initiated or Active party-states, the network shall: stop timer T399, and clear the party toward the calling user with the cause received in the ADD PARTY REJECT message.

If an ADD PARTY REJECT is received before an ADD PARTY ACKNOWLEDGE message has been received, and there are no other parties of the call on the interface in the Add Party Initiated or Active party-states, the network shall: stop timer T399, and clear the party toward the calling user with the cause received in the ADD PARTY REJECT message, and initiate link clearing procedures toward the called user as described in §5.6.3.5.

5.6.2.5.3 Call failure

If the network does not receive any response to the transmitted ADD PARTY message prior to the expiration of timer T399, then the network shall initiate procedures to send an ADD PARTY REJECT message towards the calling user with cause #18, *"no user responding"*. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"Normal unspecified."*

5.6.2.6 Call/Connection accept

A user indicates acceptance of an incoming add party request by sending an ADD PARTY ACKNOWLEDGE message to the network.

Upon sending the ADD PARTY ACKNOWLEDGE message, the user enters the Active party-state.

5.6.2.7 Active indication

On receipt of the ADD PARTY ACKNOWLEDGE message, the network shall: stop timer T399; enter the Active party-state; and initiate procedures to send an ADD PARTY ACKNOWLEDGE message towards the calling user.

5.6.3 Party clearing

5.6.3.1 Terminology

Terminology is defined in §5.5.4.1.

5.6.3.2 Exception conditions

Under normal conditions, dropping a party is usually initiated when the user or the network sends a RELEASE or DROP PARTY message and follows the procedures defined in §§5.5.4.3, 5.5.4.4, 5.6.3.3 and 5.6.3.4. The only exceptions to the above rule are as follows:

a) In response to a SETUP message (when the call is still in a point-to-point configuration), the call clearing procedures of §5.5.4.2 apply.

b) In response to an ADD PARTY message, the user or network can reject an Add Party request by: responding with an ADD PARTY REJECT provided no other response has previously been sent. In addition, after sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"Normal unspecified."*

5.6.3.3 Dropping a party initiated by the user

Apart from the exceptions identified in §§5.6.3.2 and 5.6.5, the user shall initiate dropping a party by sending a RELEASE or DROP PARTY message.

The RELEASE message is sent if all other parties belonging to the same call on the interface are in the Null party-state, a Drop Party Initiated party-state, or a Drop Party Received party-state. When a RELEASE message is sent, the normal clearing procedures of §5.5.4 shall be used and all parties on this interface are cleared (i.e., enter the Null party-state and stop all party-state timers.)

When the network receives a RELEASE message:

- Parties in the Drop Party Initiated and Drop Party Received party-state shall enter the Null party-state

- Parties in the Add Party Received party-state and the Active party-state shall be cleared towards the remote user with the cause contained in the RELEASE message or cause #31, *"Normal unspecified"* if no cause was included in the RELEASE message.

- Parties in the Add Party Initiated party-state shall be reoffered on a new call reference (see §5.6.2.1).

Note - After sending a RELEASE message, and while in the Release Request link-state, the user shall ignore any ADD PARTY messages pertaining to that call reference until the call reference is available for reuse.

A DROP PARTY message is used to initiate party clearing when:

- The party is in the Active or Add Party Initiated party-states, and

- There are other parties to the call on this interface in the Add Party Initiated, Add Party Received, or Active party-state.

After sending a DROP PARTY message the user shall start timer T398 (the value of timer T398 is specified in §5.7), and enter the Drop Party Initiated party-state.

If one or more parties associated with the call are in the Active party-state, an Add Party Initiated or Add Party Received party-state, this message then prompts the network to release the endpoint reference and to initiate procedures for dropping the party along the path to the remote user. Once the endpoint reference used for the party has been released, the network shall: send a DROP PARTY ACKNOWLEDGE message to the user; and enter the Null party-state.

If all other parties associated with the call are in the Null party-state, a Drop Party Initiated party-state, or a Drop Party Received party-state, this message then prompts the network to release the endpoint reference and to initiate procedures for dropping the party along the path to the remote user. Once the endpoint reference used for the party has been released, the network shall send a RELEASE message to the user.

Note - The DROP PARTY ACKNOWLEDGE message has only local significance and does not imply an acknowledgment of clearing from the remote user.

On receipt of the DROP PARTY ACKNOWLEDGE message the user shall: cancel timer T398; release the endpoint reference; and return to the Null party-state. If all parties on the call at the interface are in the Null party-state, the user shall release the call by sending a RELEASE message.

If timer T398 expires:

If one or more parties associated with the call are in the Active, Add Party Initiated or Add Party Received party-state, the user shall: send a DROP PARTY ACKNOWLEDGE message to the network with the cause number originally contained in the DROP PARTY message; and enter the Null party-state. In addition, the user may indicate a second cause information element with cause #102, "*recovery on timer expiry*". Equipment may use implementation-dependent recovery procedures, such as initiating status enquiry procedures, to verify that the party has been dropped.

If all parties associated with the call are in the Null, Drop Party Received, or Drop Party Initiated party-state, the user shall: send a RELEASE message to the network with the cause number originally contained in the DROP PARTY message. In addition, the user may indicate a second cause information element with cause #102, "*recovery on timer expiry*".

5.6.3.4 Dropping a party initiated by the network

Apart from the exception conditions identified in §§5.6.3.2 and 5.6.5, the network shall initiate dropping a party by: sending a RELEASE or DROP PARTY message.

The RELEASE message is used if all other parties belonging to the same call on the interface are in the Null party-state, Drop Party Received party-state, or Drop Party Initiated party-state. When a RELEASE message is used, the normal clearing procedures of §5.5.4 shall be used and all parties are cleared (i.e., enter the Null party-state and stop all party-state timers.)

When the user receives a RELEASE message:

- Parties in the Drop Party Initiated and Drop Party Received party-state shall enter the Null party-state

- Parties in the Add Party Received party-state and the Active party-state shall be cleared towards the remote user with the cause contained in the RELEASE message or cause #31, *"Normal unspecified"* if no cause was included in the RELEASE message.

- Parties in the Add Party Initiated party-state shall be reoffered on a new call reference (see §5.6.2.1).

Note - After sending a RELEASE message, and while in the Release Indication link-state, the network shall ignore any ADD PARTY messages pertaining to that call reference.

A DROP PARTY message is used to initiate party clearing when:

- The party is in the Active or Add Party Initiated party-states, and

- There are other parties to the call on this interface in the Add Party Initiated, Add Party Received, or Active party-state.

5.6.3.4.1 Clearing with a DROP PARTY message

After sending a DROP PARTY message, the network shall start timer T398 and enter the Drop Party Initiated party-state.

If all other parties associated with the call are in the Null party-state, Drop Party Initiated party-state or Drop Party Received party-state, the user shall respond to a DROP PARTY message by sending a RELEASE message.

If any other parties associated with the call are in the Active party-state, Add Party Initiated party-state, or Add Party Received party-state the user shall respond to a DROP PARTY message by releasing the endpoint reference, sending a DROP PARTY ACKNOWLEDGE message and entering the Null party-state.

On receipt of the DROP PARTY ACKNOWLEDGE message, the network shall: stop timer T398; release the endpoint reference; and return to the Null party-state. If all parties associated with the call are in the Null party-state, a Drop Party Initiated party-state or a Drop Party Received party-state, the network shall: send a RELEASE message to the user.

If timer T398 expires:

If one or more parties associated with the call are in the Active, Add Party Initiated or Add Party Received party-state, the network shall: send a DROP PARTY ACKNOWLEDGE message to the user with the cause number originally contained in the DROP PARTY

message; and enter the Null party-state. In addition, the network may indicate a second cause information element with cause #102, *"recovery on timer expiry"*. Equipment may use implementation-dependent recovery procedures, such as initiating status enquiry procedures, to verify that the party has been dropped.

If all parties associated with the call are in the Null party-state, a Drop Party Initiated party-state or a Drop Party Received party-state, the network shall: send a RELEASE message to the user with the cause number originally contained in the DROP PARTY message. In addition, the network may indicate a second cause information element with cause #102, *"recovery on timer expiry"*.

5.6.3.5 Clear collision

Clear collision occurs when both the user and the network transfer simultaneously DROP PARTY messages specifying the same call reference value and endpoint reference value.

Upon receiving a DROP PARTY message whilst in the Drop Party Initiated party-state, and while there are one or more parties associated with the call in the Active, Add Party Initiated or Add Party Received party-state, the recipient shall: stop timer T398; release the endpoint reference; send a DROP PARTY ACKNOWLEDGE message; and enter the Null party-state.

Similarly, upon receiving a DROP PARTY message whilst in the Drop Party Initiated party-state, and while all parties associated with the call are in the Null party-state, Drop Party Initiated party-state, or a Drop Party Received party-state, the recipient shall: stop timer T398; release the endpoint reference; disconnect the bearer virtual channel; and send a RELEASE message.

With point-to-multipoint connections another type of clear collision is when clearing messages (i.e., DROP PARTY, DROP PARTY ACKNOWLEDGE or ADD PARTY REJECT) pertaining to the last two parties on an interface cross. In this case, each entity receiving such a message shall initiate link clearing procedures by returning a RELEASE message and following the clearing procedures in § 5.5.4

5.6.4 Restart Procedure

In addition to the procedures of §5.5.5, when the virtual channel (connection) is restarted, all parties associated with the virtual channel should be cleared. The network will initiate normal drop party procedures toward the remote user(s) for all parties associated with the call. On the interface the party-state of all parties associated with the virtual channel is set to Null.

5.6.5 Handling of error conditions

The point-to-point procedures for handling error conditions should be applied first.

This section discusses error handling that specifically applies to adding or dropping parties in a point-to-multipoint call. The normal error procedures of §5.5.6 also apply.

Sections 5.6.5.1 through 5.6.5.8 are listed in order of precedence.

5.6.5.1 Protocol Discriminator Error

Refer to §5.5.6.1.

5.6.5.2 Message too short

Refer to §5.5.6.2.

5.6.5.3 Call reference and Endpoint Reference errors

5.6.5.3.1 Call reference procedural errors

Whenever an ADD PARTY, ADD PARTY ACKNOWLEDGE, ADD PARTY REJECT, DROP PARTY or DROP PARTY ACKNOWLEDGE message is received while in the Null link-state, a RELEASE COMPLETE message is sent with cause #81, *"invalid call reference value"* and following the procedures in §5.5.4, specifying the call reference in the received message.

5.6.5.3.2 Endpoint reference error

The following section assumes that there are no call reference errors and only the endpoint reference is in error.

5.6.5.3.2.1 Invalid endpoint reference format

If the endpoint reference information element is not properly formatted (i.e., incorrect length, type or flag), then a STATUS message is returned with cause #100, *"invalid information element contents"*, and procedures of 5.5.7.7.2 followed. In this case, no Endpoint reference information element is contained in the STATUS message. No other action is taken on this message.

5.6.5.3.2.2 Endpoint reference procedural errors

a) Whenever any message except SETUP, ADD PARTY, or DROP PARTY ACKNOWLEDGE is received for a party in the NULL party-state, dropping is initiated by sending a DROP PARTY ACKNOWLEDGE message with cause #89 *"invalid endpoint reference value"* and remain in the Null party-state.

b) When a DROP PARTY ACKNOWLEDGE message is received for a party in the NULL party-state, no action should be taken.

c) When an ADD PARTY message is received while not in the NULL or Add Party Received party-state, a STATUS message, containing the Active link-state value, the associated endpoint reference and endpoint state information elements and values, and cause value 101, *"message not compatible with call state"*, is responded.

d) When an Add Party message is received while in the Add Party Received party-state, the Add Party is ignored.

5.6.5.4 Message type or message sequence errors

Procedures specified in § 5.5.6.4 also apply in this section.

When the network or user receives an unexpected RELEASE COMPLETE message, the procedures for handling the party-states will be the same as specified in §5.6.3.3 and §5.6.3.4 on receipt of a RELEASE message with the exception that cause #111, *"protocol error, unspecified"* is used if no cause is specified in the RELEASE COMPLETE message.

Whenever the network receives an unexpected DROP PARTY ACKNOWLEDGE message, the network shall: initiate normal party clearing procedures toward the remote user with the cause indicated by the user or, if not included, cause #111, *"protocol error, unspecified"*; release the endpoint reference; stop all timers; and enter the Null party-state. Whenever the user receives an unexpected DROP PARTY ACKNOWLEDGE message, the user shall: release the endpoint reference; stop all timers; and enter the Null party-state. If no parties remain in the Active, Add Party Initiated or Add Party Received party-state on the call at the interface when either side receives the DROP PARTY ACKNOWLEDGE message, the side receiving the DROP PARTY ACKNOWLEDGE shall disconnect the bearer virtual channel and send a RELEASE message.

The receipt of an ADD PARTY, ADD PARTY ACKNOWLEDGE, or DROP PARTY ACKNOWLEDGE message in any link-state other than the Active link-state is an unexpected message and the procedures of §5.5.6.4 shall apply.

5.6.5.5 Message length errors

Refer to §5.5.6.5.

5.6.5.6 General Information Element errors

Refer to §5.5.6.6.

5.6.5.7 Mandatory information element error

5.6.5.7.1 Mandatory information element missing

When an ADD PARTY message is received which has one or more mandatory information elements missing, an ADD PARTY REJECT message with cause #96, *"mandatory information element is missing"* shall be returned. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"Normal unspecified."*

When a DROP PARTY message is received with the Cause information element missing, the actions taken shall be the same as if a DROP PARTY message with cause #31, *"normal, unspecified"* was received (see §5.6.3), with the exception that the DROP PARTY ACKNOWLEDGE or RELEASE message, as appropriate, sent on the local interface contains cause #96, *"mandatory information element is missing"*.

When a DROP PARTY ACKNOWLEDGE or ADD PARTY REJECT message is received with a Cause information element missing, it will be assumed that the message was received with cause #31, *"normal, unspecified"*.

5.6.5.7.2 Mandatory information element content error

When an ADD PARTY message is received which has one or more mandatory information elements with invalid content, an ADD PARTY REJECT or RELEASE message, as appropriate, with cause #100, *"invalid information element contents"* shall be returned. After sending the ADD PARTY REJECT message, if there are no remaining parties in the Active or Add Party Received party-state then the network shall send a RELEASE message to the user. The cause used in the RELEASE message is #31, *"Normal unspecified."*

When a DROP PARTY message is received with invalid content of the Cause information element, the actions taken shall be the same as if a DROP PARTY message with cause #31, *"normal, unspecified,"* was received (see §5.5.4), with the exception that the DROP PARTY ACKNOWLEDGE or RELEASE message, as appropriate, sent on the local interface contains cause #100, *"invalid information element contents"*.

When a DROP PARTY ACKNOWLEDGE message is received with invalid content of the Cause information element, it will be assumed that a DROP PARTY ACKNOWLEDGE message was received with cause #31, *"normal, unspecified"*.

Information elements with a length exceeding the maximum length (given in §5.4) will be treated as information elements with content error.

5.6.5.8 Non-mandatory information element errors

The following sections identify actions on information elements not recognized as mandatory.

5.6.5.8.1 Unrecognized information element

When a message is received that has one or more unrecognized information elements, then the receiving entity shall proceed as follows:

Action shall be taken on the message and those information elements which are recognized and have valid content. When the received message is an ADD PARTY, ADD PARTY ACKNOWLEDGE or ADD PARTY REJECT, a STATUS message may be returned containing one cause information element. The STATUS message indicates the link-state and endpoint reference state of the receiver after taking action on the message. The cause information element shall contain cause #99, *"information element non-existent or not implemented"*, and the diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized, subject to the length constraint of the Cause Information Element size.

Subsequent actions are determined by the sender of the unrecognized information elements. If a clearing message contains one or more unrecognized information elements, the error is reported to the local user in the following manner:

a) When a DROP PARTY message is received which has one or more unrecognized information elements, a DROP PARTY ACKNOWLEDGE or RELEASE message with cause #99, *"information element non-existent or not implemented"*, shall be returned. The cause information element diagnostic field, if present, shall contain the information element identifier for each information element which was unrecognized.

b) When a DROP PARTY ACKNOWLEDGE message is received which has one or more unrecognized information elements, no action shall be taken on the unrecognized information.

Note - The diagnostic(s) of cause #99 facilitates the decision in selecting an appropriate recovery procedure at the reception of a STATUS message. Therefore, it is recommended to provide cause #99 with diagnostic(s) if a layer 3 entity expects the peer to take an appropriate action at the receipt of a STATUS message, although inclusion of diagnostic(s) is optional.

5.6.5.9 Signalling AAL reset

Whenever indication of a Signalling AAL reset is received from the Q.SAAL layer (see §5.9) by means of the AAL-ESTABLISH-INDICATION primitive, the following procedures apply:

a) For parties in the clearing phase (party-states Drop Party Initiated and Drop Party Received), no action shall be taken.
b) Parties in the establishment phase (party-states Add Party Initiated and Add Party Received), shall be maintained. Optionally the status enquiry procedures may be invoked.
c) Parties in the active party-state shall be maintained according to the procedures in other parts of §5.6.

5.6.5.10 Signalling AAL failure

Whenever the network layer entity is notified by its Signalling AAL entity via the AAL-RELEASE-INDICATION primitive that there is a Signalling AAL malfunction, the following procedure shall apply:

a) Any Parties not in the Active party-state shall be cleared internally.

5.6.5.11 Status enquiry procedure

To check the correctness of a party-state at a peer entity, a STATUS ENQUIRY message may be sent requesting the party-state, by including the endpoint reference of the party-state to be checked. This may, in particular, apply to procedural error conditions described in 5.6.5.9 and 5.6.5.10.

In addition whenever indication is received from the Signalling AAL that a disruption has occurred at the data link layer, a STATUS ENQUIRY message shall be sent to check the correctness of the party-state at the peer entity.

Upon sending the STATUS ENQUIRY message, timer T322 shall be started in anticipation of receiving a STATUS message. While timer T322 is running, only one outstanding request for party-state information shall exist. Therefore, if timer T322 is already running, it shall not be restarted. If a party clearing message is received before timer T322 expires, timer T322 shall be stopped and party clearing shall continue.

Upon receipt of a STATUS ENQUIRY message, the receiver shall respond with a STATUS message, reporting the current party-state (the current party-state of an active party or a party in progress, or the Null party-state if the endpoint reference does not relate to an active party or a party in progress) and cause #30, *"response to status enquiry"* . Receipt of the STATUS ENQUIRY message does not result in a party-state change.

The sending or receipt of the STATUS message in such a situation will not directly affect the party-state of either the sender or receiver. The side having received the STATUS message shall inspect the Cause information element. If a STATUS message is received that contains cause #30, *"Response to STATUS ENQUIRY"*, timer T322 shall be stopped and the appropriate action taken, based on the information in that STATUS message, relative to the current state of the receiver.

If timer T322 expires, and no STATUS message was received, the STATUS ENQUIRY message may be retransmitted one or more times until a response is received. The number of times the STATUS ENQUIRY message is retransmitted is an implementation dependent value. The party shall be cleared to the local interface with cause #41, *"temporary failure"*, if the STATUS ENQUIRY is retransmitted the maximum number of times. If appropriate, the network shall also clear the network connection, using cause #41, *"temporary failure"*.

5.6.5.12 Receiving a STATUS message

On receipt of a STATUS message reporting an incompatible party-state, the receiving entity shall:

a) clear the party by sending the appropriate clearing message with cause #101, *"message not compatible with call state"*; or,

b) take other actions which attempt to recover from a mismatch and which are an implementation option.