ATM Forum: Technical Committee, Signalling Subworking Group
ATM Forum/95-1434R13

****

Title: UNI Signalling 4.0

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Abstract: The final letter ballot version of the UNI Signalling Specification (UNI Signalling 4.0) is presented. This document is formulated as a delta document from ITU-T Recommendation Q.2931 and related ITU-T Recommendations. Updates from the last ATM Forum meeting are included.

****

Date: June 10 - 14, 1995.
Orlando, Florida.

Distribution: ATM Forum Principal Members

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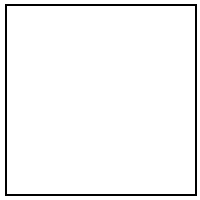

Technical Committee

ATM User-Network Interface (UNI) Signalling Specification

Version 4.0

af-sig-0061.000

ATM Forum/95-1434R13

(Letter Ballot Version)

June, 1996

ATM User-Network Interface Signalling Specification
Version 4.0

af-sig-0061.000

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A C K N O W L E D G M E N T S

Preparation of a Specification of this kind requires a concerted effort on the part of many individuals. The following individuals (names listed alphabetically), among others, devoted valuable time towards the development of this Specification.

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1.0 General

This Specification provides the signalling procedures for dynamically establishing, maintaining and clearing ATM connections at the ATM User-Network Interface. The procedures are defined in terms of messages and the information elements used to characterize the ATM connection. The procedures included in this Specification apply to the interface between terminal or endpoint equipment and a public network, referred to as Public UNI, and terminal or endpoint equipment connected to a private network, referred to as Private UNI.

Throughout this document, frequent reference is made to ITU-T Recommendations. In some cases, the ATM Forum UNI Signalling Specification, 4.0 deviates from the ITU-T Recommendations. It should be understood that all ATM Forum modifications apply to the procedures described in this document, even though the ITU-T Recommendations are being referenced directly.

1.1 Reference Configurations

The protocol is valid for the private and public UNI.

The purpose of a reference configuration for the UNI Signalling Specification is to list all the elements of an ATM network and the links among them, to which this Specification applies.

Network elements in this context are:

- Endpoint equipment
- Private ATM network
- Public ATM network.

For the purpose of this Specification, a network, public or private, consists of one or more ATM switching systems under the same administration.

The possible reference configurations that apply to this Specification are given in Table 1-1. Except where noted in this document, the procedures for Public UNI and Private UNI are identical.

Table 1-1 Reference Configurations

BETWEEN → ↓	End-point Equipment	Private ATM Network	Public ATM Network
End-point Equipment	Note 1	Private UNI	Public UNI
Private ATM Network	Private UNI	Note 1	Public UNI
Public ATM Network	Public UNI	Public UNI	Note 1

Note 1 - The table entry for this connection is outside the domain of this Specification.

1.2 UNI 4.0 Capabilities

Table 1-2 shows the capabilities available within the ATM Forum UNI Signalling Specification, 4.0. Capabilities are listed as applicable to a terminal equipment and a network node (switching system) and are categorized as mandatory (M) or optional (O).

Implementations claiming conformance to the UNI Signalling Specification, Version 4.0, shall support the capabilities listed as Mandatory in table 1-2; i.e., by implementing the procedures of the corresponding sections of this Specification. Some capabilities that are categorized as mandatory in this Specification are not provided in the UNI 3.1 Specification, the B-ICI 2.0 Specification and/or the relevant ITU-T Recommendations. Procedures are provided in this Specification to support interworking across such interfaces. UNI Signalling 4.0 implementations shall support at least these procedures and recognize the corresponding information elements.

Table 1-2 UNI Signalling 4.0 Capabilities

No.	Capability	Terminal Equipment	Switching System
1.	Point-to-point Calls	M	M
2.	Point-to-multipoint Calls	O	M
3.	Signalling of Individual QoS Parameters	M	M
4.	Leaf Initiated Join	O	O
5.	ATM Anycast	O	Note 1
6.	ABR Signalling for Point-to-point Calls	O	O
7.	Generic Identifier Transport	O	O
8.	Virtual UNIs	O	O
9.	Switched Virtual Path (VP) service	O	O
10.	Proxy Signalling	O	O
11.	Frame Discard	O	O(Note 2)
12.	Traffic Parameter Negotiation	O	O
13.	Supplementary Services	-	-
13.1.	Direct Dialing In (DDI)	O	O
13.2.	Multiple Subscriber Number (MSN)	O	O
13.3.	Calling Line Identification Presentation (CLIP)	O	O
13.4.	Calling Line Identification Restriction (CLIR)	O	O
13.5.	Connected Line Identification Presentation (COLP)	O	O
13.6.	Connected Line Identification Restriction (COLR)	O	O
13.7.	Subaddressing (SUB)	O	Note 3
13.8.	User-user Signalling (UUS)	O	O

Note 1 - This capability is optional for public networks/switching systems and is mandatory for private networks/switching systems.

Note 2 - Transport of the Frame Discard indication is Mandatory.

Note 3 - This capability is mandatory for networks/switching systems (public and private) that support only native E.164 address formats.

1.3 References

It should be noted that only the specific versions of the following referenced documents and the specific versions of the documents referenced within these documents are applicable to this Specification.

1. ITU-T E.164 (1991)	Numbering Plan for the ISDN era
2. ITU-T I.113 (1991)	B-ISDN Vocabulary of Terms
3. ITU-T I.150 (1993)	B-ISDN Asynchronous Transfer Mode Functional Characteristics
4. ITU-T I.211 (1993)	B-ISDN Service Aspects
5. ITU-T I.311 (1993)	B-ISDN General Network Aspects
6. ITU-T I.321 (1991)	B-ISDN Protocol Reference Model and its Application
7. ITU-T I.327 (1993)	B-ISDN Functional Architecture
8. ITU-T I.361 (1993)	B-ISDN ATM Layer Specification
9. ITU-T I.362 (1993)	B-ISDN ATM Adaptation Layer (AAL) Functional Description
10. ITU-T I.363 (1993)	B-ISDN ATM Adaptation Layer (AAL) Specification
11. ITU-T I.413 (1993)	B-ISDN User-Network Interface
12. ITU-T Q.2110 (1994)	B-ISDN SAAL Service Specific Connection Oriented Protocol (SSCOP)
13. ITU-T Q.2130 (1994)	B-ISDN SAAL Service Specific Coordination Function (SSCF) at the UNI
14. ITU-T Q.2610 (1995)	B-ISDN Usage of Cause and Location in B-ISDN User Part and DSS2
15. ITU-T Q.2931 (Note 1)	B-ISDN DSS2 User-Network Interface (UNI) Layer 3 Specification for Basic Call/Connection Control
16. ITU-T Q.2951 (1995)	Stage 3 Description for Number Identification Supplementary Services Using B-ISDN DSS2 Basic Call
17. ITU-T Q.2957 (1995)	B-ISDN, Stage 3 Description for Additional Information Transfer Supplementary Services Using B-ISDN DSS 2, Basic Call
18. ITU-T Q.2961.1 (Note 1)	B-ISDN DSS2 Negotiation/Modification: Additional Traffic Parameter Indications
19. ITU-T Q.2962 (Note 1)	B-ISDN DSS2 Connection Characteristics Negotiation During Call/Connection Establishment Phase
20. ITU-T Q.2971 (Note 1)	B-ISDN DSS2 UNI Layer 3 Specification for Point-to-Multipoint Call/Connection Control
21. ATM Forum (1994)	User-Network Interface, Version 3.1.
22. ATM Forum (1995)	Circuit Emulation Service Interoperability Specification 1.0
23. ATM Forum (1996)	Native ATM Services: Semantic Description, Version 1.0 Specification, af-saa-0048-000.
24. ATM Forum	Private Network-Network Interface Specification, Version 1.0, af-pnni-0055.000
25. ATM Forum	Traffic Management Specification Version 4.0
26. ATM Forum (Note 1)	ILMI Specification Version 4.0
27. ATM Forum (1995)	SAA/AMS Specification Version 1.0
28. ISO/IEC 6523-1984	Data Interchange - Structure for the identification of organizations
29. ISO/IEC 8348	Information Technology - Telecommunications and Information Exchange Between Systems - Network Service Definition, 1993.
30. IETF RFC 1629	Guidelines for NSAP Allocation in the Internet

Note 1 - This document is in course of preparation for publication in 1996.

1.4 Document Organization

Table 1-3 offers a brief overview of the organization of this document.

Table 1-3 UNI Signalling 4.0 Document Organization

Section	Description
1	UNI Signalling 4.0 Specification scope, capabilities and references
2	Messages and procedures for point-to-point calls
3	Addressing considerations for public and private networks
4	Definition of the Signalling ATM Adaptation Layer (SAAL)
5	Procedures for point-to-multipoint calls
6	Messages and procedures for Leaf-Initiated Join point-to-multipoint calls
7	ATM Anycast capability
8	Connection Characteristics (Traffic Parameters) Negotiation
9	Signalling of individual QoS Parameters
10	Point-to-point ABR Connections
Annex 1	Guidelines for use of ATM address formats
Annex 2	Proxy signalling capability
Annex 3	Common identification of Leaf Initiated Join calls
Annex 4	Supplementary service support
Annex 5	Guidelines for assigning ATM Group Addresses
Annex 6	Connection scope selection for the Anycast capability
Annex 7	Procedures when optional capabilities are not supported
Annex 8	Use of Virtual UNIs
Annex 9	Guidelines on use of Bearer Class, Traffic Parameters and Quality of Service
Annex 10	Handling of the RM Fixed Round Trip Time for ABR Connections
Appendix A	Examples of codings for UNI 4.0 Signalling
Appendix B	Overview of the Leaf Initiated Join calls
Appendix C	Information on Cell Replication for point-to-multipoint connections
Appendix D	Known Differences between Q.2931 and Section 8.
Appendix E	Known Differences with UNI 3.1

It should be noted that the sections 1 - 10 and the Annexes 1 - 10 form the normative part of this Specification. The Appendices are for informative purposes.

2.0 Basic Point-to-Point Call

When setting up a point-to-point call, the ITU-T Recommendations Q.2931 and Q.2961.1 shall apply, with the exceptions stated in this section.

All clauses, annexes and appendices of Recommendations Q.2931 and Q.2961.1 shall apply. Only the subclauses/annexes/appendices of Q.2931/Q.2961.1 that have been modified by this document are given below. In this Specification, subclauses, annexes, appendices, etc. of referenced documents, such as Q.2931, are identified by the actual subclause/annex/appendix number from that document, the document number and the title of the subclause/annex/appendix. For example, an exception to procedures in section 3.1.3 of Q.2931 is identified below by a statement titled "3.1.3/Q.2931 CONNECT".

When a VPCI/VCI value is assigned, the allocation is in both directions even when the connection is unidirectional (has zero backward bandwidth). The VPCI/VCI value cannot be used for another connection until the call is cleared.

1.0/Q.2931 Scope:
This Section and all its subsections are for informative purpose only.

1.3.11/Q.2931 Public UNI ATM Addressing:
Add the phrase "and/or private UNI" after "public UNI."

2.2/Q.2931 Additional B-ISDN call/connection states relating to interworking requirements:
The states U2, U25, N2, N25 are not supported.

3.0/Q.2931 Message Functional Definitions and Contents:
Only information elements from codeset 0 are supported.

3.1.1/Q.2931 ALERTING:
Add the following to Table 3-2/Q.2931:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1	both	O	4-33

3.1.2/Q.2931 CALL PROCEEDING:
Clarification of Note 1 -
The Connection identifier information element is mandatory in the network-to-user direction regardless of whether Annex H is implemented or not. It is mandatory in the user-to-network direction, unless the user accepts the connection identifier indicated in the SETUP message.

3.1.3/Q.2931 CONNECT:
The OAM traffic descriptor is not supported.
AAL parameters maximum length is modified from 21 to 11.
End-to-end transit delay maximum length is modified from 10 to 7.
Note 4 is superseded by Note 1 of Section 9.1.1.1.

Note 1 of section 1.8.1.2/Q.2961.1 is replaced by the following:

Note 1- Included in the user-to-network direction only when the SETUP message contained an ATM traffic descriptor information element with the Tb parameter set to "1" or with the Backward Frame Discard indicator set to "1". Included in the network-to-user direction only when the SETUP message contained an ATM traffic descriptor information element with the Tf parameter set to "1", or with the Backward Frame Discard indicator set to "1". In this message this information element contains only octets 1, 2, 3, 4, 17, and 17.1.

Add the following to Table 3-4/Q.2931:

Information Element Name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1	both	O	4-33

3.1.5/Q.2931 RELEASE:
Add the following to Table 3-6/Q.2931:

Information Element Name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1	both	O	4-33

3.1.6/Q.2931 RELEASE COMPLETE:
Add the following to Table 3-7/Q.2931:

Information Element Name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1	both	O	4-33

3.1.7/Q.2931 SETUP:
Called party number is mandatory in the network-to-user and user-to-network directions.
Called party number minimum length depends on addressing and the maximum length is specified at 25.
Calling party number maximum length is specified at 26.
OAM traffic descriptor is not supported.
Broadband sending complete is optionally included in the user-to-network and network-to-user directions.
End-to-end transit delay maximum length is modified from 10 to 11 (see Section 9.1.1.2).
Note 10 is superseded by Note 1 of Section 9.1.1.2.
Inclusion of the QoS parameter information element in this message is optional. See section 9.1.1.2 for additional information.
Transit network selection maximum length is specified at 9 octets. This information element is included only once in the message.
If the Calling party subaddress information element is used to convey an ATM endsystem address, then an additional Calling party subaddress information element may be present to convey an OSI NSAP or User specified subaddress. If the Called party subaddress information element is used to convey an ATM endsystem address, then an additional Called party subaddress information element may be present to convey an OSI NSAP or User specified subaddress.
Add the following to Table 3-8/Q.2931:

Information Element Name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1	both	O	4-33

3.2/Q.2931 Additional or modified messages related for the support of 64 kbit/s based ISDN circuit-mode services:
Exceptions noted for Section 3.1/Q.2931 above apply to this section as well (for the same messages).

3.2.4/Q.2931 INFORMATION:
This message type is not supported.

3.2.7/Q.2931 SETUP:
Exceptions noted for 3.1/Q.2931 above apply with the following exception:
Broadband Sending Complete is mandatory in the user-to-network and network-to-user directions.

3.2.8/Q.2931 SETUP ACKNOWLEDGE:
This message type is not supported.

3.3.1/Q.2931 RESTART:
Replace the first paragraph with the following:

This message is sent by the user or the network to request the recipient to restart (i.e., return to an idle condition) the indicated virtual channel, the indicated virtual path, or all virtual channels in the indicated virtual path connection, or all virtual channels and virtual paths controlled by the signalling virtual channel. See Table 3-22/Q.2931.

Replace Note 2, Table 3-22/Q.2931 as follows:

Included when necessary to indicate the particular virtual channel(s) or virtual path to be restarted.

3.3.2/Q.2931 RESTART ACKNOWLEDGE:

Replace Note 2, Table 3-23/Q.2931 as follows:

Included when necessary to indicate the particular virtual channel(s) or virtual path which have been restarted.

4.4.1/Q.2931 Message Type:
The following message types are not supported:
SETUP ACKNOWLEDGE
INFORMATION
Escape to national specific message types is not supported.

4.5.1/Q.2931 Coding Rules:

Maximum length and maximum number of occurrences in a message are specified for each supported information element as follows (note: this additional information is presented for clarification only):

Table 2-1 UNI Signalling 4.0 Information Elements

Bits 8 7 6 5	Bits 4 3 2 1	Information Element	Max Length	Max no. of Occurrences
0 0 0 0	0 1 0 0	Narrowband bearer capability (1, 2)	14	3
0 0 0 0	1 0 0 0	Cause (1)	34	2
0 0 0 1	0 1 0 0	Call state	5	1
0 0 0 1	1 1 1 0	Progress indicator (1)	6	2
0 0 1 0	0 1 1 1	Notification indicator	(3)	(3)
0 1 0 0	0 0 1 0	End-to-end transit delay	11	1
0 1 0 0	1 1 0 0	Connected number	25	1
0 1 0 0	1 1 0 1	Connected subaddress	25	1
0 1 0 1	0 1 0 0	Endpoint reference	7	1
0 1 0 1	0 1 0 1	Endpoint state	5	1
0 1 0 1	1 0 0 0	ATM adaptation layer parameters	21	1
0 1 0 1	1 0 0 1	ATM traffic descriptor	30	1
0 1 0 1	1 0 1 0	Connection identifier	9	1
0 1 0 1	1 1 0 0	Quality of service parameter	6	1
0 1 0 1	1 1 0 1	Broadband high layer information	13	1
0 1 0 1	1 1 1 0	Broadband bearer capability	7	1
0 1 0 1	1 1 1 1	Broadband low-layer information (2)	17	3
0 1 1 0	0 0 0 0	Broadband locking shift	5	(4)
0 1 1 0	0 0 0 1	Broadband non-locking shift	5	(4)
0 1 1 0	0 0 1 0	Broadband sending complete	5	1
0 1 1 0	0 0 1 1	Broadband repeat indicator	5	2
0 1 1 0	1 1 0 0	Calling party number	26	1
0 1 1 0	1 1 0 1	Calling party subaddress (1)	25	2
0 1 1 1	0 0 0 0	Called party number	25	1
0 1 1 1	0 0 0 1	Called party subaddress (1)	25	2
0 1 1 1	1 0 0 0	Transit network selection	9	1
0 1 1 1	1 0 0 1	Restart indicator	5	1
0 1 1 1	1 1 0 0	Narrowband low layer compatibility (2)	20	2
0 1 1 1	1 1 0 1	Narrowband high layer compatibility (1)	7	2
0 1 1 1	1 1 1 1	Generic identifier transport (1)	33	3
1 0 0 0	0 0 0 1	Minimum acceptable traffic descriptor	20	1
1 0 0 0	0 0 1 0	Alternative ATM traffic descriptor	30	1
1 0 0 0	0 1 0 0	ABR setup parameters	36	1
1 1 1 0	1 0 0 0	Leaf initiated join call identifier	9	1
1 1 1 0	1 0 0 1	Leaf initiated join parameters	5	1
1 1 1 0	1 0 1 0	Leaf sequence number	8	1
1 1 1 0	1 0 1 1	Connection scope selection	6	1
1 1 1 0	0 1 0 0	ABR additional parameters	14	1
1 1 1 0	1 1 0 0	Extended QoS parameters	25	1

Note 1 - This information element may be repeated without the Broadband repeat indicator information element.

Note 2 - This information element may be repeated in conjunction with the Broadband repeat indicator information element.

Note 3 - The maximum length and the number of repetitions of this information element are network dependent.

Note 4 - See Section 2 (4.5.3/Q.2931, 4.5.4/Q.2931 and 5.6.6/Q.2931) for treatment of these information elements.

Coding standard for ISO/IEC standard and national standard are not supported.

The use of the information element identifier value "1111 1111" as a mechanism to extend the information element identifier code space is not supported and information elements with this identifier value will be treated as unrecognized information elements.

4.5.2/Q.2931 Extension of codesets:
Not supported.

4.5.3/Q.2931 Broadband locking shift procedures:
Recognition of Broadband locking shift information element is mandatory (all shifted information elements may be treated as unrecognized information elements; see Section 2, 5.6.6/Q.2931).

4.5.4/Q.2931 Broadband non-locking shift procedures:
Recognition of Broadband non-locking shift information element is mandatory (all shifted information elements may be treated as unrecognized information elements; see Section 2, 5.6.6/Q.2931).

4.5.5/Q.2931 ATM adaptation layer parameters:
AAL type 2 is not supported.

4.5.6/Q.2931 ATM traffic descriptor:
Octet groups 5 and 6 are marked with an * since they are optional (note that this corrects an editorial error in Q.2931).

Add the following traffic descriptor subfields (and related notes) to Figure 4-13/Q.2931, as modified by Figure 1/Q.2961.1:

8	7	6	5	4	3	2	1	Bit Positions
Traffic Management Options Identifier								17*
1	0	1	1	1	1	1	1	
Forward Frame Discard	Backward Frame Discard	0	0	0	0	Tagging Backward	Tagging Forward	17.1*
Best Effort Indicator								18* (Note B)
1	0	1	1	1	1	1	0	

Note B - The interpretation of the Forward Peak Cell Rate (CLP=0+1) parameter and the Backward Peak Cell Rate (CLP=0+1) parameter is modified by the best effort indication (see the ATM Forum Traffic Management Specification Version 4.0).

Best Effort Indication (octet 18)

The best effort indication is used in conjunction with the Broadband bearer capability to indicate the UBR service category (see Annex 9). This octet is included when best effort is requested (see the ATM Forum Traffic Management Specification, Version 4.0).

Table 2/Q.2961.1 is modified by the following addition:

- Forward Frame Discard (octet 17.1) (Note E) Bit 8 0 No Frame discard allowed in Forward direction 1 Frame discard allowed in Forward direction - Backward Frame Discard (octet 17.1) (Note E) Bit 7 0 No Frame discard allowed in Backward direction 1 Frame discard allowed in Backward direction

Note E - The frame discard capability is described in the ATM Forum Traffic Management Specification 4.0, where a frame is delimited by the ATM user-to-user indication in the PTI field of an ATM cell. Absence of octet 17.1 indicates no frame discard allowed in forward or backward direction.

The OAM traffic descriptor information element is not supported in this Specification. The ATM traffic descriptor specified by the user shall include both user traffic and the end-to-end F5 OAM traffic. The user cells and the end-to-end F5 OAM cells shall be policed together. If the use of fault management procedures is anticipated, the user shall allocate at least one cell per second in the Peak Cell Rate and one cell per second in the Sustainable Cell Rate (when applicable) to accommodate the fault management traffic. If higher end-to-end F5 OAM cell rate is expected, the user shall allocate higher Peak Cell Rate (when applicable) accordingly to accommodate it.

The network specific coding standard can be used to specify additional experimental parameters. These parameters may be used to provide a more detailed traffic characterization (e.g., Average cell rate, Average burst size, etc.) See the ATM Forum Traffic Management Specification, Version 4.0 for definitions of parameters used by this information element.

The valid combinations of the traffic descriptor subfields in the ATM traffic descriptor information element are shown in Annex 9.

4.5.7/Q.2931 Broadband bearer capability:

Modify Figure 4-14/Q.2931 and Table 4-8/Q.2931 by adding a new Bearer Class codepoint to indicate Transparent Virtual Path (VP) service and by restructuring Octet 5a to support a new field “ATM Transfer Capability”.

Note: The change to Octet 5a is backward compatible with the use of Octet 5a in Q.2931 and is in alignment with future use of this Octet in the ITU-T.

Replace Octet 5a in Figure 4-14/Q.2931 with the following:

1 ext	ATM Transfer Capability (ATC)	5a

The Note to Figure 4-14/Q.2931 is deleted. In Table 4-8/Q.2931 delete all references and coding of the Traffic Type and Timing Requirements fields.

Add the following to Table 4-8/Q.2931:

The following codepoint is added to the Bearer Class Field in Octet 5:

- Bearer Class (octet 5)
Bits 5 - 1

1 1 0 0 0 Transparent VP Service

Values used on transmission and reception (Note A, Note G)

ATM transfer capability (octet 5a)
Bits

7	6	5	4	3	2	1	
0	0	0	0	1	0	1	CBR (Note B)
0	0	0	0	1	1	1	CBR with CLR commitment on CLP=0+1 (Note H)
0	0	0	1	0	0	1	Real time VBR (Note G)
0	0	1	0	0	1	1	Real time VBR with CLR commitment on CLP=0+1 (Note I)
0	0	0	1	0	1	0	Non-real time VBR (Note C, Note D)
0	0	0	1	0	1	1	Non-real time VBR with CLR commitment on CLP=0+1 (Note J)
0	0	0	1	1	0	0	ABR

Additional values recognized on reception (Note E)

ATM Transfer Capability (octet 5a)
Bits

7	6	5	4	3	2	1	
0	0	0	0	0	0	0	Non-real time VBR
0	0	0	0	0	0	1	Real time VBR
0	0	0	0	0	1	0	Non-real time VBR
0	0	0	0	1	0	0	CBR
0	0	0	0	1	1	0	CBR
0	0	0	1	0	0	0	Non-real time VBR

Additional reserved values (Note F)

ATM Transfer Capability (octet 5a)
Bits

7	6	5	4	3	2	1	
x	x	0	0	0	0	0	reserved for backward compatibility
x	x	0	0	0	0	1	reserved for backward compatibility
x	x	0	0	0	1	0	reserved for backward compatibility
x	x	0	0	1	0	0	reserved for backward compatibility
x	x	0	0	1	0	1	reserved for backward compatibility
x	x	0	0	1	1	0	reserved for backward compatibility
x	x	0	1	0	0	0	reserved for backward compatibility
x	x	0	1	0	0	1	reserved for backward compatibility
x	x	0	1	0	1	0	reserved for backward compatibility

where:
x x = “0 1”, “1 0”, or “1 1”

All other values are reserved.

Note A: The allowed combinations of the ATC field and Bearer Class field are specified in Annex 9.

Note B: When the Bearer Class is coded BCOB-A, this octet shall only be present if the ATC is other than *CBR*.

Note C: When the Bearer Class is coded BCOB-C, this octet shall only be present if the ATC is other than *non-real time VBR*.

Note D: When the Bearer Class is coded BCOB-X or Transparent VP service, and this octet is absent the ATC is *non-real time VBR*.

Note E: In order to be backward compatible with UNI 3.0/UNI 3.1 Specification, these codepoints must be

recognized in combination with the Bearer Class field coding of "BCOB-X". A UNI 4.0 compliant system will not include these values in a transmitted SETUP message.

Note F: These values are reserved to promote backward compatibility with UNI 3.0/UNI 3.1 (i.e. the two bits marked x x are spare bits in UNI 3.0/UNI 3.1 and would accordingly be ignored by such equipment) and will not be used for the indication of an ATM transfer capability.

Note G: The ITU-T uses the term Statistical Bit Rate (SBR) which is equivalent to VBR and the ITU-T uses the term Deterministic Bit Rate (DBR) which is equivalent to CBR. When the ITU-T uses SBR without timing this is equivalent to Non-real time VBR and when the ITU-T uses SBR with timing this is equivalent to Real time VBR (see section 1.2 in the ATM Forum Traffic Management Specification, Version 4.0).

Note H: This ATC differs from the ATC for *CBR* in that for this ATC the CLR objective applies to the aggregate CLP=0+1 stream whereas for the *CBR* ATC the CLR objective may only apply to the CLP=0 stream (see the conformance definition in the ATM Forum Traffic Management Specification, Version 4.0). This ATC is not supported by UNI 3.1.

Note I: This ATC differs from the ATC for *Real time VBR* in that for this ATC the CLR objective applies to the aggregate CLP=0+1 stream whereas for the *Real time VBR* ATC the CLR objective may only apply to the CLP=0 stream (see the conformance definition in the ATM Forum Traffic Management Specification, Version 4.0). This ATC is not supported by UNI 3.1.

Note J: This ATC differs from the ATC for *Non-real time VBR* in that for this ATC the CLR objective applies to the aggregate CLP=0+1 stream whereas for the *Non-real time VBR* ATC the CLR objective may only apply to the CLP=0 stream (see the conformance definition in the ATM Forum Traffic Management Specification, Version 4.0). This ATC is not supported by UNI 3.1.

4.5.8/Q.2931 Broadband high layer information:

Add the following after the first paragraph:

See the ATM Forum Native ATM Services: Semantic Description, Version 1.0 Specification for the use of this information element to specify the proper entity within the called user ATM device that receives the notification of the incoming call.

4.5.9/Q.2931 Broadband low layer information:

Add the following after the first paragraph:

See the ATM Forum Native ATM Services: Semantic Description, Version 1.0 Specification for the use of this information element to specify the proper entity within the called user ATM device that receives the notification of the incoming call.

Add the following octets to B-LLI contents:

User information layer 1 protocol (octet group 5) is not supported by the user equipment.
In Figure 4-16/Q.2931, replace the 8 octets 7.1-7.8 by the following:

0/1 ext	Reserved					Terminal Type		7a* (Note A)
1	0	Forward Multiplexing				Backward Multiplexing		7b*
ext	Spare	Capability				Capability		(Note A)
0 ext	ISO/IEC TR 9577 Initial Protocol Identifier (IPI) (bits 8-2)							7a* (Note 5)
1 ext	IPI (bit1)	0	0	0	0	0	0	7b* (Note 5)
		Spare						
1 ext	0 SNAP ID	0	0	0	0	0	0	8* (Note B)
			Spare					
OUI Octet 1								8.1*

OUI Octet 2	8.2*
OUI Octet 3	8.3*
PID Octet 1	8.4*
PID Octet 2	8.5*

Note A- This octet may be present only if octet 7 indicates ITU-T Rec. H.310.
Note B - This octet group shall be present only if octet 7 indicates ISO/IEC TR 9577 and octets 7a and 7b indicate IEEE 802.1 SNAP.

Add the following paragraph to the end of section 4.5.9/Q.2931:
Terminal Type (bits 4-1 Octet 7a) (Note 1)

4 3 2 1	Bits
0 0 0 1	Receive only
0 0 1 0	Send only
0 0 1 1	Receive and send

Forward Multiplexing Capability (bits 6-4 Octet 7b) (Note 1)

6 5 4	Bits
0 0 0	No multiplexing
0 0 1	Transport stream (TS)
0 1 0	Transport stream with forward error correction
0 1 1	Program stream (PS)
1 0 0	Program stream with forward error correction
1 0 1	ITU-T Rec. H.221

Backward Multiplexing Capability (bits 3-1 Octet 7b) (Note 1)

3 2 1	Bits
0 0 0	No multiplexing
0 0 1	Transport stream (TS)
0 1 0	Transport stream with forward error correction
0 1 1	Program stream (PS)
1 0 0	Program stream with forward error correction
1 0 1	ITU-T Rec. H.221

Note 1 - The allowable combination of codepoints for the Multiplexing capability and Terminal type fields may be restricted. These restrictions are provided within the terminal protocol specifications.

ISO/IEC TR 9577 Network Layer Protocol Identifier (NLPID) and IEEE 802.1 SNAP identifier (octets 7a-7b, 8-8.5):

Bits 1-7 of octet 7a and bit 8 of octet 7b indicate the ISO/IEC TR 9577 Initial Protocol Identifier (IPI) for the protocol to be carried in the user plane. If these 8 bits in octets 7a and 7b are coded as '10000000', indicating an IEEE 802.1 SNAP identifier (see Annex D of ISO/IEC TR 9577), Octets 8.1-8.5 will contain a 40 bit SNAP identifier, consisting of a 24-bit organization unique identifier (OUI) and a 16-bit protocol identifier (PID). The NLPID coding shall only be used if there is no ITU-T standardized coding for the layer 3 protocol being used, and an ISO/IEC TR 9577 or SNAP coding applies for that protocol. The SNAP coding shall be used for a layer 3 protocol only if ISO has not assigned an NLPID for the layer 3 protocol. The SNAP coding can also be used to indicate that bridged LAN frames are to be carried in the user plane.

Octet groups 5 (layer 1 id.), 6 (layer 2 id.), and 7 (layer 3 id.) of the Broadband low layer information element are not position independent, but, if present at all, shall be sent in the order as specified in Figure 4-16/Q.2931.

4.5.10/Q.2931 Call state:
Call states U2, N2, U25, and N25 are not supported.

4.5.11/Q.2931 Called party number:
The maximum length of this information element is 25 octets.
Replace all occurrences of "NSAP address" and "NSAP addressing" with "ATM endsystem address".
Replace

0 0 1 0 NSAP Addressing (ISO/IEC 8348) (Note 8, Note 9)

in Table 4-12/Q.2931with

0 0 1 0 ATM endsystem address (Note 8, Note 9)

Only two combinations of Type of number and Addressing/numbering plan identification are supported:

Unknown/ATM endsystem address
International number/ISDN numbering plan (E.164)

Replace Note 8 of Table 4-12/Q.2931 with the following text:

If the use of ATM endsystem address is indicated in the addressing/numbering plan identification, the address is coded as described in X.213 | ISO/IEC 8348 Addendum 2, using the "preferred binary encoding".

4.5.12/Q.2931 Called party subaddress:
Replace

0 0 1 User specified ATM endsystem address

in Table 4-13/Q.2931with

0 0 1 ATM endsystem address

Replace the paragraph beginning with 'For the "User specified ATM Endsystem Address" ' in Table 4-13/Q.2931 with:

For the "ATM endsystem address", this field is formatted as defined in Section 3.1 of this Specification. The encoding is made according to the "preferred binary encoding" as defined in X.213 | ISO/IEC 8348.

Replace Note 2 with the following text:

Guidelines on the use of subaddresses are described in Annex 1.

Delete Note 4.

4.5.13/Q.2931 Calling party number:
The maximum length of this information element is 26 octets.
Replace all occurrences of "NSAP address" and "NSAP addressing" with "ATM endsystem address".
Replace

0 0 1 0 NSAP addressing (ISO/IEC 8348) (Note 8, Note 9)

in Table 4-14/Q.2931with

0 0 1 0 ATM endsystem address (Note 8, Note 9)

Only two combinations of Type of number and Addressing/numbering plan identification are supported:

Unknown/ATM endsystem address
International number/ISDN number plan (E.164)

Replace Note 8 of Table 4-14/Q.2931 with the following text:

If the use of ATM endsystem address is indicated in the addressing/numbering plan identification, the address is coded as described in X.213 | ISO/IEC 8348 Addendum 2, using the "preferred binary encoding".

4.5.14/Q.2931 Calling party subaddress:
Replace

0 0 1 User specified ATM endsystem address

in Table 4-15/Q.2931with

0 0 1 ATM endsystem address

Replace the paragraph beginning with 'For the "User specified ATM endsystem address" ' in Table 4-15/Q.2931 with:

For the "ATM endsystem address", this field is formatted as defined in Section 3.1 of this Specification. The encoding is made according to the "preferred binary encoding" as defined in X.213 | ISO/IEC 8348.

Replace Note 2 with the following text:

Guidelines on the use of subaddresses are described in Annex 1.

Delete Note 4.

4.5.15/Q.2931 Cause:
Network-specific cause value 23 is added as follows:

0 0 1 0 1 1 1	23	User rejects all calls with calling line identification restriction (CLIR) (Note A)	-

Note A - 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.

4.5.16/Q.2931 Connection identifier:
VP associated signalling codepoint is not supported.

At the end of first paragraph, add the following sentence:
See the procedures and the messages sections for further details.

The following codepoint is added to the preferred/exclusive field of Octet 5 in table 4-16/Q.2931.

Bits
3 2 1
1 0 0 Exclusive VPCI; no VCI (used for switched VPCs)

Note 1 of Figure 4-22/Q.2931 is replaced with:

Note 1 - If the "Pref./Ex"- Field indicates "any VCI" or "no VCI", the VCI field shall be ignored.

Note for clarification:

When a VPCI/VCI value is assigned, the allocation is in both directions. The VPCI/VCI value cannot be used for another connection until the call is cleared.

4.5.17/Q.2931 End-to-end transit delay parameter:
See section 9.1.2.1 for changes.

4.5.18/Q.2931 Quality of Service parameter:
QoS classes 0-4 are supported - replace the tables for octets 5 and 6 with the following:
QoS Class Forward (octet 5)

Bits 8 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0 0	QoS class 0 - Unspecified QoS class (Notes 1,4)
0 0 0 0 0 0 0 1	QoS class 1 (Note 2)
0 0 0 0 0 0 1 0	QoS class 2 (Note 2)
0 0 0 0 0 0 1 1	QoS class 3 (Note 2)
0 0 0 0 0 1 0 0	QoS class 4 (Note 2)
1 1 1 1 1 1 1 1	Reserved by ITU-T for future indication of parameterized QoS (Notes 1, 3)

QoS Class Backward (octet 6)

Bits 8 7 6 5 4 3 2 1	Meaning
0 0 0 0 0 0 0 0	QoS class 0 - Unspecified QoS class (Notes 1,4)
0 0 0 0 0 0 0 1	QoS class 1 (Note 2)
0 0 0 0 0 0 1 0	QoS class 2 (Note 2)
0 0 0 0 0 0 1 1	QoS class 3 (Note 2)
0 0 0 0 0 1 0 0	QoS class 4 (Note 2)
1 1 1 1 1 1 1 1	Reserved by ITU-T for future indication of parameterized QoS (Notes 1, 3)

Note 1 - This codepoint is taken from the coding standard value 00. The meaning of this code point applies only for coding standard 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 reserves the right to assign all values for coding standard value 11. However, these values will be assigned in ascending sequence.

Note 3 - This codepoint 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.

For usage of the QoS Classes, see Annex B.3 of the ATM Forum Traffic Management Specification, Version 4.0.

4.5.20/Q.2931 Restart indicator:
The description of the class codepoint 000 should be changed to:
Indicated switched virtual channel (Note 1)

The description of the class codepoint 001 should be changed to:
Indicated switched virtual path or all switched virtual channels in a virtual path which are controlled by the signalling virtual channel on which the RESTART message is sent (Note 2)

The description of the class codepoint "010" should be changed to:
All switched virtual channels and switched virtual paths controlled by the layer 3 entity which sends the RESTART message.

Note 1 should be changed to:
The Connection identifier information element must be included and indicates the switched virtual channel to be restarted.

Line 1 of note 2 should be changed to:
The Connection identifier information element must be included and indicates the switched virtual path to be restarted or the virtual path in which all switched virtual channels are to be restarted.

Line 2 of note 3 should be modified to
All switched virtual channels and paths controlled by the layer 3 entity are to be restarted.

4.5.22/Q.2931 Transit network selection:
Only one combination of Type of Network Identification and Network Identification Plan is supported:
National network identification/Carrier identification code

The maximum length of this information element is 9 octets.

4.5.23/Q.2931 Notification indicator:
When received in a message the user may either ignore this indication or pass it on to the application using the signalling layer.

4.5.24/Q.2931 OAM traffic descriptor:
Not supported.

5.0/Q.2931 B-ISDN Call/connection control procedures:

The signalling virtual channel uses VPI=0, VCI=5 as a default. See Annexes 2 and 8 for examples of the use of other VPI/VCI values for the signalling channel.

The procedures in this Specification allow for optional support of Switched Virtual Paths (SVPs). Except where noted, the references to Switched Virtual Channels (SVCs) apply equally to the SVPs.

Note: The primitives to/from Q.2931 are described in Annex A/Q.2931.

5.1.1/Q.2931 Call/Connection request:
Broadband sending complete is optionally included by the user.
Retransmission of the SETUP message is optional.
Delete the second paragraph.

Add the following sentence:

The user shall include the Called party number information element.

5.1.2/Q.2931 Connection identifier (VPCI/VCI) allocation/selection - Origination:
Associated signalling is not supported.

5.1.2.1/Q.2931 Associated signalling:
Associated signalling is not supported.

5.1.2.2/Q.2931 Non-associated signalling:
When the establishment of a Switched VP (SVP) is requested (i.e. the Bearer Class field of the Bearer capability information element in the SETUP message indicates "Transparent VP Service"), the user shall indicate one of the following:

c) No indication is included (i.e., the Connection identifier information element is not included in the SETUP message), or
d) Exclusive VPCI; no VCI

In case (c), the network selects any available VPCI.
In case (d), if the indicated VPCI is available, the network selects it for the call. The selected VPCI is indicated in the Connection identifier information element in the first message returned by the network in response to the SETUP message (e.g., CALL PROCEEDING). The VP associated signalling field is coded as "explicit indication of VPCI". The preferred/exclusive field is coded as "exclusive VPCI; no VCI".

In case (c), if the network is not able to allocate a VPCI, a RELEASE COMPLETE message with Cause *#45 "No VPCI/VCI available*" is sent by the network.

In case (d), if the indicated VPCI is not available, a RELEASE COMPLETE message with Cause #35 "*Requested VPCI/VCI not available*" is sent by the network.

5.1.2.3/Q.2931 Use of VPCI:
The default is that the VPCI values are numerically equal to the VPI value.

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

5.1.3/Q.2931 QoS and traffic parameters selection procedures:
Replace this section with the following text:

The user shall indicate the requested ATM traffic descriptor in the ATM traffic descriptor information element. The user may indicate a requested QoS class in the QoS parameter information element (see Section 9).

The network determines the ATM service category for the call from the Bearer Class and ATM Transfer Capability fields in the Broadband bearer capability information element and from the Best Effort Indicator in the ATM traffic descriptor information element, as specified in Annex 9. If the network is not able to provide the requested service category, the network shall reject the call, returning a RELEASE or RELEASE COMPLETE message with one of the following causes:

#57 Bearer capability not authorized;
#58 Bearer capability not presently available;
#65 Bearer service not implemented.

If the network detects that the Broadband bearer capability and ATM traffic descriptor information elements contain a non-supported set of parameters, the network shall return a RELEASE or RELEASE COMPLETE message with Cause #73, "*Unsupported combination of traffic parameters"*.

If the network is not able to provide the requested ATM traffic descriptor, the network shall reject the call, returning a RELEASE or RELEASE COMPLETE message with Cause #37, "*User cell rate unavailable*".

If the network is not able to provide the requested QoS parameters (see Section 9.2), the network shall reject the call, returning a RELEASE or RELEASE COMPLETE message with Cause #49*, "Quality of service unavailable*".

If the network is able to provide the requested traffic and QoS parameters, the network shall progress the call to the called user.

5.1.5/Q.2931 Call/connection proceeding:
Sending a CALL PROCEEDING message is optional (consistent with Annex H/Q.2931).

5.2.2/Q.2931 Address and Compatibility Check:
The Address and Compatibility Check procedures are not part of this Specification and are left as an implementation option.

5.2.2.2.1/Q.2931 General principles

Add the following note:

Note: The Broadband category 1 compatibility information is applicable for SVCs and SVPs. The OAM traffic descriptor is not supported, so the called user need not check for this information element. The Broadband category 2 compatibility information is applicable to SVCs. Currently, no equivalent Broadband category 2 compatibility information is defined for SVPs.

5.2.3/Q.2931 Connection identifier (VPCI/VCI) allocation/selection - Destination:
Associated signalling is not supported.

5.2.3.1/Q.2931 Associated Signalling:
Associated signalling is not supported.

5.2.3.2/Q.2931 Non-associated Signalling:
When the establishment of a Switched VP (SVP) is requested (i.e. the Bearer Class field of the Bearer capability information element in the SETUP message indicates "Transparent VP Service"), the network shall indicate one of the following:

c) No indication is included (i.e., the Connection identifier information element is not included in the SETUP message), or
d) Exclusive VPCI; no VCI

In case (c), the user selects any available VPCI.

In case (d), if the indicated VPCI is available, the user selects it for the call. The selected VPCI is indicated in the Connection identifier information element in the first message returned by the user in response to the SETUP message (e.g., CALL PROCEEDING). The VP associated signalling field is coded as "explicit indication of VPCI". The preferred/exclusive field is coded as "exclusive VPCI; no VCI". If the Connection identifier information element is not present in the first response message, the Connection identifier in the SETUP message shall be assumed.

In case (c), if the user is not able to allocate a VPCI, a RELEASE COMPLETE message with Cause #45 *"No VPCI/VCI available*" is sent by the user.

In case (d), if the indicated VPCI is not available, a RELEASE COMPLETE message with Cause #35 "*Requested VPCI/VCI not available*" is sent by the user.

5.2.4/Q.2931 QoS and traffic parameter selection procedures:
Replace this section with the following text:

The user determines the ATM service category for the call from the Bearer Class and ATM Transfer Capability fields in the Broadband bearer capability information element and from the Best Effort Indicator in the ATM traffic descriptor information element, as specified in Annex 9. If the user is not able to provide the requested service category, the user shall reject the call, returning a RELEASE or RELEASE COMPLETE message with one of the following causes:

#57 Bearer capability not authorized;
#58 Bearer capability not presently available;
#65 Bearer service not implemented.

If the user detects that the Broadband bearer capability and ATM traffic descriptor information elements contain a non-supported set of parameters, the user shall return a RELEASE or RELEASE COMPLETE message with Cause #73, "*Unsupported combination of traffic parameters"*.

If the user is not able to provide the requested ATM traffic descriptor, the user shall reject the call, returning a RELEASE or RELEASE COMPLETE message with Cause #37, "*User cell rate unavailable*".

If the user is not able to provide the requested QoS parameters (see Section 9.2), the user shall reject the call, returning a RELEASE or RELEASE COMPLETE message with Cause #49*, "Quality of service unavailable*".

5.2.5.1/Q.2931 Response to en-bloc SETUP or completion of overlap receiving:
Add the following text after Section 5.2.5.1/Q.2931:

When the user receives a SETUP message without the calling party number and the user rejects all incoming calls that do not provide the calling party 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 Section 5.2.5.3/Q.2931.

When the user is not an ATM endpoint and the user is able to provide the requested ATM traffic descriptor and the QoS, the user shall progress the call.

5.2.5.4/Q.2931 Call failure:
Retransmission of SETUP is optional.

5.2.7/Q.2931 Active Connection:
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.

Note - In order to avoid the possibility of losing received data on the connection before the CONNECT ACKNOWLEDGE has been received and processed, the called user should be prepared to receive data on a new connection at any time after returning the CONNECT message to the network.

5.5/Q.2931 Restart procedure:
Line 1 of paragraph 2 should be changed to:

The restart procedure is used to return a switched virtual channel, all switched virtual channel in a virtual path, a switched virtual path, or all switched virtual channels and switched virtual paths controlled by the signalling virtual channel to the idle condition.

Line 3 of note should be changed to:

In the case where the same switched virtual channel(s) or switched virtual path(s) are specified, they shall not be considered free for reuse until all relevant restart procedures are completed.

5.5.1/Q.2931 Sending RESTART:
5.5.1.1/Q.2931 Normal Procedure
Paragraph 1 should be changed to:

A RESTART message is sent by the network or user equipment in order to return switched virtual channels or switched virtual paths to the idle condition. The Restart indicator information element shall be present in the RESTART message to indicate whether an “indicated switched virtual channel”, “indicated switched virtual path or all switched virtual channels in a virtual path” or “all switched virtual channels and switched virtual paths controlled by the layer 3 entity” are to be restarted. If the Restart indicator information element is coded as “indicated switched virtual channel” or “indicated switched virtual path or all switched virtual channels in a virtual path” then the Connection identifier information element shall be present to indicate which switched virtual channel or switched virtual path is to be returned to the idle condition. If the Restart indicator information element is coded as “all switched virtual channels and switched virtual paths controlled by the later 3 entity”, then the Connection identifier information element shall not be included.

Line 3 & 4 of paragraph 2 should be changed to:

Receipt of a RESTART ACKNOWLEDGE message stops timer T316 and indicates that the switched virtual channel(s)/switched virtual path(s) and associated resources (e.g., call reference value(s)) can be freed for reuse. The Null state will be entered after the switched virtual channel/switched virtual path and call reference value are released.

Paragraph 4 should be changed to:

Calls associated with restarted switched virtual channel(s)/switched virtual path(s) shall be cleared towards the remote parties using Cause #41, "*Temporary failure*".

5.5.1.2/Q.2931 Exceptional Procedures
Line 2 of paragraph 1 should be changed to:

While timer T316 is running, the switched virtual channel(s)/switched virtual path(s) being restarted shall not be used to support new calls requested using the call setup procedures.

Line 6 of paragraph 1 should be changed to:

The switched virtual channel(s)/switched virtual path(s) is considered to be in an out-of-service condition until maintenance action has been taken.

Paragraph 2 should be changed to:

If a RESTART ACKNOWLEDGE message is received indicating a different set of switched virtual channel(s)/switched virtual path(s) from the set indicated in the RESTART message, the RESTART ACKNOWLEDGE message shall be discarded.

5.5.2/Q.2931 Receipt of RESTART:
5.5.2.1/Q.2931 Normal Procedures
Line 1 of paragraph 1 should be changed to:

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 switched virtual channel(s)/switched virtual path(s) to the idle condition and release all call references associated with it.

Paragraph 2 should be changed to:

Calls associated with restarted switched virtual channel(s)/switched virtual path(s) shall be cleared towards the remote parties using cause #41, "*Temporary failure*".

Paragraph 3 should be changed to:

Even if all the specified switched virtual channel(s)/switched virtual path(s) are in the idle condition, or already in the process of restart to the idle condition, receiving entity shall transmit a RESTART ACKNOWLEDGE message to the originator upon receiving a RESTART message.

Paragraph 4 should be changed to:

If the Restart indicator information element is coded as "all switched virtual channels and switched virtual paths 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.

In paragraph 5, replace all occurrences of "all user plane virtual channels in the indicated VPC controlled via the signalling virtual channel in which the RESTART message is sent" by "indicated switched virtual path or all switched virtual channels in a virtual path".

In paragraph 7, replace all occurrences of "switched virtual channels" by "switched virtual channels and switched virtual paths".

5.5.2.2/Q.2931 Exceptional procedures
Paragraph 2, 3 & 4 should be changed to:

If the Restart indicator information element is coded as "all switched virtual channels and switched virtual paths 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 subclause 5.6.8.3 of Q.2931.

If the Restart indicator information element is coded as "indicated switched virtual channel" or "indicated switched virtual path or all switched virtual channels in a virtual path" and the Connection identifier information element is not included, then the procedures in subclause 5.6.7.1 of Q.2931 shall be followed.

If the Restart indicator information element is coded as "indicated switched virtual channel" or "indicated switched virtual path or all switched virtual channels in a virtual path" and the Connection identifier information element contains an unrecognized VPCI, then the procedures in subclause 5.6.7.2 of Q.2931 shall be followed.

5.6.6/Q.2931 General information element errors:
When a Broadband-locking shift information element occurs in a message, the Broadband-locking shift information element and all subsequent information elements may be treated as unrecognized information elements. However, when a Cause information element is generated to report errors of these shifted information elements the diagnostic field of the Cause information element (if present) should only include the information element identifier for the Broadband-locking shift information element and of any non-shifted information element in error.

When a Broadband-non-locking shift information element occurs in a message, the Broadband-non-locking shift information element and the subsequent information element may be treated as unrecognized information elements. However, when a Cause information element is generated to report errors of these shifted information elements the diagnostic field of the Cause information element (if present) should only include the information element identifier for the Broadband-non-locking shift information element and of any non-shifted information element in error.

6.4.5/Q.2931 Cause information:
The DSS2 network-specific Cause #23 "*User rejects all calls with calling line identification restriction (CLIR)*" shall be mapped to the DSS1 Cause #31 "*Normal, unspecified*".

6.5/Q.2931 Overlap sending and receiving:
Not supported.

6.7.1/Q.2931 Tones and announcements:
When the network offers voice/audio services, tones and announcements shall be provided as specified in this section.

7.1/Q.2931 Timers in the network side:
Retransmission of SETUP is optional.

7.2/Q.2931 Timers in the user side: Retransmission of SETUP is optional.

Annex B/Q.2931 Compatibility checking:
The Address and Compatibility Check procedures are not part of this Specification and are left as an implementation option.

Annex C.1/Q.2931 General:
The following text is added to the end of the section as follows:

The procedures of this Annex are required in support of some applications (e.g., multiprotocol interconnection). Endpoints should assume that the B-LLI negotiation procedures will be offered by most networks. Therefore it is strongly recommended that networks support all of the procedures of this Annex. At a minimum, all networks shall carry the B-LLI information element in the SETUP message.

Annex D/Q.2931 Transit network selection:
Only one transit network selection information element is supported.

Annex D.2/Q.2931 Selection supported:
Specification of more than one transit network is not supported.

Annex E.2/Q.2931 Mapping functions for the direction DSS 2 → DSS 1: and
Annex E.3/Q.2931 Mapping functions for the direction DSS 1 → DSS 2:

The DSS2 N-BC and DSS1 BC information elements shall also support n x 64kbit/s service. The OAM traffic descriptor information element is not supported.

Annex E.4/Q.2931 Codepoint values of information elements to support 64 Kbits/s based circuit-mode ISDN services in B-ISDN:
The QoS class forward and QoS class backward should both be coded to class 1 or 0. Class 1 should be used when all network or destination equipment is ATM Forum compatible. Class 0 should be used when ITU compatible equipment is used within the network or at the destination or when the type of equipment is unknown. For DS1/E1 circuit emulation services, the forward and backward peak cell rate should be coded as described in the ATM Forum Circuit Emulation Service Interoperability Specification Version 1.0.

Annex F.2/Q.2931 ATM Adaptation Layer Parameter Indication in the SETUP Message:
User defined AAL indication in the SETUP message added as follows:

d) for User defined AAL:
- User defined AAL information (four octets).

Annex F.3/Q.2931 ATM Adaptation Layer Indication in the CONNECT Message:
User defined AAL indication in the CONNECT message added after item c) as follows:

When the called user has received an ATM adaptation layer parameter information element in a SETUP message and the AAL type is User defined AAL, the ATM adaptation layer parameter information may be included in the CONNECT message.

Annex I/Q.2931:
The OAM traffic descriptor information element is not supported; its absence does not in itself mean that no OAM flow will be used within the call. If the network or user receives this information element, it shall treat it as an unrecognized information element according to the procedures defined in 5.6/Q.2931.

Annex K/Q.2931Handling of the End-to-end transit delay information element:
This Annex is superseded by Section 9.2.

Appendix I/Q.2931 Guidelines for the use of instruction indicator:
Add following to Table I-1/Appendix I.

Message	Flag	Origin	Action Indicator
LEAF SETUP FAILURE	not used	N&U	Not significant
LEAF SETUP REQUEST	not used	N&U	Not significant

Add following to Table I-2/Appendix I.

Information Element	Flag	Origin	Action Indicator
Generic identifier transport	used	N&U	Clear call
Connection scope selection	not used	N&U	Not significant
LIJ call identifier	used	N&U	Clear Call (U) Discard information element and proceed (N)
LIJ parameters	used	N&U	Clear Call (U) Discard information element and proceed (N)
Leaf sequence number	used	N&U	Discard information element and proceed

Alternative ATM traffic descriptor	used	N&U	Discard, proceed and report status
Minimum acceptable ATM traffic descriptor	used	N&U	Discard, proceed and report status
ABR setup parameters	not used	N&U	Not significant
ABR additional parameters	used	N&U	Discard information element and proceed
Extended QoS parameters	used	N&U	Discard information element and proceed

Appendix III/Q.2931 Signalling for Semi-Permanent Connection Control:
Not supported.

2.1 Additional Information Elements

This section describes information elements defined by this Specification which are not defined in ITU-T Recommendations.

2.1.1 Generic Identifier Transport Information Element

The Generic identifier transport information element is used to carry an identifier between two users. The network may process and examine the contents of this information element. Depending on the identifier type, its purpose and structure are defined either in this Specification or in other specifications or standards. The number of instances of this information element in a message is limited to three.

Bits 8	7	6	5	4	3	2	1	Octets
Generic identifier transport information element								
0	1	1	1	1	1	1	1	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action Ind.			2
Length of Generic identifier transport information element contents								3
Length of Generic identifier transport information contents (continued)								4
Identifier Related Standard/Applications								5
Identifier Type								6 (Note 1)
Identifier Length								6.1
Identifier Value								6.2 to 6.m
Identifier Type								N (Note)
Identifier Length								N.1 (Note)
Identifier Value								N.2 (Note) to N.n (Note)

Note - Octet group 6 can be repeated to form new octet groups numbered sequentially octet group 7, 8, ..., N.

Figure 2-1 Generic identifier transport information element

Identifier related standard/application (octet 5) (Note 1)

Bits 7 6 5 4 3 2 1	
0 0 0 0 0 0 1	Digital Storage Media Command & Control (DSM-CC) resourceId (ISO/IEC 13818-6) (Note 2)
0 0 0 0 0 1 0	Recommendation H.245 (Note 3)

All other values are reserved.

Note 1 - Each application requiring a different set/structure of identifiers (coded in octet group 6 and possibly in subsequent octet groups) should use a different value of octet 5.

Note 2 - When the Identifier related standard/application field is coded as DSM-CC (ISO/IEC 13818-6), octet group 6 specifies DSM-CC sessionId part of the resourceId and octet group 7 specifies the resourceNum. The encoding format is defined in ISO/IEC 13818-6.

Note 3 - When the Identifier related standard/application field is coded as Recommendation H.245, a H.245 Resource/Correlation number is coded in octet group 6. The encoding format is specified in ISO/IEC 13818-6.

Identifier type, length and content (octet group 6 and possibly subsequent octet groups):

Octet group 6 is used to define an identifier or one part of an identifier composed of multiple parts. Octet group 6 may be repeated. When an identifier is structured and consists of more than one part, an octet group starting with octet group 6 and successively numbered octet group 7, 8, etc. represents one of the identifier parts. When an identifier consists of only one part, this part is coded integrally in octet group 6.

Identifier type (Octet 6, 7, ..., N) (Note 1)
Bits
7 6 5 4 3 2 1
0 0 0 0 0 0 1 Session (Note 2)
0 0 0 0 0 1 0 Resource (Note 3)
All other values are reserved.

Note 1 - The value coded in the Identifier type field is independent of the Identifier related standard/application field (octet 5). For example, when the Identifier type field is coded as Session '00000001', it refers to a Session identifier regardless of the coding of octet 5. However, the format of the Identifier value is dependent on the value specified in octet 5.

Note 2 - When the identifier type is coded as Session, a Session identifier shall be coded in the Identifier value field of the octet group. The maximum length is 20 octets.

Note 3 - When the identifier type is coded as Resource, a Resource identifier shall be coded in the Identifier value field of the octet group. The maximum length is 4 octets.

Identifier length:

A binary number indicating the length in octets of the identifier coded in the subsequent octets of the octet group.

Identifier value:

Value of an identifier coded according to the Recommendation or the Standard identified in octet 5.

Coding of DSM-CC resourceId:

1. When octet 5 is coded as DSM-CC (ISO/IEC 13818-6), octet groups 6 and 7 follow. They include the sessionId value of DSM-CC in octet group 6 and the resourceNum value in octet group 7.

Identifier Related Standard/Applications								5
0	0	0	0	0	0	0	1	
Session								6
0	0	0	0	0	0	0	1	
Identifier Length								6.1
Identifier Value								6.2 to 6.m

Resource								7
0	0	0	0	0	0	1	0	
Identifier Length								71
Identifier Value								7.2 to 7.n

Figure 2-1(a) Coding of the Generic identifier transport information element for DSM-CC resourceId

2. When octet 5 is coded as H.245, octet groups 6 and 7 follow. They include the Session ID value in octet group 6 and the resource ID value in octet group 7.

Identifier Related Standard/Applications								5
0	0	0	0	0	0	1	0	
Session								6
0	0	0	0	0	0	0	1	
Identifier Length								6.1
Identifier Value								6.2 to 6.m
Resource								7
0	0	0	0	0	0	1	0	
Identifier Length								71
Identifier Value								7.2 to 7.n

Figure 2-1(b) Coding of the Generic identifier transport information element for H.245 correlation ID

2.2 Additional Procedures

This section describes procedures applicable to the capabilities listed in this Specification in addition to those described in the ITU-T Specifications.

2.2.1 Frame Discard

The procedures in this section address how to handle a SETUP message with an indication of frame discard.

2.2.1.1 Originating Procedures

Upon receipt of a SETUP message with the forward frame discard bit coded to *frame discard allowed*, the network shall, if possible, pass this indication towards the called party and the network may perform frame discard (see the ATM Forum Traffic Management Specification Version 4.0) for the forward direction of the connection. If the indication of *frame discard allowed* can not be transported towards the

destination user (e.g., because of interworking with UNI 3.1 signalling protocol) the call shall progress without the indication. When the forward frame discard bit is absent or is coded to *no frame discard allowed*, the network shall pass this indication towards the called party and the network shall not perform frame discard for the forward direction of the connection.

Upon receipt of a SETUP message with the backward frame discard bit coded to *frame discard allowed*, the network shall, if possible, pass this indication towards the called party. If the indication of *frame discard allowed* can not be transported towards the destination user (e.g., because of interworking with UNI 3.1 signalling protocol) the call shall progress without the indication.

Upon receipt of an answer indication with an indication of backward *frame discard allowed*, the network shall pass this indication towards the calling party in a CONNECT message and the network may perform frame discard for the backward direction of the connection.

Upon receipt of an answer indication with either no backward frame discard indication or with an indication of *no backward frame discard allowed*, the network shall not perform frame discard for the backward direction of the connection and shall pass this indication towards the calling party in a CONNECT message by either not including the frame discard bit in the message or by coding the backward frame discard bit to *no frame discard allowed* in the message.

When the user (if not the endsystem) receives a CONNECT message with a backward frame discard indication coded to *frame discard allowed* the user shall (if possible) pass this indication towards the calling party and the user may perform frame discard for the backward direction of the connection. When the user (if not the endsystem) receives a CONNECT message with either no backward frame discard indication or with an indication of *no backward frame discard allowed* the user shall not perform frame discard for the backward direction of the connection and shall pass this indication towards the calling party.

2.2.1.2 Terminating Procedures

Upon receipt of a SETUP message with the forward frame discard bit coded to *frame discard allowed*, the user (if not the endsystem) shall, if possible, pass this indication towards the called party and the user may perform frame discard for the forward direction of the connection. When the forward frame discard bit is absent or is coded to *no frame discard allowed*, the user (if not the endsystem) shall, if possible, pass this indication towards the called party and the user shall not perform frame discard for the forward direction of the connection.

Upon receipt of a SETUP message with the backward frame discard bit coded to *frame discard allowed*, the user (if not the endsystem) shall, if possible, pass this indication towards the called party. If the indication of *frame discard allowed* can not be transported towards the destination user (e.g., because of interworking with UNI 3.1 signalling protocol) the call shall progress without the indication.
The endsystem shall interpret the receipt of a SETUP message with the backward frame discard bit coded to *frame discard allowed*, as a request by the calling party that the called endsystem request backward frame discard in the CONNECT message.

When the called user wishes to request frame discard for the backward direction, the user shall include a backward frame discard indication coded to *frame discard allowed* in the CONNECT message.
When the network receives a CONNECT message with a backward frame discard indication coded to *frame discard allowed* the network shall (if possible) pass this indication towards the calling party and the network may perform frame discard for the backward direction of the connection. When the network receives a CONNECT message with either no backward frame discard indication or with an indication of

no backward frame discard allowed the network shall not perform frame discard for the backward direction of the connection and shall pass this indication towards the calling party.

2.2.2 Procedures for Generic Identifier Transport

When the network receives a message with a Generic identifier transport information element, the Generic identifier transport information element shall be transported without modification by the network towards the called party.

3.0 Addressing

An ATM address may be either a native E.164 number up to 15 digits in length, or a 20-octet ATM Endsystem Address based on the ISO NSAP encoding format. Use of the standard ATM addresses for private and public networks is specified in this section. Procedures to register addresses across a UNI and the related MIB definition are included in the ATM Forum ILMI Specification, Version 4.0.

3.1 Private Networks

For the purposes of switched virtual connections established by the procedures of this Specification, an ATM endsystem address identifies one or more ATM endpoints. The format of an ATM Address for endpoints in private ATM networks is modeled after the format of an OSI Network Service Access Point, as specified in ISO 8348 and ITU-T X.213; specifically, using the same structure, abstract semantics, abstract syntax, and preferred binary encoding. The structure of the low-order part (ESI and SEL) of the Domain Specific Part (DSP) is as specified in ISO 10589. Three Initial Domain Identifier (IDI) formats are specified in this Specification. The structure of the ATM address with the IDI in each of these formats is illustrated in Figures 3-1a, 3-1b, and 3-1c.

In ATM networks there are two types of ATM addresses: individual and group; an ATM individual address identifies a single ATM end system whereas an ATM group address identifies one or more ATM end systems. The definition and guidelines for usage of the group address can be found in Annex 5.

Note 1 - While the ISO NSAP encoding structure is used, in the context of the OSI Network Layer addressing, an ATM endsystem address is a subnetwork point of attachment. When coding the appropriate signalling messages, the ATM endsystem address will be identified unambiguously as such.

Note 2 - The hierarchy of the ATM address structure has implications on the PNNI routing hierarchy (see the ATM Forum PNNI Specification, Version 1.0).

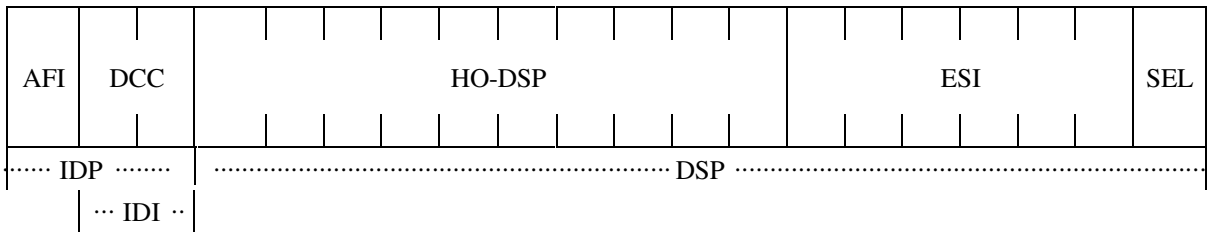


Figure 3-1a DCC ATM Format

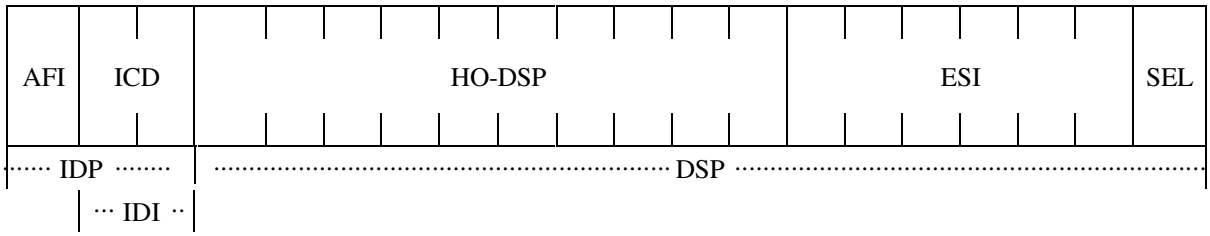


Figure 3-1b ICD ATM Format

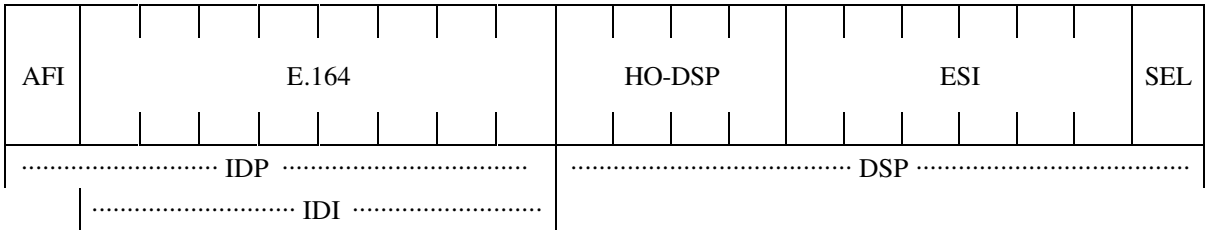


Figure 3-1c E.164 ATM Format

The ability of an endpoint to originate a call to any other endpoint shall be independent of the structure of the ATM address of the called system. All private networks shall be able to accept the initial call setup messages containing ATM addresses with any of the IDI formats which are approved in this document, and progress the corresponding call towards the destination endpoint, if it is reachable. Selection of one of the IDI formats to be used for the addresses of endpoints attached to any particular private ATM network is beyond the scope of this Specification.

In addition to the structure, abstract semantics, abstract syntax, and coding specified in this Specification, endpoints and private networks may, by mutual agreement, support other forms of ATM address. However, the ATM address will always be 20 octets.

Guidelines for ATM addresses are provided in Annex 1.

Each of the address fields in the formats above are specified below.

3.1.1 Initial Domain Part (IDP)

The Initial Domain Part (IDP) uniquely specifies an administration authority which has the responsibility for allocating and assigning values of the Domain Specific Part (DSP). The IDP consists of two fields, the Authority and Format Identifier (AFI) and Initial Domain Identifier (IDI).

The AFI identifies the authority allocating the Data Country Code, International Code Designator, or E.164 number; the format of the IDI, and the syntax of the remainder of the address. The length of this field is 1 octet. See ISO/IEC 8348/Addendum 2 for coding rules for NSAP addressing.

The following codes are specified:

AFI		Format
Hexadecimal	Bits	
0x39	0 0 1 1 1 0 0 1	DCC ATM Format
0x47	0 1 0 0 0 1 1 1	ICD ATM Format
0x45	0 1 0 0 0 1 0 1	E.164 ATM Format

All other code values are reserved. Additional AFIs are defined for group address in Annex 5.

3.1.1.1 Data Country Code (DCC)

The Data Country Code specifies the country in which an address is registered. The codes are given in ISO 3166. The length of this field is two octets. The digits of the Data Country Code are encoded in

Binary Code Decimal (BCD) syntax. The codes will be left justified and padded on the right with the hexadecimal value 'F' to fill the two octets. For example, a DCC of 007 is encoded as 0x007F.

3.1.1.2 International Code Designator (ICD)

The International Code Designator identifies an authority which administers a coding scheme. The body responsible for the coding scheme identified by the ICD provides an Administrative authority that is responsible for the allocation of identifiers within this coding scheme to organizations. The registration authority for the International Code Designator is maintained by the British Standards Institute. The length of this field is two octets. The digits of the International Code Designator are encoded in Binary Coded Decimal (BCD) syntax. The codes are left justified and padded on the right with the hexadecimal value 'F' to fill the two octets. For more details on ICD structure and administration see ISO 6523-1984. Note that ICDs are allocated to identify coding schemes in common usage within at least one country not normally to private schemes within a single organization.

3.1.1.3 E.164

E.164 specifies Integrated Services Digital Network numbers. These numbers include telephone numbers. The international format of these numbers will be used. These numbers can be up to 15 digits long. The length of this field is eight octets. The digits of the E.164 number are encoded in Binary Coded Decimal (BCD) syntax. The E.164 address is padded with as many leading semi-octets 0000 as needed to obtain the maximum length of 15 digits. A single semi octet 1111 is then added at the end to obtain an integral number of octets.

3.1.2 Domain Specific Part (DSP)

The Domain Specific Part is subdivided into the High Order DSP (HO-DSP) and low order part which consists of the End System Identifier (ESI) and Selector (SEL).

3.1.2.1 HO-DSP

The coding of this field is specified by the authority or the coding scheme identified by the IDP. The authority determines how identifiers will be assigned and interpreted within that domain. The authority can create further subdomains. That is, the authority may define some number of subfields of the HO-DSP and use these to identify a lower authority which in turn defines the balance of the HO-DSP. Sub-fields of the HO-DSP to the left are always more significant than fields to the right. The contents of this field not only describes the hierarchy of addressing authority, but also conveys topological significance. That is, the HO-DSP should be constructed in such a way that routing through interconnected ATM subnetworks is facilitated. Further details on how the HO-DSP is sub-allocated can be found in ISO 8348, RFC 1629, and Annex 1 of this Specification.

3.1.2.2 End System Identifier (ESI)

The end system identifier identifies an end system. This identifier must be unique within a particular value of the IDP + HO-DSP. In addition, to ensure the ability of an end system to autoconfigure its address, this end system identifier can be a globally unique identifier specified by an IEEE MAC address. The length of this field is 6 octets.

3.1.2.3 Selector

The selector is not used for ATM routing, but may be used by endsystems. The length of this field is 1 octet.

3.2 Public Networks

The Public UNI shall support one of the following:

1. Native E.164 address structure:
   - Type of Number field = international number
   - Numbering Plan Identification field= Recommendation E.164.
2. Private ATM Address Structure (all 3 formats, as defined in section 3.1):
   - Type of Number = Unknown
   - Numbering Plan Indication = ATM Endsystem Address.
3. Both of 1 and 2 above.

Note - E.164 numbers are covered by the following definitions:

1. Native E.164 numbering is defined by ITU-T Recommendation E.164.
2. E.164 numbers are administered by public networks.
3. E.164 numbers uniquely identify interfaces to public networks.
4. Several E.164 numbers can identify the same interface to the public network.
5. Routing internal to public networks based on E.164 is outside the scope of this Specification.

4.0 Signalling Virtual Channel and Signalling ATM Adaptation Layer (SAAL)

4.1 Signalling ATM Adaptation Layer

This section specifies the Signalling ATM Adaptation Layer (SAAL) for use at the UNI. The SAAL resides between the ATM layer and Q.2931. The purpose of the SAAL is to provide reliable transport of

Q.2931 messages between peer Q.2931 entities (e.g., ATM Switch and host) over the ATM layer. The SAAL is composed of two sublayers, a common part and a service specific part. The service specific part is further subdivided into a Service Specific Coordination Function (SSCF), and a Service Specific Connection Oriented Protocol (SSCOP). Figure 4-1 illustrates the structure of the SAAL.

The SAAL for supporting signalling shall use the protocol structure as illustrated in Figure 4-1.

The Common Part AAL protocol provides unassured information transfer and a mechanism for detecting corruption of SDUs. AAL Type 5 Common Part protocol shall be used to support signalling. The AAL Type 5 Common Part Protocol is specified in Recommendation I.363.

The Service Specific Connection Oriented Protocol (SSCOP) resides in the Service Specific Convergence Sublayer (SSCS) of the SAAL. SSCOP is used to transfer variable length Service Data Units (SDUs) between users of SSCOP. SSCOP provides for the recovery of lost or corrupted SDUs. SSCOP is specified in Q.2110.

The SAAL for supporting UNI 4.0 signalling shall utilize SSCOP as specified in Q.2110.
An SSCF maps the service of SSCOP to the needs of the SSCF user. Different SSCFs may be defined to support the needs of different AAL users. The SSCF used to support Q.2931 at the UNI is specified in Q.2130.

The external behavior of the SAAL at the UNI shall appear as if the UNI SSCF as specified in Q.2130 were implemented.

4.2 Signalling Virtual Channel

Except when the optional proxy signalling capability (see Annex 2), or when the optional Virtual UNI capability (see Annex 8) is used, the signalling virtual channel shall be that identified by VPI = 0, VCI = 5.

A default ATM layer service category and default traffic contract are defined in this specification to be, respectively, the service category and values of traffic contract parameters for the signalling VCC that apply absent any configuration or subscription option. The specification of standard defaults means that degradation of signalling performance due to cell loss can be avoided without requiring configuration or use of optional ILMI procedures. If used, procedures specified in the ATM Forum ILMI Specification, Version 4.0 will override the default service category and traffic contract.

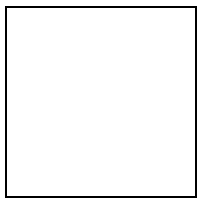


Figure 4-1 SAAL Structure

Note: The Figure represents the allocation of functions and is not intended to illustrate sub-layers as defined by OSI modeling principles.

The default ATM layer service category for the signalling virtual channel shall be either real time or non-real time VBR, as defined in section 2 of the ATM Forum Traffic Management Specification, Version 4.0. Selection of one of these service categories is network specific. If real time VBR is used, no objective is specified for CDV. A service category other than the default may be selected by mutual agreement (e.g., at subscription time).

The signalling protocol defined in this Specification is sensitive to delay and message loss. The network should bound CLR to be 10^{-6} or better. The network should also be engineered such that the end-to-end transfer delay objective for the AA-DATA primitive (see ITU-T Recommendation Q.2110) is 500 ms or better when the default traffic contract parameters are met, for an AA-DATA PDU which is five cells long. Other assumptions in performing this engineering are implementation specific.

Note: Networks that do not bound CTD for nrt-VBR connections may need to use the rt-VBR service category in order to meet these objectives. If the 500 ms objective cannot be met, it will be necessary to increase the value of some SSCOP timers, and possibly some DSS2 timers.

In order to avoid window starvation (i.e. a condition wherein the transmission rate is limited by the SSCOP window size), it is recommended that the following relationship be maintained between the average signalling message size (avgMS, in cells), SCR, MBS, maximum SAAL window size (maxWS), and signalling round trip delay (SRTD) which includes SAAL delays:

maxWS _ PT + (MBS +SCR*SRTD)/avgMS when SRTD _ MBS/(PCR-SCR); or,
maxWS _ PT + PCR * SRTD/avgMS otherwise

Where:

PT is the poll time, which is either:
25, when SCR > 100 cells/s; or
.75 * SCR when SCR <= 100 cells/s
based on the default values for the Poll Timer (i.e., 750 msec) and MaxPD (i.e., 25 ms) as defined in Recommendation Q.2130

Only CLP=0 cells shall be sent on the signalling VCC. The default traffic contract parameters for shaping the output of the signalling VCC are: SCR (0+1), MBS(0+1) and PCR(0+1). However, the UPC function in the network may use either the VBR.1 (i.e., UPC is on PCR(0+1) and SCR(0+1), no tagging allowed) or VBR.3 (i.e., UPC is on PCR(0+1) and SCR(0), and tagging is allowed) traffic contract definition.

Note: As long as only CLP=0 cells are sent, shaping to SCR(0+1) is equivalent to shaping to SCR(0)

The output of the signalling VCC should be shaped to conform with the traffic contract. Implementations that do not perform this shaping may, during periods of congestion, or when connected to networks that do not perform tagging for the VBR.3 traffic contract definition, experience degraded signalling performance

due to cell loss. Degradation might take the form of excessive delay in establishment or clearing of connections, or a signalling VCC outage.

Note: The UNI 3.1 Specification made no statement about service category or traffic parameters for the signalling VCC. However, the specification of a default service category in this Specification does not affect backward compatibility with implementations according to the UNI 3.1 Specification. At worst, a non-default traffic contract might be needed to provide adequate signalling performance. If a UNI 4.0 device detects that it is connected to a UNI 3.0 or UNI 3.1 device, it should use the VBR.3 traffic contract definition.

Networks that use the VBR.3 traffic contract definition for the signalling VCC may implement tagging and preferential discard on the signalling VCC, so as to minimize the likelihood that implementations that do not shape will experience degraded signalling performance during incidental periods when the traffic contract on SCR(0) is exceeded. Networks may also implement frame discard, so that if the traffic contract is exceeded and it is necessary to discard, fewer signalling messages will be affected.

The default traffic contract for the signalling virtual channel at the S (or S/T) reference point shall be as follows:

- PCR = the payload rate of the UNI or Virtual UNI
- SCR shall be as shown in Table 4-1
- MBS = 16 cells

The payload rate is the ATM cell rate of the UNI (i.e., excluding any physical layer overhead) or Virtual UNI. All implementations of this Specification at the S or S/T reference point shall support this default traffic contract.

Devices should support traffic contracts in addition to the default at the S (or S/T) reference point (e.g., by configuration or subscription option).

Table 4-1 Default SCR at the S (or S/T) Reference Point

Nominal Interface rate	SCR (approx. thruput)	SCR (cells/s)
<1.5 Mbit/s	8 kbit/s	21
1.5 Mbit/s to < 4 Mbit/s	16 kbit/s	42
4 Mbit/s to < 8 Mbit/s	32 kbit/s	84
8 Mbit/s to < 20 Mbit/s	48 kbit/s	126
20 Mbit/s to < 30 Mbit/s	128 kbit/s	334
30 Mbit/s to < 50 Mbit/s	192 kbit/s	500
50 Mbit/s to < 100 Mbit/s	256 kbit/s	667
100 Mbit/s to < 300 Mbit/s	768 kbit/s	2000
>= 300 Mbit/s	3.072 Mbit/s	8000

Note: For ITU-T compliant public UNIs, the default traffic contract is PCR(0+1) = 168 cells/s (see Recommendation Q.2120)

5.0 Point-to-Multipoint Calls

When setting up point-to-multipoint calls, the ITU-T Recommendation Q.2971 shall apply with the exceptions stated in this section.

Note: All sections of Recommendation Q.2971 and its annexes and appendices shall apply. Only the subsections/annexes/appendices of Q.2971 that have been modified by this Specification are given below. In this Specification, subsections, annexes, appendices, etc. of referenced documents, such as Q.2971, are identified by the actual subsection/annex/appendix number from that document, the document number and the title of the subclause/annex/appendix.

Note for clarification: When a VPCI/VCI value is assigned, the allocation is in both directions. The VPCI/VCI value cannot be used for another connection until the call is cleared.

Add the following sections:

8.1.2.1/Q.2971 ADD PARTY:
Called party number minimum length depends on addressing and maximum length is specified at 25.
Calling party number maximum length is specified at 26.
Transit network selection maximum length is specified at 9 octets.
This information element is included only once in the message.

If the Calling party subaddress information element is used to convey an ATM endsystem address, then an additional Calling party subaddress information element may be present to convey an OSI NSAP or User specified subaddress. If the Called party subaddress information element is used to convey an ATM endsystem address, then an additional Called party subaddress information element may be present to convey an OSI NSAP or User specified subaddress.

Add the following to Table 8-10/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

8.1.2.2/Q.2971 ADD PARTY ACKNOWLEDGE:
AAL parameters maximum length modified from 21 to 11.
Add the following to Table 8-11/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

8.1.2.3/Q.2971 PARTY ALERTING:
Add the following to Table 8-12/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

8.1.2.4/Q.2971 ADD PARTY REJECT:
Add the following to Table 8-13/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

8.1.2.5/Q.2971 DROP PARTY:
Add the following to Table 8-14/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

8.1.2.6/Q.2971 DROP PARTY ACKNOWLEDGE:
Add the following to Table 8-15/Q.2971:

Information Element name	Reference	Direction	Type	Length
Generic identifier transport information element	2.1.1 (Note A)	both	O	4-33

Note A - Also see the ATM Forum SAA/AMS IA 1.0 for more information.

9/Q.2971 Signalling procedures at the coincident S_B and T_B reference point
and
10/Q.2971 Procedures at the T_B reference point for interworking with private B-ISDNs:
These two sections describe the procedures for point-to-multipoint calls.

Clause 9/Q.2971 specifies the procedures applicable at the "coincident S_B and T_B reference point"; e.g. the procedures applicable for a terminal. Clause 10/Q.2971 specifies the procedures applicable at the "T_B reference point for interworking with private B-ISDNs"; e.g. the procedures applicable for a B-ISDN PBX. The major difference between these two sets of procedures is the procedure for establishing additional leaves at the destination UNI. The Clause 9/Q.2971 procedures use a SETUP message for each add party request at a leaf UNI. The Clause 10/Q.2971 procedures use a SETUP message for the first add party request at a leaf UNI and an ADD PARTY message for each subsequent add party requests at a leaf UNI where the call is already present.

Both sets of procedures, those specified in Clause 9/Q.2971 and those specified in clause 10/Q.2971, shall apply. Which of these two procedures is used at a specific UNI shall be determined by bilateral agreement (e.g., using ILMI procedures) between the user and the network.

Note: Although the procedures of Clause 10/Q.2971 may be in force at a particular UNI, there are cases where the network may forward a request to add a party as a SETUP message.

Add the following:

13.1/Q.2971 Timers at the user side:
The value of T399 shall be in the range 30-120 seconds (i.e. the sum of T303 and T310).

6.0 Leaf Initiated Join Capability

Section 5 and the ITU-T Q.2971 point-to-multipoint procedures allow the Root of a connection to join Leaves to the connection, but there is no capability to allow for one or more Leaves to join the connection without intervention from the Root of that connection. This section provides a capability where Leaves can join point-to-multipoint connections with or without intervention from the Root of the connection.

There are two modes of operation associated with the Leaf-Initiated Join (LIJ) capability:

- Leaf-prompted join without root notification: A Leaf can generate and send a request over the UNI to join a point-to-multipoint connection. In this mode of operation, if the Leaf's request is for an existing connection, the request is handled by the network. The Root is not notified when each Leaf is added to or dropped from a connection (except when the root adds or drops the leaf itself). Note that when a Leaf requests to be added to a connection that is not yet established, the Root will perform the initial set up of the connection. This type of connection is referred to as a *Network LIJ* connection.
- Root-prompted join: A Leaf can generate and send a request over the UNI to join a point-to-multipoint connection. In this mode of operation, the request is handled by the Root of the connection. The Root adds Leaves to or removes Leaves from a new or established connection via the point-to-multipoint procedures outlined in Section 5. This type of connection is referred to as a *Root LIJ* connection.

The LIJ capability requires a new state machine. The new LIJ-state machine exists only on the user side of the UNI where a Leaf is attempting to be added to or dropped from a connection; this user side can be in one of the following two states at any given time:

Leaf-Setup Initiated:
Entered when a LEAF SETUP REQUEST message has been sent to the network side of the UNI interface.

Null:
Entered when a SETUP, ADD PARTY, or LEAF SETUP FAILURE message has been received on the user side of the interface, or when the timer T331 expires.

Note: Since a leaf-initiated-join request uses the dummy call reference, the state machine is identified by a Leaf sequence number which is unique.

6.1 Coding Requirements

This sub-section specifies the messages and information elements required to support the LIJ capability.

6.1.1 Messages

6.1.1.1 Modification of Point-to-point Messages

6.1.1.1.1 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate B-ISDN call and connection establishment. See Table 6-1 below for additions to the structure of this message from that shown in section 8.1.1.4/Q.2971.

Table 6-1 SETUP Message Additional Content

Message Type: SETUP

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
LIJ call identifier	6.1.2.1	both	O(1)	4-9
LIJ parameters	6.1.2.2	both	O(1,2)	4-8
Leaf sequence number	6.1.2.3	both	O(3)	4-8

Note 1 - Not included for point-to-point calls. Included in the user-to-network direction to request the support of leaf initiated join capability. This information will be used by the network to support LIJ capability. Included in the network-to-user direction for interworking with private B-ISDN networks or to provide endpoint (Leaf) rejoin option.

Note 2 - When present, the LIJ call identifier and Calling party number information elements must also be present.

Note 3 - Must be included when initiating a call to a party (Leaf) in response to a LEAF SETUP REQUEST message. The value must be equal to the value specified by the Leaf in the LEAF SETUP REQUEST message.

6.1.1.2 Modification of Point-to-multipoint Messages

6.1.1.2.1 ADD PARTY

This message is sent from the user to the network to request the addition of a party to an existing connection (see Section 9/Q.2971). At the interface between a customer network and a public B-ISDN, it is sent in the network to user direction to request the addition of a party to an existing connection (see

Section 10/Q.2971). See Table 6-2 below for additions to the structure of this message from that shown in Table 8-8/Q.2971.

Table 6-2 ADD PARTY Message Additional Content

Message type: ADD PARTY

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
Leaf sequence number	6.1.2.3	both	O(1)	4-8

Note 1 - Must be included when adding a new party to a point-to-multipoint call in response to a LEAF SETUP REQUEST message. The value must be equal to the value specified by the Leaf in the LEAF SETUP REQUEST message.

6.1.1.3 Messages for Leaf Initiated Join Call and Connection Control

Table 6-3 shows the new messages added for the LIJ capability. Both the LEAF SETUP FAILURE and LEAF SETUP REQUEST messages are sent on the dummy call reference.

Table 6-3 Messages Used with ATM Leaf Initiated Join Call and Connection Control

Message	Reference
LEAF SETUP FAILURE	6.1.1.3.1
LEAF SETUP REQUEST	6.1.1.3.2

Table 6-4 shows the new codings used for these messages. These are in addition to those of Table 4-2/Q.2931 in Section 4.4.1/Q.2931, and Table 8-14/Q.2971 in Section 8.2.3/Q.2971.

Table 6-4 LIJ Message Identifier Additional Codings

Message type (octet 1) Bits								Meaning
8	7	6	5	4	3	2	1	
1	0	0	1	0	0	0	0	LEAF SETUP FAILURE
1	0	0	1	0	0	0	1	LEAF SETUP REQUEST

6.1.1.3.1 LEAF SETUP FAILURE

This message is sent to the Leaf by the Root or the network to indicate failure to join the Leaf to the requested leaf initiated join call. See Table 6-5.

Table 6-5 LEAF SETUP FAILURE Message Content

Message Type: LEAF SETUP FAILURE

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	4.2/Q.2931	both	M	1
Call reference	4.3/Q.2931	both	M(1)	4
Message type	4.4.1/Q.2931	both	M	2
Message length	4.4.2/Q.2931	both	M	2
Cause	4.5.15/Q.2931	both	M	6-34
Called party number	4.5.11/Q.2931	both	O(2)	(3)
Called party subaddress	4.5.12/Q.2931	both	O(4)	4-25
Leaf sequence number	6.1.2.3	both	M	8
Transit network selection	4.5.22/Q.2931	both	O	4-8

Note 1 - Must be set to the dummy call reference value.

Note 2 - Mandatory in the user-to-network direction. Mandatory in the network-to-user direction if the calling party number was included in the LEAF SETUP REQUEST message.

Note 3 - Minimum length depends on the numbering plan. Maximum length is 25 octets.

Note 4 - Mandatory if LEAF SETUP REQUEST message contained a Calling party subaddress; otherwise, not allowed.

6.1.1.3.2 LEAF SETUP REQUEST

This message is sent to initiate leaf joining procedures. See Table 6-6.

Table 6-6 LEAF SETUP REQUEST Message Content

Message Type: LEAF SETUP REQUEST

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
Protocol discriminator	4.2/Q.2931	both	M	1
Call reference	4.3/Q.2931	both	M(1)	4
Message type	4.4.1/Q.2931	both	M	2
Message length	4.4.2/Q.2931	both	M	2
Transit network selection	4.5.22/Q.2931	both	O(2)	4-8
Calling party number	4.5.13/Q.2931	both	M	(3)

Calling party subaddress	4.5.14/Q.2931	both	O	4-25
Called party number	4.5.11/Q.2931	both	M	(4)
Called party subaddress	4.5.12/Q.2931	both	O	4-25
LIJ call identifier	6.1.2.1	both	M	9
Leaf sequence number	6.1.2.3	both	M	8

Note 1 - Must be set to the dummy call reference value.

Note 2 - Used to specify the transit network over which the Root (called party) of the LIJ call should be reached.

Note 3 - Minimum length depends on the numbering plan. Maximum length is 26 octets.

Note 4 - Minimum length depends on the numbering plan. Maximum length is 25 octets.

6.1.2 Information Elements

The information element and coding rules of section 8.2/Q.2971 shall apply with the additions listed below. Table 2-1 contains the information element codings needed for the new LIJ information elements.

6.1.2.1 Leaf Initiated Join Call Identifier

The Leaf Initiated Join (LIJ) call identifier information element is used to uniquely identify a point-to-multipoint call at a Root's interface. The LIJ call identifier is specified in the SETUP message when the Root creates a point-to-multipoint call with LIJ capability. The LIJ call identifier is specified in the LEAF SETUP REQUEST message when a Leaf wishes to join the identified call. How a Leaf knows an LIJ call identifier is outside the scope of this Specification. For example, it could be obtained through yellow pages, or as a well known id or found through some directory service.

Bits 8	7	6	5	4	3	2	1	Octets
Leaf initiated join call identifier								
1	1	1	0	1	0	0	0	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field					2
			Flag	Reserved	Information Element Action Ind.			
Length of LIJ call identifier contents								3
Length of LIJ call identifier contents (continued)								4
1 ext	0	0	0	Spare	Type			5
Identifier Value								6
Identifier Value (continued)								7
Identifier Value (continued)								8
Identifier Value (continued)								9

Figure 6-1 Leaf Initiated Join Call Identifier Information Element

LIJ Call Identifier Type (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 0	Root assigned (Note) All other values reserved.

Note - The "Root assigned" type indicates that the Root specified the Identifier Value of the LIJ call identifier.

Identifier Value (octets 6-9)

The Identifier Value is a four octet value used to differentiate calls created by the same Root. It is coded as a 32-bit binary integer, with Bit 8 of the first octet being the most significant bit and Bit 1 of the fourth octet being the least significant.

6.1.2.2 Leaf Initiated Join Parameters

The Leaf Initiated Join (LIJ) parameters information element is used by the Root to associate options with the call when the call is created.

Bits 8	7	6	5	4	3	2	1	Octets
Leaf initiated join parameters								
1	1	1	0	1	0	0	1	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action Ind.			2
Length of LIJ parameters contents								3
Length of LIJ parameters contents (continued)								4
1 ext	0	0	0 Spare		Screening Indication			5

Figure 6-2 Leaf Initiated Join Parameters Information Element

Screening Indication (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 0	Network Join Without Root Notification All other values reserved.

6.1.2.3 Leaf Sequence Number

The Leaf sequence number information element is used by a joining Leaf to associate a SETUP, ADD PARTY or LEAF SETUP FAILURE response message with the corresponding LEAF SETUP REQUEST message that triggered the response.

Bits 8	7	6	5	4	3	2	1	Octets
Leaf sequence number								
1	1	1	0	1	0	1	0	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action Ind.			2
Length of Leaf sequence number contents								3
Length of Leaf sequence number contents (continued)								4
Leaf sequence number								5
Leaf sequence number (continued)								6
Leaf sequence number (continued)								7
Leaf sequence number (continued)								8

Figure 6-3 Leaf Sequence Number Information Element

Leaf Sequence Number (octets 5-8)

The Leaf sequence number is used by a joining Leaf to associate a SETUP, ADD PARTY or LEAF SETUP FAILURE response message with the corresponding LEAF SETUP REQUEST message that triggered the response. It is coded as a 32-bit binary integer, with Bit 8 of the first octet being the most significant bit and Bit 1 of the fourth octet being the least significant.

6.2 Signalling Procedures in Support of the Leaf Initiated Join Capability

6.2.1 Leaf Join Procedures at the Leaf Interface

6.2.1.1 Leaf Setup Request

When a Leaf wishes to join a call, the Leaf transfers a LEAF SETUP REQUEST message using the dummy call reference across the interface, starts timer T331 and enters the Leaf Setup Initiated LIJ-state. The Leaf is required to include a Leaf sequence number information element in the LEAF SETUP REQUEST message and the value of the Leaf sequence number identifies the associated LIJ state machine. This allows the Leaf to later associate the SETUP, ADD PARTY or LEAF SETUP FAILURE response message to the LIJ state machine corresponding to the LEAF SETUP REQUEST message that triggered the response. The Leaf must select an unused Leaf sequence number (i.e., one not associated with a non-Null LIJ state machine) each time a LEAF SETUP REQUEST message is sent and should avoid reusing Leaf sequence numbers for as long as possible.

To identify the call to be joined, the LEAF SETUP REQUEST message must contain the LIJ call identifier information element and the Root's address (in the Called party number information element and, optionally, the Called party subaddress information element). The Leaf shall include its address in the Calling party number and may optionally include a Calling party subaddress information element in the LEAF SETUP REQUEST message. The Calling party number shall not include a Group address (see Annex 5 for the definition of the Group address). If the Calling party subaddress information element is omitted, the network assumes that none is required to uniquely identify the Leaf.

Note - If the Leaf attempts to join a non-existent call or a *Root LIJ* call for which network joining of leaves has not been enabled, the Presentation indicator of the Calling party number in the LEAF SETUP REQUEST message must not be set to "Presentation restricted" since the Root uses the Calling party number from the LEAF SETUP REQUEST message to generate a Called party number in the SETUP or ADD PARTY message that is sent back to the Leaf (see Section 6.2.5.8).

As an option, the Leaf may include the Transit network selection information element in the LEAF SETUP REQUEST message. The network uses this transit network to route the LEAF SETUP REQUEST message towards the Root.

If the timer T331 expires before receiving a response, the Leaf may optionally retransmit the LEAF SETUP REQUEST message. The Leaf may either use the same Leaf sequence number as in the original request or select a new value. If the same value is used, the Leaf should reuse the existing LIJ state machine (remaining in the Leaf Setup Initiated state), but will not be able to differentiate a delayed response to the first (timed out) LEAF SETUP REQUEST message from a response to the second request. Hence, a new Leaf sequence number value should be chosen if such differentiation is required. If the Leaf chooses not to retransmit the LEAF SETUP REQUEST message or if timer T331 expires a second time, the Leaf shall transition the LIJ state machine to the Null state.

6.2.1.2 Invalid Call/Connection Control Information or Service Request in the LEAF SETUP REQUEST Message

Upon receiving the LEAF SETUP REQUEST message, the network does not enter or change state at the Leaf's UNI. Rather, the Called party number and Called party subaddress (if specified) are used to internally forward the LEAF SETUP REQUEST message towards the Root. If the network determines that the call information received from the user is invalid (e.g., invalid Called party number), then the network will send a LEAF SETUP FAILURE message to the Leaf using the dummy call reference and using the same Leaf sequence number as that in the LEAF SETUP REQUEST message. The Called party number and the called party subaddress in the LEAF SETUP FAILURE message are taken from the Calling party number and Calling party subaddress (if the subaddress is included) of the LEAF SETUP REQUEST message, respectively.

The cause used in the failure message indicates the reason for failure, such as:

#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 a LEAF SETUP FAILURE message with the following cause:

#63 "*Service or option not available, unspecified*".

After sending the LEAF SETUP FAILURE message, the network does not change state since no state change was made upon receipt of the LEAF SETUP REQUEST message.

6.2.1.3 Leaf Setup Request Received

If the network can determine that access to the requested LIJ service is authorized and available, the network shall progress the leaf setup request message using the received Leaf Sequence Number.

6.2.1.4 Leaf Setup Request Completed

If the Leaf Setup Request is successful a SETUP or ADD PARTY message will be sent to the Leaf to add it to the requested LIJ call. The SETUP or ADD PARTY message sent to the Leaf contains the Leaf Sequence Number from the LEAF SETUP REQUEST message, and may also contain the LIJ call identifier and LIJ parameters for this call. If present in either the SETUP or ADD PARTY message, the Calling party number and Calling party subaddress will be that of the Root, as specified in the Called party number and Called party subaddress information elements of the LEAF SETUP REQUEST message.

Note - Normally, the Calling party number of the SETUP or ADD PARTY message will equal the Called party number of the LEAF SETUP REQUEST message. However, this is not always the case (for example, they may not be equal when interworking between public and private networks).

Upon receipt of the SETUP or ADD PARTY message, the Leaf extracts the Leaf sequence number and uses this to locate an LIJ state machine. If the Leaf does not have an LIJ state machine with the indicated Leaf sequence number value (which should only happen, under normal circumstances, if the Leaf's timer T331 previously expired), then the SETUP or ADD PARTY message should be treated as an independent call offering (that is, not a response to a LEAF SETUP REQUEST message) and accepted or rejected, as desired. If the Leaf does have an LIJ state machine with the indicated Leaf sequence number, then the Leaf shall stop the associated timer T331, enter the Null LIJ-state, then follow the appropriate procedures for acceptance (or rejection) of the incoming call request, as described in Q.2971.

6.2.1.5 Leaf Setup Request Failure

If the network or Root is unable to complete the join request for any reason, a LEAF SETUP FAILURE message is returned to the Leaf using the dummy call reference. The LEAF SETUP FAILURE message contains the following information from the LEAF SETUP REQUEST message: Leaf sequence number, Called party number (from the Calling party number) and, optionally, the Called party subaddress (from the Calling party subaddress). The Leaf uses the Leaf sequence number from the LEAF SETUP FAILURE message to locate the LIJ state machine and associate the response with the corresponding LEAF SETUP REQUEST message that triggered the response. Upon receiving the LEAF SETUP FAILURE message, timer T331 is stopped and the Null LIJ-state is entered.

Regardless of the reason for failure, the indication at the Leaf's interface is essentially unchanged (that is, receipt of the LEAF SETUP FAILURE message with appropriate cause code). However, the failure message may either be originated by the network or by the Root, depending on who detected the failure and when the failure occurred.

The cause used in the failure message indicates the reason for failure, such as:

#21 "*Call rejected*" (for Root rejections of the join request, Section 6.2.2.2.3)

#47 "*Resources unavailable, unspecified*" (for network or Root detection of resource limitations);

#49 "*Quality of Service unavailable*" (for network or Root detection of QoS limitations).

Refer to Q.2971 for more failure codes and the circumstances which result in each.

6.2.2 Leaf Join Procedures at the Root Interface

6.2.2.1 Creation of Leaf Initiated Join Call

In order to create a leaf prompted join (*Network LIJ*) call, one for which the network automatically attempts to join requesting Leaves, the Root uses the point-to-multipoint procedures of Section 9.1.1/Q.2971, and includes the Calling party number, LIJ parameters and LIJ call identifier information elements in the initial SETUP message. All of these information elements are mandatory for the creation of a Network LIJ call. If the LIJ parameters information element is specified without specifying both the Calling party number and the LIJ call identifier information elements, the network shall reject the setup request with Cause #96, "*Mandatory information element is missing*". If the LIJ call parameters information is not specified, the network will assume the creation of a *Root LIJ* call (and will never automatically attempt to join requesting Leaves). When creating a *Network LIJ* call, the LIJ call identifier specified by the Root must be unique (i.e., the LIJ call identifier value must not be in use for another *Network LIJ* call created by this Root). For this purpose, the Root is identified as specified in Annex 3.

The Root can optionally specify the Leaf sequence number and Calling party subaddress information elements when creating a *Network LIJ* call. The Leaf sequence number is required if the SETUP message is issued in response to a LEAF SETUP REQUEST message, as described in Section 6.2.2.2.1. The network combines the Calling party number, Calling party subaddress (if specified) and LIJ call identifier to form a globally unique label for this *Network LIJ* call within the network as specified in Annex 3. Note that while the Calling party number may equal the subscriber's number, this is not required, since the Root may not be an ATM endpoint.

Upon receipt of the SETUP message, the network verifies that the LIJ parameters information element is valid, as described in Section 6.1.2.2. Additionally, the LIJ call identifier information element is checked and must be of a valid type and format, as described in Section 6.1.2.1, and the optional Leaf sequence number information element must be valid, as described in Section 6.2.2.3. If any of these checks fail, the network rejects the SETUP request with Cause #100, "*Invalid information element contents*".

The remaining call set up steps follow the procedures outlined in Section 9.1.1/Q.2971.

6.2.2.2 Incoming Leaf Setup Request

If a Leaf attempts to join a *Root LIJ* call or a *Network LIJ* call that is not in the Active link-state on the Root's UNI, but one for which a valid Root has been specified (as indicated by a valid Called party number and, optionally, Called party subaddress), the LEAF SETUP REQUEST message will be delivered by the network to the Root using the dummy call reference. Upon sending the LEAF SETUP REQUEST message to the Root, the network does not change link-state, does not instantiate a new party-state, does not start any timers and does not cache any internal information regarding the LEAF SETUP REQUEST message. Instead, the Root is required to respond and end-to-end error detection (via the Leaf's timer T331) is used to detect protocol errors as described in Section 6.2.1.1.

The LEAF SETUP REQUEST message delivered to the Root contains all of the information elements specified by the Leaf.

6.2.2.2.1 Join Acceptance via Setup

Assuming that the call does not yet exist, upon receipt of the LEAF SETUP REQUEST message, the Root has the option of rejecting the request (as described in Section 6.2.2.2.3) or of accepting the request by creating a call to the Leaf. In the case where the Root chooses to create the call, it is assumed that the LIJ call identifier specified by the Leaf has some significance to the Root with respect to the type of call to be created (that is, the LIJ call identifier implies a certain traffic descriptor, quality of service, etc.). If not, the Root can reject the request.

The Root creates a point-to-multipoint call using any available Call reference. The Root is required to include the Leaf sequence number from the LEAF SETUP REQUEST message in the SETUP message used to create the call. The Called party number value should be taken from the Calling party number information element of the LEAF SETUP REQUEST message. Likewise, the Called party subaddress value should be taken from the Calling party subaddress information element of the LEAF SETUP REQUEST message (or omitted, if none was specified).

The Root can either create the call as a *Network LIJ* call, where network joining of leaves is supported, or as a *Root LIJ* call, where all subsequent LEAF SETUP REQUEST messages will be forwarded to the Root. To create a *Network LIJ* call, the procedures described of Section 6.2.2.1 are followed. To create a *Root LIJ* call, the procedures of Q.2971 are followed.

Since the network delivers all LEAF SETUP REQUEST messages to the Root when the indicated call is not in the Active or Call Delivered state, the LEAF SETUP REQUEST message can arrive at the Root side of the interface when the call already exists. When the Root wishes to join the leaves, the two cases of concern are:

1) The LEAF SETUP REQUEST message arrives when the call is in a clearing state. In this case, the Root should hold the LEAF SETUP REQUEST message until the call becomes Null, then proceed as described above in this section to create the call.
2) The LEAF SETUP REQUEST message arrives when the call is in an establishment state. In this case, the Root shall wait until the call enters the Active or Call Delivered state. Then the Root adds the Leaf using the add party procedures of Section 6.2.2.2.2. If the call transitions from an establishment state to a clearing state or the Null state, then the Root should proceed as described in the previous clause (1).

For leaves that the Root explicitly adds by sending SETUP or ADD PARTY messages, the Root receives explicit acknowledgment of the add success or failure via the point-to-multipoint procedures.

6.2.2.2.2 Join Acceptance via Add Party

Assuming that the call does exist when the LEAF SETUP REQUEST message arrives, the Root has the option of rejecting the request (as described in Section 6.2.2.2.3) or of accepting the request by adding the Leaf to the ongoing call. To add the Leaf, the Root issues an ADD PARTY message containing the Leaf sequence number from the LEAF SETUP REQUEST message. The Called party number and Called party subaddress should be taken from the Calling party number and Calling party subaddress information elements of the LEAF SETUP REQUEST message, respectively. The rest of the add party procedures follow Section 9.1/Q.2971.

If the call is in a clearing state when the LEAF SETUP REQUEST message arrives, the Root should hold the LEAF SETUP REQUEST message until the call becomes Null, then proceed as described in Section 6.2.2.2.1. If the call is in an establishment state, the Root should wait until the call enters the Active state,

Call Delivereed, or the Null state, then add the Leaf by issuing an ADD PARTY or a SETUP message, as described in this section and in Section 6.2.2.2.1, respectively.

6.2.2.2.3 Join Rejection via Leaf Setup Failure

When the Root receives a LEAF SETUP REQUEST message and wishes to reject the leaf join, it should respond with a LEAF SETUP FAILURE message, sent on the dummy call reference, containing the Leaf sequence number from the LEAF SETUP REQUEST message and an appropriate cause, such as one of the following:

#17 "*User busy*";

#21 "*Call rejected*";

#47 "*Resources unavailable, unspecified*";

#49 "*Quality of Service unavailable*";

#88 "*Incompatible destination*".

If no Cause is specified, the network will insert Cause #31, "*Normal unspecified*". The LEAF SETUP FAILURE message contains the following information from the LEAF SETUP REQUEST: Leaf Sequence Number, the Called party number (from the Calling party number), and the Called party subaddress (from the Calling party subaddress) information elements.

6.2.3 Call/Connection and Party clearing

Call/connection and party clearing in LIJ calls follow the appropriate point-to-multipoint clearing procedures, as specified in Sections 9.3/Q.2971 and 10.3/Q.2971 with two exceptions.

- If the Root drops the last party it added in a *Network LIJ Connection*, it should do so by sending a DROP PARTY message rather than a RELEASE message, and continue to keep the call in the Active link-state. If there are no leaves active in the call that have joined themselves, then the network will release the call (as described in Sections 9.3.3/Q.2971 and 10.3.3/Q.2971). Otherwise, the network will maintain the call in the Active link-state until the last Leaf drops itself. In the meantime, the Root can add additional parties. If the Root wants to clear the call, it can send a RELEASE message at any time.
- When the network drops the last party added by the Root in a *Network LIJ Connection,* but while other Leaves (that have added themselves) are still participating in the call, the network will send a DROP PARTY message rather than a RELEASE message, and continue to keep the call in the Active link-state. Upon receipt of the DROP PARTY message, the Root should likewise maintain the call in the Active link-state. The network will send a RELEASE message when the last Leaf to add itself drops out of the call. As stated above, the Root can send a RELEASE message at any time to clear the call.

6.2.4 Restart Procedure

The restart procedures of Sections 9.4/Q.2971 and 10.4/Q.2971 are followed for LIJ calls.

6.2.5 Handling of Error Conditions

This section discusses error handling that specifically applies to LIJ calls. The error procedures of Sections 5.6/Q.2931, 5.7/Q.2931, 9.5/Q.2971 and 10.5/Q.2971 also apply.

The precedence of sections 5.6.1 through 5.6.8 of Recommendation Q.2931 is defined by normative reference from sections 6.2.5.1 through 6.2.5.8.

6.2.5.1 Protocol Discriminator Error

Refer to Section 5.6.1/Q.2931.

6.2.5.2 Message Too Short

Refer to Section 5.6.2/Q.2931.

6.2.5.3 Call Reference, Endpoint Reference and Leaf Sequence Number Errors

6.2.5.3.1 Call Reference Procedural Errors

Refer to Section 9.5.3.1/Q.2971.

6.2.5.3.2 Endpoint Reference Error

Refer to Sections 9.5.3.2/Q.2971 and 10.5/Q.2971.

6.2.5.3.3 Leaf sequence number error

If the Leaf receives a LEAF SETUP FAILURE message containing a Leaf sequence number that does not correspond to any LIJ state machine in the Leaf Setup Initiated LIJ-state, the message is ignored.

6.2.5.4 Message Type or Message Sequence Errors

Procedures specified in Sections 5.6.4/Q.2931, 9.5.4/Q.2971 and 10.5/Q.2971 also apply in this section.

6.2.5.5 Message Length Errors

Refer to Sections 5.6.5/Q.2931.

6.2.5.6 General Information Element Errors

Refer to Section 5.6.6/Q.2931.

6.2.5.7 Mandatory Information Element Errors

The procedures of section 5.6.7/Q.2931, 9.5.7/Q.2971 and 10.5/Q.2971 apply with the following additions.

6.2.5.7.1 Mandatory Information Element Missing

If a LEAF SETUP REQUEST message is received which has one or more mandatory information elements missing, a LEAF SETUP FAILURE message with Cause #96, "*Mandatory information element is missing*" shall be returned.

If a LEAF SETUP FAILURE message is received with the Cause information element missing, the actions taken shall be the same as if a LEAF SETUP FAILURE message with Cause #31, "*Normal, unspecified*" was received.

6.2.5.7.2 Mandatory Information Element Content Error

If a LEAF SETUP REQUEST message is received which has one or more mandatory information elements with invalid contents, a LEAF SETUP FAILURE message with Cause #100, "*Invalid information element contents*" shall be returned.

If a LEAF SETUP FAILURE message is received with invalid contents in the Cause information element, it will be assumed that a LEAF SETUP FAILURE message was received with a missing Cause information element, as described in Section 6.2.5.7.1.

6.2.5.8 Non-mandatory Information Element Errors

The procedures of sections 5.6.8/Q.2931 and 9.5.8/Q.2971 apply with the following addition.

If a LEAF SETUP REQUEST message is received by the network from the Leaf with a Presentation indication of "Presentation restricted" in the Calling party number information element, and the network is not able to join the Leaf to an point-to-multipoint call with LIJ capability internally, then the network shall respond with a LEAF SETUP FAILURE message containing Cause #111, "*Protocol error, unspecified"*.

6.3 Parameter values

6.3.1 Timers at the User Side

The timer specified in Table 6-7 is used on the user side.

Table 6-7 Time in the user side defined in Section 6.2.

Timer Number	Default Time-out Value	State of Call	Cause for Start	Normal Stop	At The First Expiry	At The Second Expiry	Implementation
T331	60s	Leaf Setup Initiated LIJ-state	LEAF SETUP REQUEST sent	SETUP, ADD PARTY or LEAF SETUP FAILURE received	Optionally retransmit LEAF SETUP REQUEST and restart T331	Clear internal call, enter Null LIJ-state	Mandatory

7.0 ATM Anycast Capability

The ATM Anycast capability allows a user to request a point-to-point connection to a single ATM end system that is part of an ATM group (see Annex 5).

ATM Anycast capability can be requested by a calling user sending a SETUP message across its user-network interface. This SETUP message shall contain the desired ATM group address in the called party number information element. The user-plane-connection-configuration field shall be set to point-to-point. The network, upon receiving this SETUP message, shall establish a single point-to-point connection to a member of the group identified by the called party number. When the connection request reaches one member of the group, the called member may return its own individual ATM address or subaddress to the calling user through the Connected party number and the Connected party subaddress information elements in the CONNECT message as specified in Annex 4, Section A4.5.

This section extends the Q.2931 point-to-point signalling protocol as outlined in the previous paragraph to support the ATM Anycast capability.

7.1. Addressing

To support the ATM Anycast capability, ATM group addresses are used as specified in Annex 5. As a consequence, the AFIs defined in section 3.1.1 are extended to support the following new group AFIs:

AFI		Format
Hexadecimal	Bits	
0xBD	1 0 1 1 1 1 0 1	DCC ATM Format
0xC5	1 1 0 0 0 1 0 1	ICD ATM Format
0xC3	1 1 0 0 0 0 1 1	E.164 ATM Format

Procedures are only specified to support the ATM group address in the Called party number information element.

7.2. Coding Requirements

This section lists the messages and information elements whose contents have been modified to support ATM anycast capability.

7.2.1 Modified Messages

The SETUP message is modified to support the ATM Anycast Capability.

3.1.7/Q.2931 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate call establishment.

Message Type: SETUP
Significance: global
Direction: both

Information Element	Reference	Direction	Type	Length
Connection scope selection	7.2.2.1	both	O (A)	6

Note A - May only be included when the calling user requests a point-to-point connection containing a group address in the Called party number information element. When included, the network shall progress the call and update the Connection scope selection information element as specified in Annex 6.

Figure 7-1/Q.2931 SETUP Message Content

7.2.2 Additional Information Elements

7.2.2.1 Connection Scope Selection

The purpose of the Connection Scope Selection information element is to allow the calling user to indicate to the network that the call/connection shall be processed and progressed within the selected routing range.

Bits 8	7	6	5	4	3	2	1	Octets
Connection Scope Selection								
1	1	1	0	1	0	1	1	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action Ind.			2
Length of Connection scope selection information element contents								3
Length of Connection scope selection information element contents (continued)								4
1 ext	Spare			Type of connection scope				5
Connection scope selection								6

Figure 7-2 Connection Scope Selection Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
1 1	ATM Forum Specific

Type of connection scope (octet 5)

Bits 4 3 2 1	Meaning
0 0 0 1	Organizational
All others	Reserved

Connection scope selection (octet 6): when the Type of connection scope is coded as "Organizational" (Note 1):

Bits 8 7 6 5	Bits 4 3 2 1	Meaning
0 0 0 0	0 0 0 0	Reserved
0 0 0 0	0 0 0 1	Local network
0 0 0 0	0 0 1 0	Local network plus one
0 0 0 0	0 0 1 1	Local network plus two
0 0 0 0	0 1 0 0	Site minus one
0 0 0 0	0 1 0 1	Intra-site
0 0 0 0	0 1 1 0	Site plus one
0 0 0 0	0 1 1 1	Organization minus one
0 0 0 0	1 0 0 0	Intra-organization
0 0 0 0	1 0 0 1	Organization plus one
0 0 0 0	1 0 1 0	Community minus one
0 0 0 0	1 0 1 1	Intra-community
0 0 0 0	1 1 0 0	Community plus one
0 0 0 0	1 1 0 1	Regional
0 0 0 0	1 1 1 0	Inter-regional
0 0 0 0	1 1 1 1	Global

Note 1 - The calling user may use the guideline as described in section A5.2 to select a proper value of this field.

7.3 Call/Connection Control Procedures for ATM Point-to-point Calls

This section describes the modified point-to-point call/connection control procedures to support the ATM anycast capability.

5.1.5/Q.2931 Call/Connection proceeding
Add the following procedures:

When the SETUP message contains an ATM group address in the Called party number information element, the network shall progress the call to one of the members of the group with the Called party number remaining unchanged. Selection of a specific member of the group is outside the scope of this Specification. However, the Connected Line Presentation (see Annex 4, Section 4.5) capability allows the originating ATM endsystem to receive the address of the connected party.

If the received SETUP message contains an ATM group address and there are no registered members within the indicated connection scope, the network shall initiate the call clearing procedure in accordance with §5.4/Q.2931 with Cause #3 "*No route to destination*" toward the calling user.

7.4 Address Registration

In order to support the ATM Anycast Capability, ILMI address registration must support the atmfAddressOrgScope MIB object and related procedures, as specified in Section 9 of the ILMI 4.0 Specification.

8.0 Connection Characteristics Negotiation During Establishment Phase

This section specifies the signalling protocol for negotiation of connection characteristics for point-to-point calls/connections and for the first party of point-to-multipoint calls/connections. The negotiation capabilities are only applicable during the call/connection establishment phase. In particular, the following capabilities are specified:

- negotiation of connection characteristics using an Alternative ATM traffic descriptor and
- negotiation of peak cell rate traffic parameters using a Minimum acceptable ATM traffic descriptor

In the case of the use of the Alternative ATM traffic descriptor information element the parameters of the information element are handled as a single entity whereas the Minimum acceptable ATM traffic descriptor information element allows the specification of a range of values for parameters which are handled independently. The use of the Alternative ATM traffic descriptor information element allows negotiation of all traffic parameters whereas the use of the Minimum acceptable ATM traffic descriptor is restricted to negotiation of peak cell rates and ABR minimum cell rates.

This section applies to CBR, rt-VBR and nrt-VBR ATM service category calls, and to ABR calls using the procedures described in Section 10. It applies to UBR calls with the restriction that only the Minimum acceptable ATM traffic descriptor information element is supported

8.1 Coding requirements

This section lists the messages and information elements whose contents have been modified to support negotiation of connection characteristics during the call/connection establishment phase.

8.1.1 Messages

Table 8-1 lists the existing Q.2931 messages that need modification to support the connection characteristics negotiation function during the establishment phase of the call/connection.

Table 8-1 Modified Q.2931 Messages

Message	Reference
SETUP	8.1.1.1
CONNECT	8.1.1.2

8.1.1.1 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate call/connection establishment. See Table 8-2 for additions to the structure of this message shown in Table 3-8/Q.2931 and in 8.1/Q.2961.1.

Message type: SETUP

Significance: Global

Direction: Both

Table 8-2 SETUP Message Additional Content

Information element	Reference	Direction	Type	Length
Alternative ATM traffic descriptor	8.1.2.1	both	O (Note 1)	4-30
Minimum acceptable ATM traffic descriptor	8.1.2.2	both	O (Note 1)	4-20

Note 1 - Either the Alternative ATM traffic descriptor information element or Minimum acceptable ATM traffic descriptor information element, but not both, shall be included in the SETUP message when traffic parameters are negotiable.

8.1.1.2 CONNECT

This message is sent by the called user to the network and by the network to the calling user to indicate call/connection acceptance by the called user. See Table 8-3 for additions to the structure of this message shown in Table 3-2/Q.2931.

Message type: CONNECT

Significance: Global

Direction: Both

Table 8-3 CONNECT Message Additional Content

Information element	Reference	Direction	Type	Length
ATM traffic descriptor	4.5.6/Q.2931 4.1/Q.2961.1	both	O (Note 1)	4-30

Note 1 - Included to specify the traffic parameter values allocated for the call/connection if one or more traffic parameters were negotiable in the SETUP message.

8.1.2 Information elements

8.1.2.1 Alternative ATM traffic descriptor

The purpose of the Alternative ATM traffic descriptor information element is to specify an alternative ATM traffic descriptor for the negotiation of traffic parameters during call/connection setup. This information element is applicable to CBR and VBR calls.

The Alternative ATM traffic descriptor information element is coded as shown in Figure 8-1. The maximum length of this information element is 30 octets.

Bits 8	7	6	5	4	3	2	1	Octets
Alternative ATM traffic descriptor								1
1	0	0	0	0	0	1	0	
Information element identifier								
1 Ext	Coding standard		Information Element Instruction Field					2
			Flag	Reserved	Information Element Action Ind.			
Length of Alternative ATM traffic descriptor contents								3 4
Further octets as contents of ATM traffic descriptor (Figure 4-13/Q.2931 and Figure 1/ Q.2961.1 as modified by 4.5.6/Q.2931)								5* / 18*

Figure 8-1 Alternative ATM Traffic Descriptor Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
0 0	ITU-T standardized coding

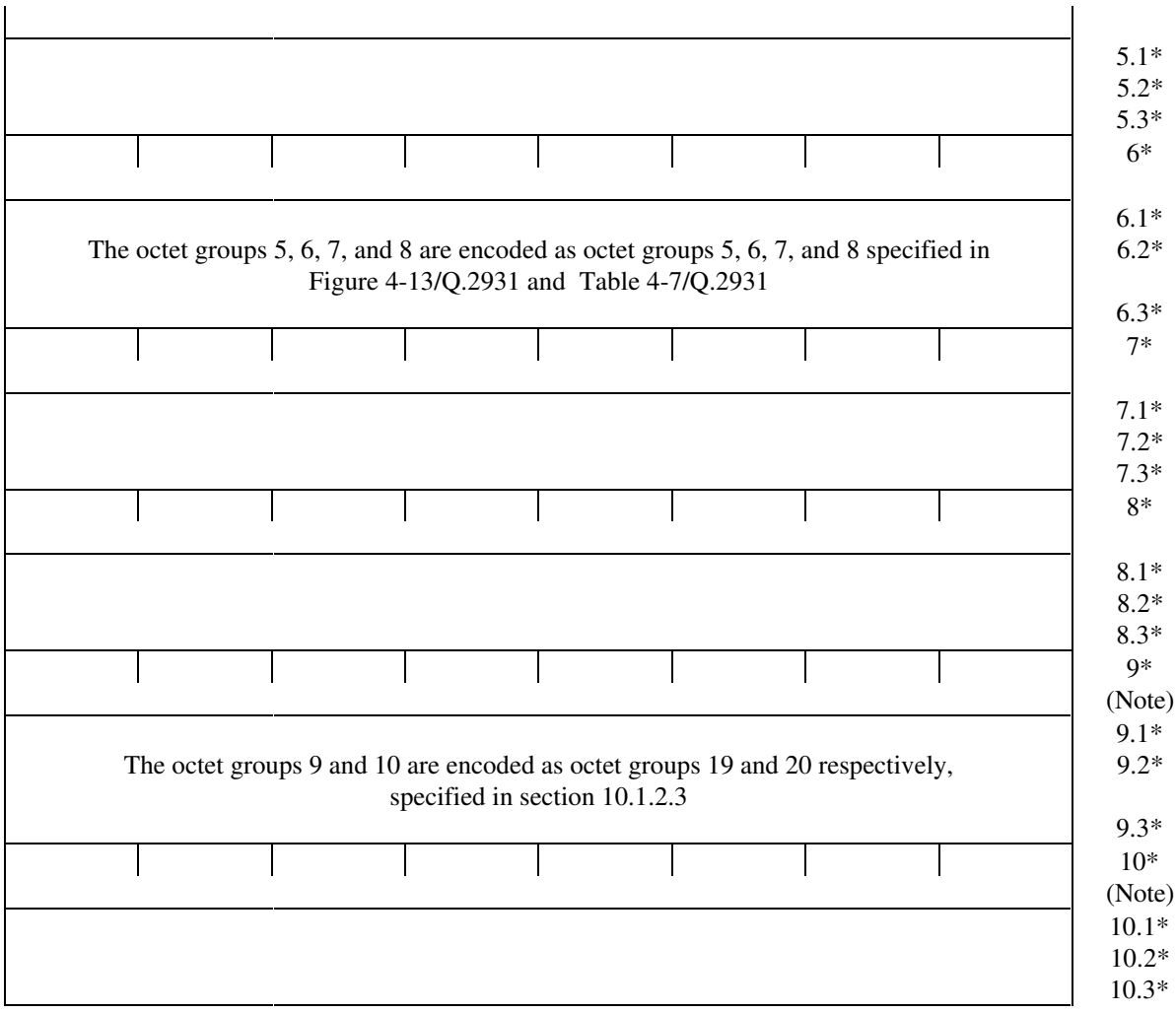
The Alternative ATM traffic descriptor information element can have any combination of traffic parameters that is allowed for the ATM traffic descriptor information element. Within a single SETUP message the combination of traffic parameters may be different for these two information elements. However, the Alternative ATM traffic descriptor information element contains the Best Effort indicator if and only if it is also contained in the ATM traffic descriptor information element. If it is determined that the alternative bandwidth requirements are "greater" than those in the ATM traffic descriptor information element, the Alternative ATM traffic descriptor information element may be treated as an information element with content error.

8.1.2.2 Minimum Acceptable ATM Traffic Descriptor

The purpose of the Minimum acceptable ATM traffic descriptor information element is to specify the minimum acceptable ATM traffic parameters in the negotiation of traffic parameters during call/connection setup. The minimum acceptable ATM traffic parameters are the lowest values that the user is willing to accept for the call/connection. This information element is applicable to CBR, VBR, ABR and UBR calls. For UBR, the negotiation procedures are described in the ATM Forum Traffic Management Specification, Version 4.0.

The Minimum acceptable ATM traffic descriptor information element is coded as shown in Figure 8-2 and Table 2-1. The maximum length of this information element is 20 octets.

Bits 8	7	6	5	4	3	2	1	Octets
Minimum acceptable ATM traffic descriptor								1
1	0	0	0	0	0	0	1	
Information element identifier								
1 Ext	Coding standard		Information element instruction field					2
			Flag	Reserved	Spare	Action indicator		
Length of Minimum acceptable ATM traffic descriptor contents								3 4
								5*



Note - These octets are only allowed for the ABR service category. For ABR service, octet groups 5 - 8 are not allowed.

Figure 8-2 Minimum acceptable traffic descriptor information element

In a SETUP message, a Peak Cell Rate traffic parameter (i.e. Forward Peak Cell Rate (CLP=0), Forward Peak Cell Rate (CLP=0+1), Backward Peak Cell Rate (CLP=0), or Backward Peak Cell Rate (CLP=0+1)) is allowed in the Minimum acceptable ATM traffic descriptor information element only if the corresponding Peak Cell Rate parameter is in the ATM traffic descriptor information element of the SETUP message (e.g. if there is no Forward Peak Cell Rate (CLP=0) parameter in the ATM traffic descriptor information element of a SETUP message then the Forward Peak Cell Rate (CLP=0) is not allowed in the Minimum acceptable ATM traffic descriptor information element of the SETUP message).

8.2 Signalling procedures

8.2.1 Negotiating the connection characteristics at the originating interface

8.2.1.1 Negotiation request (Originating interface)

The user initiates the negotiation of the connection characteristics by including in addition to the ATM traffic descriptor information element, either the Minimum acceptable ATM traffic descriptor information element or the Alternative ATM traffic descriptor information element, but not both, in the SETUP message. In the case of the use of the Alternative ATM traffic descriptor information element the parameters of the information element are handled as a single entity whereas the Minimum acceptable ATM traffic descriptor information element allows the specification of a range of values for parameters which are handled independently. If a Minimum acceptable ATM traffic descriptor information element is used the cell rates indicated shall be less than the corresponding cell rates specified in the ATM traffic descriptor information element.

If point-to-multipoint procedures are supported, the user may initiate negotiation for the first party of a point-to-multipoint call. If the user initiates negotiation, the user shall send ADD PARTY messages only if the link is in the Active state. If an ADD PARTY message is received for a call for which the SETUP message contained either a Minimum acceptable ATM traffic descriptor information element or an Alternative ATM traffic descriptor information element while in the Call Delivered state, an ADD PARTY REJECT message with a Cause information element indicating Cause #111, "*Protocol error, unspecified*" shall be sent in response.

8.2.1.2 Traffic parameter negotiation procedures (Originating interface)

When both the Minimum acceptable ATM traffic descriptor and the Alternative ATM traffic descriptor information elements are present in a SETUP message, the call shall be rejected as specified in 5.4.2/Q.2931 with Cause #73, "*Unsupported combination of traffic parameters*".

If the parameters of either the Alternative ATM traffic descriptor information element or the Minimum acceptable ATM traffic descriptor information element are not according to the allowed combinations as specified in 8.1.2.1 and 8.1.2.2 respectively, the network shall handle these information elements as if they were non-mandatory information elements with content error as specified in 5.6.8/Q.2931.

When the Minimum acceptable ATM traffic descriptor information element is included in the SETUP message and the network is able to provide the traffic parameter values specified in the ATM traffic descriptor information element, the network shall progress the connection establishment request with both the ATM traffic descriptor information element and the Minimum acceptable ATM traffic descriptor information element.

When the Alternative ATM traffic descriptor information element is included in the SETUP message and the network is able to provide the traffic parameter values specified in the ATM traffic descriptor information element and the network is able to provide the traffic parameter values specified in the Alternative ATM traffic descriptor information element, the network shall progress the connection establishment request with both the ATM traffic descriptor information element and the Alternative ATM traffic descriptor information element.

When the Alternative ATM traffic descriptor information element is included in the SETUP message and the network is able to provide the traffic parameter values specified in the ATM traffic descriptor information element and the network is not able to provide the traffic parameter values specified in the Alternative ATM traffic descriptor information element, the network shall progress the connection establishment request with the ATM traffic descriptor information element and without Alternative ATM traffic descriptor information element.

If the network is not able to provide some of the cell rates indicated in the ATM traffic descriptor information element and the Minimum acceptable ATM traffic descriptor information element is included, the procedures of 8.2.1.2.1 shall apply.

If the network is not able to provide some of the connection characteristics indicated in the ATM traffic descriptor information element and Alternative ATM traffic descriptor information element is included, the procedures of 8.2.1.2.2 shall apply.

8.2.1.2.1 Minimum acceptable ATM traffic parameter negotiation

If the network is not able to provide some of the cell rates indicated in the ATM traffic descriptor information element but is able to provide at least their corresponding cell rates in the Minimum acceptable ATM traffic descriptor information element, the network shall progress the connection establishment request after adjusting the cell rates indication in the ATM traffic descriptor information element. The adjusted parameter values will support at least the corresponding minimum acceptable values. If some of the parameters in the Minimum acceptable ATM traffic descriptor information element are still less than the corresponding parameters in the modified ATM traffic descriptor information element then the call/connection shall be progressed with the Minimum acceptable ATM traffic descriptor .information element containing all such parameters in addition to the modified ATM traffic descriptor information element. Otherwise, the call/connection shall progress with the modified ATM traffic descriptor information element and without the Minimum acceptable ATM traffic descriptor information element. For UBR, if the Minimum acceptable ATM taffic escriptor information element is present, the network should negotiate the Forwards and/or Backwards Peak Cell Rate parameters downwards to reflect the smallest bandwidth limitation along the path of the connection.

If the network is not able to provide at least the cell rates indicated in the Minimum acceptable ATM traffic descriptor, the network shall reject the connection establishment request as specified in 5.4.2/Q.2931 with Cause #37 "*User cell rate unavailable*".

8.2.1.2.2 Alternative traffic parameter negotiation

If the network is not able to provide the ATM traffic descriptor indicated in the ATM traffic descriptor information element but is able to provide the ATM traffic descriptor indicated in the Alternative ATM traffic descriptor information element, the network shall progress the connection establishment request by using the contents of the Alternative ATM traffic descriptor information element as the ATM traffic descriptor.

If the network can provide neither the ATM traffic descriptor indicated in the ATM traffic descriptor information element nor the ATM traffic descriptor indicated in the Alternative ATM traffic descriptor information element, the network shall reject the connection establishment request as specified in 5.4.2/Q.2931 with Cause #37 "*User cell rate unavailable"*.

8.2.2 Negotiation Acceptance (Originating interface)

Upon receiving an indication that the request has been accepted the network shall send a CONNECT message across the UNI and enter the Active state. The message returned to the user shall contain the ATM traffic descriptor information element indicating the cell rates finally allocated to the connection.

If no ATM traffic descriptor information element is included in the CONNECT message, the connection characteristics specified in the ATM traffic descriptor information element sent in the SETUP message shall apply.

8.3 Negotiating the connection characteristics connection at the destination interface

8.3.1 Negotiation request (Destination interface)

The network shall send a SETUP message containing, in addition to the ATM traffic descriptor information element, either the Minimum acceptable ATM traffic descriptor information element or the Alternative ATM traffic descriptor information element when traffic parameters are negotiable.

8.3.2 Traffic parameter negotiation procedures (Destination interface)

If the user is able to provide the connection characteristics specified in the ATM traffic descriptor information element, the user shall progress the connection establishment request.

If the user is not able to provide some of the cell rates indicated in the ATM traffic descriptor information element and the Minimum acceptable ATM traffic descriptor information element is included, the procedures of 8.3.2.1 shall apply.

If the user is not able to provide the ATM traffic descriptor indicated by the ATM traffic descriptor information element and Alternative ATM traffic descriptor information element is included, the procedures of 8.3.2.2 shall apply.

8.3.2.1 Minimum acceptable ATM traffic parameter negotiation

If the user is not able to provide some of the cell rates indicated in the ATM traffic descriptor information element, but is able to provide at least their corresponding cell rates in the Minimum acceptable ATM traffic descriptor information element, the user shall progress the connection establishment request.

If the user is not able to provide at least the cell rates indicated in the Minimum acceptable ATM traffic descriptor, the user shall reject the connection establishment request as specified in 5.4.2/Q.2931 with Cause #47, "*Resources not available, unspecified*".

8.3.2.2 Alternative ATM traffic parameter negotiation

If the user is not able to provide the ATM traffic descriptor indicated by the ATM traffic descriptor information element, but is able to provide the ATM traffic descriptor indicated by the Alternative ATM

traffic descriptor information element, the user shall progress the connection establishment request on the basis of the Alternative ATM traffic descriptor information element.

If the user can provide neither the ATM traffic descriptor indicated by the ATM traffic descriptor information element nor the ATM traffic descriptor indicated by the Alternative ATM traffic descriptor information element, the user shall reject the connection establishment request as specified in 5.4.2/Q.2931 with Cause #47 "*Resource not available, unspecified"*

8.3.3 Negotiation confirmation (Destination interface)

When the user receives a SETUP message and wishes to accept the request, the user responds with a CONNECT message and enters the appropriate connection state.

If the user has progressed the call based on either the Minimum acceptable ATM traffic descriptor information element or the Alternative traffic descriptor information element, the message returned by the user shall contain the ATM traffic descriptor information element with the accepted connection characteristics. If negotiation has proceeded on the basis of the Minimum acceptable ATM traffic descriptor information element, the ATM traffic descriptor information element shall contain appropriately modified values for the same set of parameters as received in the ATM traffic descriptor information element. If negotiation has proceeded on the basis of the Alternative ATM traffic descriptor information element, the ATM traffic descriptor information element shall contain the parameters and values as contained in the Alternative ATM traffic descriptor information element with the exception of the traffic management option parameters (see section 2.2.1 and Q.2961).

If the user has progressed the call based on the ATM traffic descriptor, inclusion of the ATM traffic descriptor information element in the CONNECT message is optional. If no ATM traffic descriptor information element is included in the CONNECT message, the connection characteristics specified in the ATM traffic descriptor information element sent in the SETUP message shall apply. If the ATM traffic descriptor information element is included in the CONNECT message, the connection characteristics specified in this information element shall apply.

If the user rejects the request it will send the appropriate message (RELEASE COMPLETE) and enter the Null state.

9.0 Signalling of Individual QoS Parameters

The purpose of this section is to describe the messages, information elements, and procedure modifications needed to support the signalling of individual QoS parameters. The signalling of these parameters is predicated upon the ATM Service Category in Annex 9. The messages, information elements, and procedures specified in this section support the worst-case (i.e., additive) method for accumulation of delay parameters described in the ATM Forum Traffic Management Specification, Version 4.0.

9.1 Coding Requirements

This section specifies additions and modifications to the messages and information elements used to support signalling of individual QoS parameters.

9.1.1 Modified Message Contents

9.1.1.1 CONNECT

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 9-1 below for additions to the structure of this message from that shown in Tables 3-4/Q.2931 and 8-4/Q.2971 as modified in sections 2 and 8 of this Specification.

Table 9-1 CONNECT Message Additional Contents

Message Type: CONNECT

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
End-to-end transit delay	9.1.2.1	both	O(1)	4-7
Extended QoS parameters	9.1.2.2	both	O(1)	4-13

Note 1 - Included when the called user received this information element in the SETUP or ADD PARTY message and the origin of the information element was the calling user.

9.1.1.2 SETUP

This message is sent by the calling user to the network and by the network to the called user to initiate B-ISDN call and connection establishment. See Table 9-2 below for additions to the structure of this message from that shown in Tables 3-8/Q.2931and 8-5/Q.2971as modified in sections 2, 6, 7, and 8 of this Specification.

Table 9-2 SETUP Message Additional Contents

Message Type: SETUP

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
End-to-End transit delay	9.1.2.1	both	O(1)	4-11
Extended QoS parameters	9.1.2.2	both	O(2)	4-25
QoS parameter	4.5.18/Q.2931	both	O(3)	4-6

Note 1 - Included to specify an end-to-end transit delay requirement.

Note 2 - Included to specify individual QoS parameter requirements for the call. This information element is mandatory when the QoS parameter information element is absent.

Note 3 - This information element is mandatory when the Extended QoS parameter information element is absent. When the Extended QoS parameter information element is present, the QoS parameter information element may be included to facilitate interworking with networks that do not support the Extended QoS parameter information element. See section 9.2 for further details.

9.1.1.3 ADD PARTY ACKNOWLEDGE

See Table 9-3 below for additions to the structure of this message from that shown in Table 8-11/Q.2971.

Table 9-3 ADD PARTY ACKNOWLEDGE Message Additional Contents

Message Type: ADD PARTY ACKNOWLEDGE

Significance: Global

Direction: Both

Information Element	Reference	Direction	Type	Length
End-to-End transit delay	9.1.2.1	both	O(1)	4-7

Note 1 - Included when the called user received this information element in the SETUP or ADD PARTY message and the origin of the information element was the calling user.

9.1.2 Information Elements

9.1.2.1 End-to-End Transit Delay

Add the following exceptions to section 4.5.17/Q.2931:

4.5.17/Q.2931 End-to-End Transit Delay:
The maximum end-to-end transit delay acceptable on a per call basis is specified in this information element. It includes the end user delay (e.g., AAL handling delay) in addition to the forward maximum cell transfer delay (maxCTD) objective defined in the ATM Forum Traffic Management Specification, Version 4.0. Similarly, the cumulative end-to-end transit delay specified in this information element includes the end user delay in addition to the cumulative forward maximum cell transfer delay.

The procedures which are applicable are described in Section 9.2.

The maximum length of this information element is 11 octets.

Add the following rows and note to Figure 4-23/Q.2931:

End-to-end transit delay identifier

Bits								
8	7	6	5	4	3	2	1	Octets
0	0	0	0	1	0	1	0	7*
Network generated indicator								(Note 1)

Note 1 - Included if and only if the origin of this information element is other than the originating user.

Add the following text to the end of Table 4-17/Q.2931:

- Network generated indicator [Octet 7]
  If this subfield is not present, then the origin of this information element is the originating user (so the called party can assume that the received cumulative values are end-to-end values). Otherwise, the presence of this subfield indicates the origin of this information element is other than the originating user.

9.1.2.2 Extended QoS Parameters

The purpose of the Extended QoS parameters information element is to indicate the individual QoS parameter values acceptable on a per call basis and to indicate the cumulative QoS parameter values. The QoS parameter values included in the Extended QoS parameters information element together with those included in the End-to-end transit delay information element (if present) specify a QoS capability at a UNI 4.0 interface.

The relevant QoS parameters applicable to user data transferred during the data transfer phase on the user plane are defined in the ATM Forum Traffic Management Specification, Version 4.0.

The Extended QoS parameter information element is coded as shown in Figure 9-1.
The maximum length of this information element is 25 octets.

Bits 8	7	6	5	4	3	2	1	Octets
Extended QoS parameters								
1	1	1	0	1	1	0	0	1
Information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action Ind.			2
Length of Extended QoS parameters contents								3
Length of Extended QoS parameters contents (continued)								4
Origin								5
1	0	0	1	0	1	0	0	6*
Acceptable Forward Peak-to-Peak Cell Delay Variation Identifier								
Acceptable Forward Peak-to-Peak Cell Delay Variation								6.1*
Acceptable Forward Peak-to-Peak Cell Delay Variation (cont'd)								6.2*
Acceptable Forward Peak-to-Peak Cell Delay Variation (cont'd)								6.3*
1	0	0	1	0	1	0	1	7*
Acceptable Backward Peak-to-Peak Cell Delay Variation Identifier								
Acceptable Backward Peak-to-Peak Cell Delay Variation								7.1*
Acceptable Backward Peak-to-Peak Cell Delay Variation (cont'd)								7.2*
Acceptable Backward Peak-to-Peak Cell Delay Variation (cont'd)								7.3*
1	0	0	1	0	1	1	0	8*
Cumulative Forward Peak-to-Peak Cell Delay Variation Identifier								(Note 1)
Cumulative Forward Peak-to-Peak Cell Delay Variation								8.1*
Cumulative Forward Peak-to-Peak Cell Delay Variation (cont'd)								8.2*
Cumulative Forward Peak-to-Peak Cell Delay Variation (cont'd)								8.3*
1	0	0	1	0	1	1	1	9*
Cumulative Backward Peak-to-Peak Cell Delay Variation Identifier								(Note 1)
Cumulative Backward Peak-to-Peak Cell Delay Variation								9.1*
Cumulative Backward Peak-to-Peak Cell Delay Variation (cont'd)								9.2*
Cumulative Backward Peak-to-Peak Cell Delay Variation (cont'd)								9.3*
1	0	1	0	0	0	1	0	10*
Acceptable Forward Cell Loss Ratio Identifier								(Note 2)
Acceptable Forward Cell Loss Ratio								10.1*
1	0	1	0	0	0	1	1	11*
Acceptable Backward Cell Loss Ratio Identifier								(Note 2)
Acceptable Backward Cell Loss Ratio								11.1*

Note 1 - If an acceptable forward and/or backward Peak-to-Peak CDV is included, then the corresponding cumulative forward and/or backward Peak-to-Peak CDV shall be included, respectively.

Note 2 - The acceptable forward and/or backward cell loss ratio specified is either for the CLP=0 traffic stream or for the CLP=0+1 traffic stream, depending on the conformance definition (see Annex 9).

Figure 9-1 Extended QoS Parameters Information Element

Coding Standard (octet 2)

Bits 7 6	Meaning
1 1	ATM Forum Specific

Origin (octet 5)

Indicates the origin of this information element. If the origin is the calling party, then the called party can assume that the received cumulative values are end-to-end values. Otherwise, the received cumulative values do not represent end-to-end values.

Bits 8 7 6 5	4 3 2 1	Meaning
0 0 0 0	0 0 0 0	Originating user
0 0 0 0	0 0 0 1	Intermediate network

Acceptable Forward/Backward Peak-to-Peak Cell Delay Variation (octets 6.1-6.3/7.1-7.3)

The acceptable forward and backward peak-to-peak cell delay variation parameters indicate the calling user's highest acceptable (least desired) peak-to-peak cell delay variation values, expressed in units of microseconds. They are coded as 24-bit binary integers, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit. The value "1111 1111 1111 1111 1111 1111", however, is not to be interpreted as an acceptable peak-to-peak cell delay variation value. This codepoint or the lack of this identifier in this information element indicates: 'any forward/backward peak-to-peak cell delay variation value acceptable'.

Cumulative Forward/Backward Peak-to-Peak Cell Delay Variation (octets 8.1-8.3/9.1-9.3)

The cumulative forward/backward peak-to-peak cell delay variation values are expressed in units of microseconds. They are coded as 24-bit binary integers, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit.

Acceptable Forward/Backward Cell Loss Ratio (octets 10.1/11.1)

The acceptable forward and backward cell loss ratio parameters indicate the calling user's highest acceptable (least desired) cell loss ratio values. A cell loss ratio is expressed as an order of magnitude n, where the cell loss ratio takes the value 10^{-n}. The value n is coded as a binary integer, having a range of $1 <= n <= 15$. In addition, the value "1111 1111" or the lack of this identifier in this information element indicates: 'any forward/backward cell loss ratio value acceptable'. All other values are reserved.

9.2 Signalling Procedures in Support of Individual QoS Parameters

This section describes the call/connection control procedures to support signalling of individual QoS parameters.

9.2.1 Changes to procedures of Q.2931

These procedures are in addition to the procedures in Q.2931 for specifying QoS classes.

5.1.3/Q.2931 QoS and Traffic parameters selection procedures (originating interface)
Add the following paragraphs to the end of this section:

The possible inclusion of individual QoS parameters in the SETUP message by the user is determined by the ATM service category of the call. The allowed individual QoS parameters for each ATM service category are specified in Annex 9.

If the user wants to request or indicate individual quality of service parameter values for this call, the user may include acceptable and/or cumulative values of allowed individual QoS parameters in the Extended QoS parameters information element and/or the End-to-end transit delay information element. If an acceptable value of a parameter is included, and the end-to-end value of that parameter is determined by accumulation, then the corresponding cumulative value of the parameter shall also be included. The cumulative forward and backward values of individual QoS parameters indicated by the user in the SETUP message (if present) include the cumulative values from the original user to the network boundary, and from the network boundary to the user, respectively. These values are updated sequentially along the route of the call to determine the values to be expected for this call.

The Extended QoS parameters information element takes precedence over the QoS parameter information element. The use of QoS Classes in UNI 4.0 is retained for backward compatibility with UNI 3.0/3.1 and with ITU standards (e.g. Q.2931/Q.2971). When an Extended QoS parameters information element is present, the network shall not derive values for any absent QoS parameters. When an Extended QoS parameters information element is present, if no acceptable forward value of an allowed individual QoS parameter for the corresponding ATM service category is specified (in the Extended QoS parameters or End-to-end transit delay information elements), then any value of the individual QoS parameter is deemed acceptable for this call. If the End-to-end transit delay information element is included in the SETUP message and the Extended QoS parameters information element is not included, then the QoS classes included in the QoS parameter information element shall not be used to determine any objectives for maximum end-to-end transit delays for this call/connection but may be used to determine the remaining parameters.

If the SETUP message includes an Extended QoS parameters information element and the calling user wants the call to complete even when the Extended QoS parameters information element is not supported (e.g., when interworking with UNI 3.0/3.1 or ITU standards occur), the calling user should also include the QoS parameter information element.

If the calling user does not want the call to complete when the Extended QoS parameters information element is not supported (e.g., when interworking with UNI 3.0/3.1 or ITU standards occur), the calling user should not include the QoS parameter information element.

If a user at the originating side of a Tb reference point (i.e., private network) receives a setup indication with no Extended QoS parameters information element, the user may optionally generate an Extended QoS parameter information element and/or an End-to-end transit delay information element (the latter only if none is contained in the setup indication) using a local mapping from the Forward and Backward QoS Class subfields in the QoS parameter information element. When such a mapping is used, the individual QoS parameters for which values are implied (from the QoS classes included in the QoS parameter information element and the ATM service category of the call) must be specified, and the origin of each information element including one or more of the newly generated individual QoS parameters must be marked as an ‘intermediate network’ (i.e., in the Extended QoS parameters information element the Origin field is set to ‘intermediate network’, and in the End-to-end transit delay information element a ‘network-generated indicator’ is included). The QoS parameter information element shall remain in the SETUP message progressed to the network.

If the network receives a SETUP message that does not contain any Extended QoS parameters information element and the network is able to provide the requested QoS class (including any implied values of maximum end-to-end transit delays if and only if no End-to-end transit delay information element is included), the remaining procedures in this section shall be followed. 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 receives a SETUP message that contains both the QoS parameter information element and the Extended QoS parameters information element, the network shall simply pass on the QoS parameter information element if the call is progressed and follow the remaining procedures in this section.

For each parameter contained in the Extended QoS parameters information element and/or the End-to-end transit delay information element, the network shall:

1) Additively increment the accumulated value of that parameter, if the parameter is cumulative, to account for the expected increases due to user data transfer within the network over the related connection during the data transfer phase of the call.
2) Determine if acceptable values of that parameter can be supported. If any parameter can not be supported, then the network shall reject the call, returning a RELEASE COMPLETE message with Cause #49, "*Quality of service unavailable*".

If the network detects that the Extended QoS parameters information element and/or End-to-end transit delay information element contain a non-supported set of individual QoS parameters for the ATM service category of the call (see Annex 9), the network shall return a RELEASE COMPLETE message with Cause #73*, "Unsupported combination of traffic parameters*".

If the network is able to provide the acceptable values of all specified individual QoS parameters, the network shall progress the call to the called user.

5.1.7/Q.2931 Call/Connection acceptance (originating interface)

Add the following paragraph:

If the received connect indication includes an Extended QoS parameters information element and/or an End-to-end transit delay information element, then the CONNECT message sent to the calling user shall include the Extended QoS parameters information element and/or End-to-end transit delay information element, respectively.

5.2.4/Q.2931 QoS and Traffic parameter selection procedures (destination interface)
Add the following paragraphs to the end of this section:

In the case where the network received an Extended QoS parameters information element in the setup indication, the network shall indicate the acceptable and cumulative values of each included individual QoS parameter in the Extended QoS parameters information element in the SETUP message sent to the called party.

If the network received an End-to-end transit delay information element in the setup indication, the network shall indicate the acceptable and cumulative values of the end-to-end transit delay in the End-to-end transit delay information element in the SETUP message sent to the called party.

If no Extended QoS parameters information element was contained in the received setup indication, the network may optionally generate an Extended QoS parameters information element and/or an End-to-end transit delay information element (the latter only if none is contained in the setup indication) using a local mapping from the Forward and Backward QoS Class subfields in the QoS parameter information element. When such a mapping is used, the individual QoS parameters for which values are implied (from the QoS classes included in the QoS parameter information element and the ATM service category of the call) must be specified, and the origin of each information element including one or more of the newly

generated individual QoS parameters must be marked as an 'intermediate network' (i.e., in the Extended QoS parameters information element the Origin field is set to 'intermediate network', and in the End-to-end transit delay information element a 'network-generated indicator' is included). The cumulative values of parameters generated from this mapping, as included in the SETUP message sent to the called party, must account for the known amounts due to user data transfer within the network over the related connection during the data transfer phase of the call. The QoS parameter information element shall remain in the SETUP message progressed to the user.

If the called user receives a SETUP message that does not contain an Extended QoS parameters information element, the called user shall decide whether the requested quality of service can be supported based on the QoS class and on the acceptable forward maximum end-to-end transit delay (if an End-to-end transit delay information element is included). If the called 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*."

For each parameter contained in the Extended QoS parameters information element and/or the End-to-end transit delay information element, the called user shall:

1) Additively increment the forward and backward accumulated values of that parameter, if the parameter is cumulative, to account for the expected increases due to user data transfer from the network boundary to the user or from the user to the network boundary, respectively.
2) Determine if the acceptable values of that parameter can be supported. If any parameter can not be supported, then the user shall reject the call, returning a RELEASE COMPLETE message with Cause #49, "*Quality of service unavailable*".

When an Extended QoS parameters information element is included, if no acceptable value of an allowed individual QoS parameter is specified (in the Extended QoS Parameters or End-to-end transit delay information elements), the default is that any value of the individual QoS parameter is acceptable and the user shall continue to process the call.

If the user detects that the Extended QoS parameters information element and/or End-to-end transit delay information element contains a non-supported set of individual QoS parameters for the ATM service category of the call, the called user shall return a RELEASE COMPLETE message with Cause #73, "*Unsupported combination of traffic parameters*".

5.2.6/Q.2931 Call/Connection acceptance (destination interface)
Add the following two paragraphs:

At the Sb reference point and at the coincident Sb and Tb reference point, if the received SETUP message contained an Extended QoS parameters information element or an End-to-end transit delay information element, and the origin of the information element is the originating user, then the CONNECT message sent to the network shall include the cumulative values of QoS metrics in the Extended QoS parameters information element or End-to-end transit delay information element, respectively. These values are only returned to the calling user when end-to-end cumulative values have been obtained, accounting for the entire path from the originating user to the destination user. The acceptable values of QoS parameters fields shall not be included.

If the network receives an Extended QoS parameters information element and/or an End-to-end transit delay information element in the CONNECT message containing an acceptable QoS parameter field, the field shall be discarded. The network need not check the correctness of the cumulative values of QoS metrics received in the CONNECT message.

Annex K/Q.2931 Handling of the End-to-end transit delay information element:
This annex does not apply (this annex is superseded by the procedures of this section).

9.2.2 Changes to procedures in Q.2971

The End-to-end transit delay may be specified on a leaf-by-leaf basis by the Root. If the End-to-end transit delay information element is included in the original SETUP message and this information element is not included in a subsequent ADD PARTY message, then the end-to-end transit delay is unspecified for that party.

When an add party indication is mapped into a SETUP message, the QoS parameter, Extended QoS parameters, ATM traffic descriptor, and Broadband bearer capability information elements received in the original SETUP message for this point-to-multipoint call shall be mapped into the corresponding information elements in the SETUP message progressed towards the leaf. When an add party indication that does not contain an End-to-end transit delay information element is mapped into a SETUP message:

- if the original SETUP message contained a user-generated End-to-end transit delay information element, no End-to-end transit delay information element shall be included in the SETUP message progressed toward the leaf (i.e. any value of maximum end-to-end transit delay is acceptable);
- if the original SETUP message contained a network-generated End-to-end transit delay information element, the End-to-end transit delay information element shall be mapped into the corresponding information element in the SETUP message progressed towards the leaf;
- otherwise, the procedures of Section 9.2 for the destination interface shall be followed.

If the root needs to specify the end-to-end transit delay for any party in a point-to-multipoint connection, it is recommended that the End-to-end transit delay information element be included by the root in the SETUP message and all subsequent ADD PARTY messages.

9.1.1/Q.2971 Set up of the first party
If the SETUP message contains a Broadband bearer capability information element indicating "point-to-multipoint" in the user plane connection configuration field and contains any backward value of an allowed individual QoS parameter, the network shall clear the call with Cause #73 "*Unsupported combination of traffic parameters* ".

When a user or network maps QoS classes into individual QoS parameters, the backward QoS class shall be ignored (i.e., no backward individual QoS parameters shall be created).

9.3 End-to-end transit delay relationship with ATM service categories

It is recommended that the End-to-end transit delay information element be included only if the ATM service category of the call is CBR or real-time VBR. Specification of the end-to-end transit delay for the non-real-time VBR service category is allowed, in order to retain compatibility with ITU-T Recommendations (e.g., Q.2931). Note that this inclusion is not specified by the ATM Forum Traffic Management Specification, Version 4.0. Non-real-time VBR calls with End-to-end transit delay information elements shall only be accepted when commitments can be made to achieve the specified acceptable maximum end-to-end transit delays.

10.0 Available Bit Rate (ABR) Capability

The ATM Forum Traffic Management Specification, Version 4.0 specifies the ABR capability. This section describes the signalling support required to set up a point-to-point call with ABR capability.

When establishing a point-to-point call with ABR capability, messages, information elements and procedures described in this Specification (except sections 5, 6 and 9) apply. This section describes the additional information elements and procedures applicable only for the ABR capability. The description is in an incremental form with differences from the basic point-to-point call with respect to messages, information elements and procedures for ABR being identified herein.

10.1 Coding Requirements

This sub-section describes the additional coding requirements for messages and information elements to support the point-to-point call with ABR capability.

10.1.1 Modification of Point-to-point Messages

10.1.1.1 CONNECT Message

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 10-1 for additions to the structure of this message shown in Table 3-2/Q.2931.

Table 10-1 CONNECT Message Additional Content

Message type: CONNECT

Significance: global

Direction: both

Information Element name	Reference	Direction	Type	Length
ATM traffic descriptor	4.5/Q.2931	both	O (Note 1)	12-30
ABR Setup Parameters	10.1.2.2	both	O (Note 1)	4-36
ABR Additional Parameters	10.1.2.1	both	O (Note 2)	4-14

Note 1 - Mandatory for an ABR connection.

Note 2 - Included in the user-to-network direction when the SETUP message contains the ABR additional parameters information element. Included in the network to user direction when the called user included ABR additional paramenters information element in the CONNECT message.

10.1.1.2 SETUP Message

This message is sent by the calling user to the network and by the network to the called user to initiate call establishment. See Table 10-2 for additions to the structure of this message shown in Table 3-8/Q.2931.

Table 10-2 SETUP Message Additional Content

Message type: SETUP

Significance: global

Direction: both

The Alternative ATM traffic descriptor information element is not permitted for ABR connections.

Information Element name	Reference	Direction	Type	Length
ABR Setup Parameters	10.1.2.2	both	O (Note 1)	4-36
ABR Additional Parameters	10.1.2.1	both	O (Note 2)	4-14

Note 1 - Mandatory if the calling user requested an ABR connection.

Note 2 - Included in the user-to-network direction when the calling user wants to specify explicitly a set of ABR additional parameters. Permitted only if the calling user requested an ABR connection. Included in the network-to-user direction when the calling user included it.

10.1.2 Information Elements

The modified and new information elements for ABR capability are described in this section. The new information elements are:

- ABR setup parameters, contains mandatory parameters
- ABR additional parameters, contains optional parameters

The structure of these information elements is described below.

10.1.2.1 ABR additional parameters

The purpose of the ABR Additional Parameters information element is to specify the set of additional ABR parameters during the call/connection establishment. The length of this information element is 14 octets.

	Bits							Octets
8	7	6	5	4	3	2	1	
1	1	1	0	0	1	0	0	1
ABR additional parameters information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field: Flag	Reserved	Information Element Action			2

				Ind.				
Length of ABR additional parameters information element contents								3
Length of ABR additional parameters information element contents (continued)								4
Forward Additional Parameters Record identifier								5
1	1	0	0	0	0	1	0	
Forward Additional Parameters Record								5.1
Forward Additional Parameters Record (continued)								5.2
Forward Additional Parameters Record (continued)								5.3
Forward Additional Parameters Record (continued)								5.4
Backward Additional Parameters Record identifier								6
1	1	0	0	0	0	1	1	
Backward Additional Parameters Record								6.1
Backward Additional Parameters Record (continued)								6.2
Backward Additional Parameters Record (continued)								6.3
Backward Additional Parameters Record (continued)								6.4

Coding standard (octet 2)

Bits 7 6	Meaning
1 1	ATM Forum specific

Additional Parameters Record (Octet 5.1 - 5.4 and 6.1 - 6.4)

The Additional Parameters Record is a 32-bit binary value. Bit 8 of the first octet is the most significant bit (bit position 32) and Bit 1 of the fourth octet is the least significant bit (bit position 1). The Additional Parameters value is a compressed encoding of a set of ABR parameters. See the ATM Forum Traffic Management Specification, Version 4.0, for definitions of the parameters mentioned in the table below.

To keep the encoding compact, most parameters are encoded as the $\log_2$ of the parameter value, scaled by a suitable scaling factor. In addition, some are scaled by other parameters, as described below. For each parameter there is a corresponding "present" bit, which is set to 1 to indicate that the parameter is present and 0 to indicate it is absent. If a parameter is absent, the parameter data bits shall be treated as "spare" bits.

Name	Size (bits)	Bit Position	Multiplier	Range	Encoding
Nrm present	1	32			Boolean
Trm present	1	31			Boolean
CDF present	1	30			Boolean
ADTF present	1	29			Boolean
Nrm	3	28-26	2	2-256	note 1
Trm	3	25-23	0.7813 ms	0.78-100 ms	note 1
CDF	3	22-20	1/128	0, 1/64-1	note 2
ADTF	10	19-10	10 ms	0.01-10.23 s	note 3
Spare	9	9-1			0

Note 1 - Encoded logarithmically. The encoded value is:
$\log_2$ (parameter / multiplier)
Conversely, the parameter value represented by a given encoding is:
multiplier * $2^{encoding}$

Note 2 - If the parameter value is zero, the encoding is zero. Otherwise the parameter is encoded according to Note 1.

Note 3 - Coded as a binary integer. The coding value 0 is treated as 1 (i.e., 0.01 seconds).

10.1.2.2 ABR Setup Parameters

The purpose of the ABR Setup Parameters information element is to specify the set of ABR parameters during the call/connection establishment. The maximum length of this information element is 36 octets.

Bits								Octets
8	7	6	5	4	3	2	1	
1	0	0	0	0	1	0	0	1
ABR setup parameters information element identifier								
1 Ext	Coding Standard		Information Element Instruction Field					2
			Flag	Reserved	Information Element Action Ind.			
Length of ABR setup parameters information element contents								3
Length of ABR setup parameters information element contents (continued)								4
Forward ABR Initial Cell Rate Identifier (CLP = 0+1)								5* (Note 1)
1	1	0	0	0	0	1	0	
Forward ABR Initial Cell Rate								5.1* (Note 1)
Forward ABR Initial Cell Rate (continued)								5.2* (Note 1)
Forward ABR Initial Cell Rate (continued)								5.3* (Note 1)
Backward ABR Initial Cell Rate Identifier (CLP = 0+1)								6* (Note 1)
1	1	0	0	0	0	1	1	
Backward ABR Initial Cell Rate								6.1* (Note 1)
Backward ABR Initial Cell Rate (continued)								6.2* (Note 1
Backward ABR Initial Cell Rate (continued)								6.3* (Note 1)
Forward ABR Transient Buffer Exposure Identifier								7* (Note 1)
1	1	0	0	0	1	0	0	
Forward ABR Transient Buffer Exposure								7.1* (Note 1)
Forward ABR Transient Buffer Exposure (continued)								7.2* (Note 1)
Forward ABR Transient Buffer Exposure (continued)								7.3* (Note 1)
Backward ABR Transient Buffer Exposure Identifier								8* (Note 1)
1	1	0	0	0	1	0	1	
Backward ABR Transient Buffer Exposure								8.1* (Note 1)
Backward ABR Transient Buffer Exposure (continued)								8.2* (Note 1)

Backward ABR Transient Buffer Exposure (continued)								8.3* (Note 1)
Cumulative RM Fixed Round Trip Time Identifier								9
1	1	0	0	0	1	1	0	
Cumulative RM Fixed Round Trip Time								9.1
Cumulative RM Fixed Round Trip Time (continued)								9.2
Cumulative RM Fixed Round Trip Time (continued)								9.3
Forward Rate Increase Factor Identifier								10* (Note 1)
1	1	0	0	1	0	0	0	
Forward Rate Increase Factor								10.1* (Note 1)
Backward Rate Increase Factor Identifier								11* (Note 1)
1	1	0	0	1	0	0	1	
Backward Rate Increase Factor								11.1* (Note 1)
Forward Rate Decrease Factor Identifier								12* (Note 1)
1	1	0	0	1	0	1	0	
Forward Rate Decrease Factor								12.1* (Note 1)
Backward Rate Decrease Factor Identifier								13* (Note 1)
1	1	0	0	1	0	1	1	
Backward Rate Decrease Factor								13.1* (Note 1)

Note 1 - This parameter is optional in the user-to-network direction in a SETUP message, mandatory in the network-to-user direction in a SETUP message, and mandatory in both directions in a CONNECT message.

Forward and Backward ABR Initial Cell Rate (ICR)

(octets i.1 - i.3, where i may have values 5 or 6)

These values are coded in cells per second. They are the rates at which each source may initially commence transmitting. It is coded as a 24-bit binary integer, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit. For further details see the ATM Forum Traffic Management Specification, V4.0.

Forward and Backward Transient Buffer Exposure (TBE)

(octets i.1 - i.3, where i may have values 7 or 8)

These values are coded in cells. It is the number of cells which can be supported for a VC starting up before the control loop is established. The range of this parameter is 1 through 2^{24}-1. It is coded as a 24-bit binary integer, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit. For further details see the ATM Forum Traffic Management Specification, V4.0.

Cumulative RM Fixed Round Trip Time

(octets 9 .1 - 9.3) This parameter is used to accumulate the sum of all the fixed propagation delays and queuing delays in the round trip call path from the source to the destination and back for ABR RM cells. It is coded as a 24-bit binary integer number of microseconds, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit. For further details see the ATM Forum Traffic Management Specification, V4.0.

Forward and Backward Rate Increase Factor (RIF)

(octet i.1, where i may have values 10 or 11)

This parameter controls the rate at which the cell transmission rate increases. It is signalled as $\log_2$ (RIF * 32768). The range of this parameter is 0-15. It is coded as an 8-bit binary integer, with

Bit 8 being the most significant bit and Bit 1 being the least significant bit. For further details see the ATM Forum Traffic Management Specification, V4.0.

Forward and Backward Rate Decrease Factor (RDF)

(octet i..1, where i may have values 12 or 13)

This parameter controls the rate at which the cell transmission rate decreases. It is signalled as $\log_2$ (RDF * 32768). The range of this parameter is 0-15. It is coded as an 8-bit binary integer, with Bit 8 being the most significant bit and Bit 1 being the least significant bit. For further details see the ATM Forum Traffic Management Specification, V4.0.

10.1.2.3 ATM Traffic Descriptor

Add the following traffic descriptor subfields (and related notes) to Figure 4-13/Q.2931, as modified by Figure I/Q.2961.1:

8	7	6	5	4	3	2	1	Bit Positions
Forward ABR Minimum Cell Rate Identifier (CLP = 0+1)								19* (Note 1)
1	0	0	1	0	0	1	0	
Forward ABR Minimum Cell Rate								19.1* (Note 1)
Forward ABR Minimum Cell Rate (continued)								19.2* (Note 1)
Forward ABR Minimum Cell Rate (continued)								19.3* (Note 1)
Backward ABR Minimum Cell Rate Identifier (CLP = 0+1)								20* (Note 1)
1	0	0	1	0	0	1	1	
Backward ABR Minimum Cell Rate								20.1* (Note 1)
Backward ABR Minimum Cell Rate (continued)								20.2* (Note 1)
Backward ABR Minimum Cell Rate (continued)								20.3* (Note 1)

Note 1 - If an ABR connection is being requested, this parameter is optional in the user-to-network direction in a SETUP message, mandatory in the network-to-user direction in a SETUP message, and mandatory in both directions in a CONNECT message. It is not permitted for other traffic categories.

Forward/Backward ABR Minimum Cell Rate (MCR)

(octets i.1 - i.3, where i may have values 19 or 20)

These parameters are only present for ABR connections. The forward and backward ABR minimum cell rate (MCR) parameters indicate the minimum cell rate between the users and the network. It is coded as a 24-bit binary integer, with Bit 8 of the first octet being the most significant bit and Bit 1 of the third octet being the least significant bit. Allowable combinations of Traffic Parameter subfields are described in Annex 9.

10.2 Signalling Procedures

The procedures for basic call/connection control as described in clause 5 of Recommendation Q.2931 as modified in section 2 of this Specification shall apply. Only additional procedures to handle the point-to-point ABR call/connections are described in this section. These procedures shall apply only when the SETUP message contains a Broadband bearer capability information element indicating “ABR” in the ATM transfer capability field.

10.2.1 Call/Connection Establishment at the Originating Interface

The procedures of section 2 item 5.1.1/Q.2931 shall apply with the following changes:

If the caller is requesting an ABR connection, the calling party sends a SETUP message across its user-network interface. The message shall contain a Broadband bearer capability information element indicating "ABR" in the ATM transfer capability field and "point-to-point" in the User plane connection configuration field. The ABR Setup Parameters information element is mandatory in the SETUP message.

ABR parameters for a given (forward or backward) direction may be included in the ABR setup parameters information element only if the ATM traffic descriptor information element contains a non-zero PCR (CLP=0+1) parameter for that direction. Both the forward and backward Additional Parameters Records are always included in the ABR additional parameters information element (if the information element is present), but if the PCR (CLP=0+1) parameter for a given direction in the ATM traffic descriptor information element has a value of zero, then the Additional Parameters Record for that direction shall be coded with all bits zero.

Additionally, the following rules apply:

- The Cumulative RM fixed round trip time parameter in the ABR setup parameters information element shall be set to the fixed portion of the calling user's RM cell delay contribution for the forward and backward path.
- Tagging shall not be requested.
- In the ATM traffic descriptor information element, the calling user may include value(s) for MCR in one (forward or backward) or both (forward and backward) directions.
- In the ABR setup parameters information element, the calling user may include value(s) for ICR, TBE, RIF, and RDF in one or both directions.
- If the calling user wants to allow negotiation of MCR parameter, it includes a corresponding MCR parameter in the Minimum acceptable ATM traffic descriptor parameters information element.
- In the ABR additional parameters information element, the calling user may include values for any of the parameters in the information element. For each parameter that is included, the corresponding "present" bit shall be set in the information element. For each parameter that is not supplied, the parameter bits and the corresponding "present" bit shall be set to 0.

10.2.1.1 QoS and Traffic Parameters Selection Procedures

The procedures of section 2 item 5.1.3/Q.2931 shall apply with the following changes:

In the case of an ABR connection, the following additional rules apply:

Procedures for parameter defaulting:

- Defaulting of parameters in the ATM traffic descriptor and ABR setup parameters information elements:
  The parameters that can be defaulted in the SETUP message are: MCR, ICR, TBE, RIF and RDF. If the SETUP message does not specify a value for a particular parameter in a given direction, the network shall supply a default value. In the case of MCR, the default value is zero; in the case of ICR, the default value is the corresponding PCR value; for TBE, the default value is the largest allowed value; and for RIF, the default value is 1/16 which is encoded as 11 (decimal). The default values supplied by the network (as possibly modified by the negotiation process described below) are included by the network into the SETUP message, and delivered to the called user.

The parameter negotiation by the network for the ABR service is described below.

- Negotiation of parameters in the ATM traffic descriptor and ABR setup parameters information elements:
  Parameter values for a given direction for PCR, ICR, TBE, RIF, and RDF can be negotiated by the network. MCR can be negotiated using the procedures described in section 8 if the corresponding MCR parameter is included in the Minimum acceptable ATM traffic descriptor information element in the SETUP message.

  If able to provide the indicated PCR and ABR setup parameters, the network shall progress the call towards the called user, with the original parameters.

  If unable to provide the indicated PCR, but able to provide at least the MCR value as negotiated, the network shall progress the call towards the called user, after adjusting the PCR value. The adjusted PCR value will be greater than or equal to the MCR value.

  When progressing the call, the network may, if necessary, also adjust the following ABR setup parameters: ICR, TBE, RIF and RDF. The network may adjust either or both of the forward or backward values for these parameters.

  The following table summarizes the modifications that may be made by the network:

Parameter for a given direction	Modification by the network
PCR	Decrease only
ICR	Decrease only
TBE	Decrease only
RIF	Decrease only
RDF	Increase only (Note)

  Note: At the time of publication, there is a discrepancy between the ATM Forum Traffic Management Specification, Version 4.0, and the PNNI Specification, Version 1.0, regarding the direction of modification of the RDF parameter. The above setting is aligned with the PNNI Specification, Version 1.0. An addendum will be issued to resolve this discrepancy which may result in changes to this Specification.

  Parameter negotiation maintains the following invariant:
  MCR <= ICR <= PCR.

  If the network is not able to provide the peak cell rates which are equal to MCR, then the call shall be cleared with Cause #37, "*User cell rate not available*".

  Note that the negotiation specified above occurs after parameter defaulting, if applicable. Thus the defaults specified for these parameters are not necessarily visible, with the exception of the defaults for MCR, since the default values and negotiation rules allow negotiation away from the default values. The net effect is that the value chosen by the network for default values is network specific and may take on any value in the permissible range for each of these parameters.

- Negotiation of parameters in the ATM additional parameters information element:
  Individual parameter values for the ATM additional parameters can be negotiated by the network only when the parameter is present (i.e., was supplied by the calling user). If the parameter is absent, the

default value applies, and no negotiation is possible for the parameter in this case. If the ATM additional parameters information element is not included in the SETUP message, then the default values apply to all the (additional) parameters and none is negotiable. The default values for these parameters are specified in the ATM Forum Traffic Management Specification, Version 4.0.

The ATM Forum Traffic Management Specification, Version 4.0, provides further detail on considerations relating to negotiation. The following table summarizes the modifications that may be made:

Parameter for a given direction	Modification by the network
Trm	(Note)
CDF	Increase only
ADTF	Decrease only

Note - If the indicated Trm value is not supported, it can be changed to the default value by clearing the indicated present bit.

A parameter is negotiable up to its fixed bound specified for its encoding.

- Processing of the Cumulative RM fixed round trip time parameter in the SETUP message:

  The network shall adjust the Cumulative RM fixed round trip time parameter in the ABR setup parameters information element when forwarding a SETUP message for an ABR connection. The amount of the adjustment is the fixed portion of the RM cell delay through the network (see Annex 10).

10.2.1.2 Call/Connection acceptance

In addition to the procedures of 5.1.7/Q.2931, the CONNECT message shall contain an ABR setup parameters information element, and, if included in the received connect indication, an ABR additional parameters information element.

10.2.2 Call/connection establishment at the destination interface

10.2.2.1 QoS and traffic parameter selection procedure

The procedures of 5.2.2.2.1/Q.2931 shall apply with the following changes:

Upon receipt of a SETUP message, the called user examines the ATM traffic descriptor and the ABR setup parameter values. MCR can be negotiated using the procedures described in section 8, if the corresponding minimum acceptable ATM traffic descriptor value for MCR is included in the SETUP message. To accept the call, the user shall take one of the following actions:

1. If able to support the indicated PCR and ABR parameter values, the user shall return a CONNECT message with the PCR and ABR parameters.

2. Otherwise, the user shall negotiate the PCR and/or the ABR parameters as described below and return a CONNECT message with the negotiated values:

- If unable to provide the indicated PCR, but able to provide at least the MCR value as negotiated, the user shall adjust the PCR value down to a value not less than the MCR value.
- The user may adjust the following ABR setup parameters: ICR, TBE, RIF and RDF. The called user may adjust these parameters in the forward and/or backward direction(s).
- The user may adjust the ABR additional setup parameters that are present in the SETUP message.

The parameter modifications are summarized in section 10.2.1.1, above.

10.2.2.2 Call/Connection Acceptance

The procedures of section 2 item 5.2.6/Q.2931 shall apply with the following changes:

The called user shall include an ABR setup parameters information element in the CONNECT message with the same set of parameters as in the received SETUP message.

If the user wishes to accept or modify any of the parameters in the received ABR additional parameters information element, the user shall include the ABR additional parameters information element in the CONNECT message with the accepted/modified parameters.

The adjustment of the RM cell delay for the forward and backward path is described in Annex 10.

10.2.2.3 Call/Connection Rejection

In addition to the normal call rejection procedures described in section 2, the following procedure also applies:

If the called user is not able to support a PCR that is greater than or equal to the MCR (and less than the PCR value received in the SETUP message), the user shall reject the call, returning a RELEASE COMPLETE message with Cause #47*, "Resources unavailable, unspecified*".

Annex 1: Guidelines for Use of ATM Address Formats

[Normative]

The goals of the address formats given in this Specification are:

a. To ensure that the addressing scheme is easy to administer,
b. To construct a scalable address structure,
c. To provide the ability to identify one or more ATM endpoints,
d. To accommodate public/private interworking using existing technology where appropriate.

The following guidelines are given to clarify the use of addressing in ATM networks from the perspective of users, service providers, and equipment providers:

1. The ATM address contains an Authority and Format Identifier (AFI), and an Initial Domain Identifier (IDI). In ISO 8348, the purpose of the AFI is to specify: the format of the IDI; the network addressing authority responsible for allocating values of the IDI; whether or not leading zero digits in the IDI are significant; and the abstract syntax of the DSP. The IDI specifies: the network addressing domain from which the values of the DSP are allocated; and the network addressing authority responsible for allocating values of the DSP from that domain. Thus, the combination of the AFI and IDI, which form the Initial Domain Part (IDP) of the ATM address, uniquely specify an administrative authority which has responsibility for allocating and assigning values of the DSP.

2. For the ISO ICD IDI format, the International Code Designator (ICD) is allocated and assigned by the ISO 6523 registration authority. The Administrative Authority (AA) is defined by the coding scheme specified by the ICD.

3. For the ISO DCC IDI format, the DCC is allocated and assigned to countries. The ISO National Member Body for that country (or, where no Member Body exists, another appropriate organization) allocates and assigns the Administrative Authority.

4. The ICD and DCC format are useful for organizations that wish to maintain a private numbering plan that is organizationally based.

5. The E.164 format is useful for organizations that may wish to use the existing largely geographically based public ISDN/telephony numbering format. The full ISDN number identifies an authority responsible for allocating and assigning values of the DSP. The authority is some entity within the organization which subscribes to the B-ISDN interface.

   Note 1 - For private ATM networks which are attached to one or more public ATM networks, this format must be used topologically (i.e. this format must be used with a native (non-NSAP) E.164 address(es) which identify one or more attachment points of the private network to the public network).

   For individual private networks that are connected to multiple public networks, there are several alternative methods which may be used for addressing and routing. The best manner to handle this situation is for further study. NSAP Guidelines (RFC 1629) discusses several alternatives in this case and describes their relative advantages and disadvantages.

6. At the private UNI, the private ATM address will be carried in the Called party number information element. The Called party subaddress information element is not used to carry the private ATM address, but can be used to carry a NSAP subaddress.

7. At the public UNI, when the public network supports only the native E.164 address format, the gateway of the private network will signal the appropriate native E.164 number in the Called party number information element and the private ATM address in the Called party subaddress information element (Type of subaddress = User specifed ATM endsystem address). If a NSAP address is used in addition to the private ATM address, Called party subaddress information element may appear twice (Type of subaddress = NSAP subaddress).

8. At the public UNI, when the public network supports the private ATM address format, the private ATM address will be carried in the Called party number information element. The Called party subaddress information element is not used to carry the private ATM address, but can be used to carry a NSAP subaddress.

9. A call originated on a Private UNI destined for an endsystem which only has a native E.164 address (i. e., a system directly attached to a public network supporting the native E.164 format) will code the Called party number information element in the NSAP-formatted E.164 Private ATM address format, with the DSP field set to zero.

10. The HO-DSP field of the private ATM address format should be constructed in such a way as to allow hierarchical routing and efficient use of resources. That is, the sub-allocation of fields within the HO-DSP shall be assigned with topological significance. This Specification makes no restriction on the number of subfields within the HO-DSP. The total length of the HO-DSP is fixed at 10 octets for the DCC and ICD formats and at 4 octets for E.164 private address format.

11. The private ATM address format uses:

    - Type of Number and Addressing/Numbering Plan Identification of "Unknown/ATM Endsystem Address" when conveyed via Called party number and Calling party number information elements, and

    - Type of Address as "ATM endsystem address" when conveyed via Called party subaddress or Calling party subaddress information elements.

    As an example of how the HO-DSP might be sub-allocated, consider the U.S. GOSIP coding scheme. This coding scheme has a registered ICD allowing the ICD format to be used and is indicated by an IDI of 0005. Of the 10 octets of the HO-DSP, GOSIP defines the first octet as a Domain Format Identifier (DFI). For a DFI value of 80, the next three octets are defined as the Administrative Authority (AA). The AA represents an organization to which NIST has delegated the administrative authority to sub-allocate addresses within that unique address prefix (IDP+DFI+AA). The remaining six octets of the HO-DSP can be carved up in whatever manner suits the internal structures of that organization. For example, they might want to structure a hierarchy around divisions, campuses, buildings, and switches. They might designate the first three semi-octets to divisions, the next four to campuses, the next two to buildings, and the last three to switches or groups of switches.

Useful tutorial material and supporting technical information on use of OSI NSAP addresses can be found in RFC 1629.

Annex 2: Proxy Signalling Capability

[Normative]

A2.1 Definition

Proxy Signalling is an optional capability for both the network and the user. When supported, it requires prior agreement (e.g. subscription) between the user and the network. Proxy Signalling allows a user, called the Proxy Signalling Agent (PSA), to perform signalling for one or more users that do not support signalling. The PSA may have one or more signalling Virtual Channels. Associated with each signalling VC is a set of VPCs that it controls, these VPCs may be across different UNIs. In addition, there may be an ILMI VC associated with each signalling VC.

The proxy signalling capability can be used to allow high end ATM equipment to support multiple physical interfaces that share the same ATM address. This gives the high-end equipment the ability to support connections with an aggregate bandwidth in excess of the line rate of any given physical interface. Of course, individual connections must be at a rate that is less than or equal to the line rate.

For example, consider a file server that is attached to a switch with four 155Mb/s physical interfaces that all use the same ATM address. The same server ATM address is used by all end users independent of which physical interface is used to connect to the file server. Individual connections must be less than or equal to 155 Mb/s but the total bandwidth to the server can be up to 622 Mb/s.

A2.2 Provisioning

The following subscription information is required for this capability for each signalling VC:

- The list of directory numbers that are routed to the PSA over the signalling VC.
- A mapping of VPCI values to a specific UNI and VPI combination for each VP controlled by the PSA over the signalling VC
- The VPI and VCI for the signalling VC and of the associated ILMI VC (if present).
- The virtual channel call offering procedures supported.
- As an option, the association of directory numbers with VPCIs may be provided to the network to allow the network to select the VPCI on incoming calls and to route point-to-multipoint calls properly (e.g., to know when to send a SETUP vs. an ADD PARTY message to the PSA).

  Note - The assigned VCI for the signalling channel may be other than 5 and the assigned VCI for ILMI may be other than 16. Multiple signalling and multiple ILMI virtual channels may be assigned within a VP.

A2.3 Procedures

The PSA and network can utilize the messages, procedures and information elements as described in this Specification, with amendments as described in this annex. When in conflict the annex procedure applies.

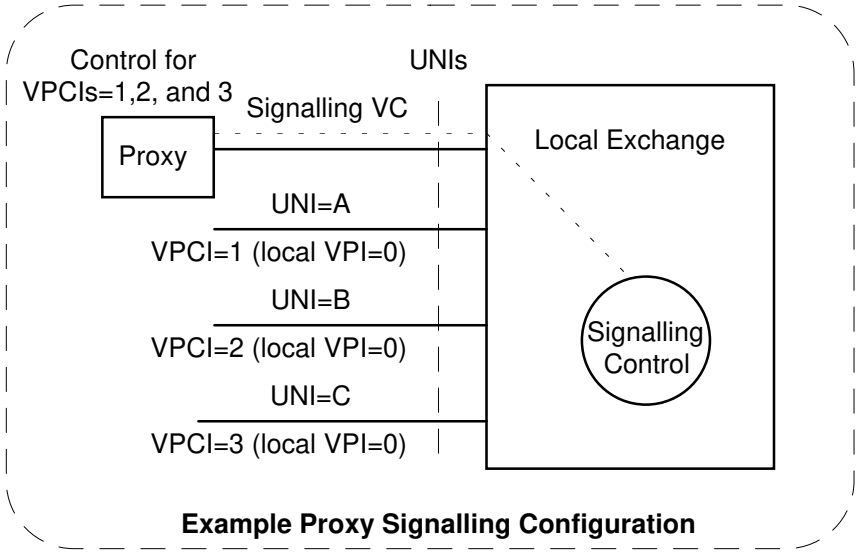
The PSA may originate or terminate a point-to-point or a point to multipoint call for both normal and LIJ calls.

When providing a signalling VC to a PSA, the switch (and PSA) shall support Non-associated signalling over that VC. The switch shall be able to support case b) during call origination. In addition, the switch must support the following subscription options on a signalling VC basis, which are user selectable, to be applied during incoming call offering (5.2.3.2/Q.2931):

- Only cases a) and c) of 5.2.3.2/Q.2931 shall be used
- Only case c) of 5.2.3.2/Q.2931 shall be used

A2.4 Remote Proxy Signalling Agent

As a further option, a network may allow the PSA to be remotely located on another switch than the UNIs that it controls. When supported, this will require the provisioning of the signalling VC and if needed an ILMI VC from the PSA to the switch on which the controlled UNIs reside. The switch to which the PSA is directly connected will treat these VCs as PVCs and need not be aware of the intended use. The PSA shall use the same signalling procedures in this case.



Example Proxy Signalling Configuration

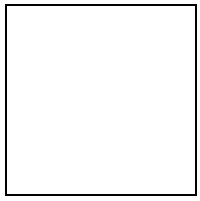
Provisioned VPCI Mapping

VPCI	Physical Interface	VPI
1	A	0
2	B	0
3	C	0

Proxy Signalling Example

A2.5 Example Message Flow

This is an example message flow for the PSA originating a call from user A to user B, where the PSA is a proxy for both user A and user B.



Annex 3: Common Identification of Leaf Initiated Join Calls

[Normative]

For *Network LIJ* calls, for which a network performs network join, the network must uniquely identify the LIJ calls so as to associate LEAF SETUP REQUEST messages with existing LIJ calls. To do this, the network pairs the "Root's address" with the LIJ call identifier. When the Root creates a *Network LIJ* call, the Root's address is taken from the Calling party number or the Calling party subaddress information element of the SETUP message as follows:

- If the SETUP message does not contain a Calling party subaddress with an Addressing/Number Plan of "ATM Endsystem Address", then the address from the Calling party number information element is paired with the LIJ call identifier to form the common identifier for the *Network LIJ* call.

- If the SETUP message does contain a Calling party subaddress with an Addressing/Number Plan of "ATM Endsystem Address," then the address from the Calling party number information element is combined with the address from the Calling party subaddress information element and with the LIJ call identifier to form the common identifier for the *Network LIJ* call. In this case, the Calling party number is ignored for the purposes of forming the common identifier.

The rationale behind this algorithm is to generate a common identifier that represents the identity of the Root and not an arbitrary entry point to a public network over which the SETUP message entered the network. Hence, the Calling party number is ignored if a Calling party subaddress of type "ATM Endsystem Address" is present in the SETUP message (since the latter contains the Root's true identity). When a LEAF SETUP REQUEST message is received, the network extracts information from the LEAF SETUP REQUEST message to identify the *Network LIJ* call the Leaf wishes to join as follows:

- If the LEAF SETUP REQUEST message does not contain a Called party subaddress with an Addressing/Number Plan of "ATM Endsystem Address", then the address from the Called party number information element is paired with the LIJ call identifier to form the common identifier for the *Network LIJ* call.

- If the LEAF SETUP REQUEST message does contain a Called party subaddress with an Addressing/Number Plan of "ATM Endsystem Address", then the address from the Calling party number information element is combined with the address from the Calling party subaddress information element and with the LIJ call identifier to form the common identifier for the *Network LIJ* call. In this case, the Called party number is ignored for the purposes of forming the common identifier.

Annex 4: Supplementary Services

[Normative]

A4.1 Direct Dialling In (DDI)

ITU-T Recommendation Q.2951 Clause 1 shall apply with the extensions of Annex C/Q.2971.

Only two combinations of Type of Number and Addressing/Numbering Plan are supported:

- Unknown/ATM Endsystem Address
- International number/ISDN numbering plan (E.164).

Only the full number may be provided, i.e., partial numbers are not allowed.

Overlap receiving is not supported.

Delivery of the Called Party Number information element is mandatory.

A4.2 Multiple Subscriber Number (MSN)

ITU-T Recommendation Q.2951 Clause 2 shall apply with the extensions of Annex C/Q.2971.

Only two combinations of Type of Number and Addressing/Numbering Plan are supported:

- Unknown/ ATM Endsystem Address
- International number/ISDN numbering plan (E.164).

Only the full number may be provided, i.e., partial numbers are not allowed.

Delivery of the Called Party Number information element is mandatory.

A4.3 Calling Line Identification Presentation (CLIP)

ITU-T Recommendation Q.2951 Clause 3 shall apply with the extensions of Annex C/Q.2971.

Only two combinations of Type of Number and Addressing/Numbering Plan are supported:

- Unknown/ ATM Endsystem Address
- International number/ISDN numbering plan (E.164).

Annex A describing the two-number delivery option is not supported.

A4.4 Calling Line Identification Restriction (CLIR)

ITU-T Recommendation Q.2951 Clause 4 shall apply with the extensions of Annex C/Q.2971.

A4.5 Connected Line Identification Presentation (COLP)

ITU-T Recommendation Q.2951 Clause 5 shall apply with the extensions of Annex C/Q.2971.

Only two combinations of Type of Number and Addressing/Numbering Plan are supported:

- Unknown/ATM Endsystem Address
- International number/ISDN numbering plan (E.164).

6.11.1/Q.2951: When interworking from N-ISDN to B-ISDN, if the connected party number is coded as a National or Subscriber number in an ISDN numbering plan, it shall be converted to an International Number in an ISDN numbering plan.

A4.6 Connected Line Identification Restriction (COLR)

ITU-T Recommendation Q.2951 Clause 6 shall apply with the extensions of Annex C/Q.2971.

A4.7 Subaddressing (SUB)

ITU-T Recommendation Q.2951 Clause 8 shall apply with the extensions of Annex C/Q.2971.

Annex 1 provides additional information on the use of subaddresses.

A4.8 User to User Signalling (UUS)

ITU-T Recommendation Q.2957 Clause 1 shall apply with the extensions of Annex D/Q.2971.

Annex 5: Guideline for assigning ATM Group addresses

[Normative]

This Annex defines ATM groups and the format of ATM group addresses. ATM groups and ATM group addresses are used in this Specification for support of the ATM anycast capability. An *ATM group* represents a collection of ATM end systems. An ATM group has one or more members, and an ATM end system can be a member of zero or more ATM groups at any time. One of the ways an ATM endsystem may join or leave a group at any time is by using the ILMI client address registration and deregistration procedures (see the ATM Forum ILMI Specification, Version 4.0); additional ways of joining or leaving a group are for further study.

A5.1 Format of ATM Group Addresses

There are two types of ATM endsystem addresses: individual and group addresses. There is a one-to-one correspondence between the AFIs of individual ATM endsystem addresses and AFIs of group ATM endsystem addresses. Table A5-1 indicates the relationship between the AFIs of individual and group addresses.

Table A5-1. Relationship of AFI Individual and Group Values

Individual	Group	Individual	Group	Individual	Group
0xFF					
10	A0	40	BE	70	DC
11	A1	41	BF	71	DD
12	A2	42	C0	72	DE
13	A3	43	C1	73	DF
14	A4	44	C2	74	E0
15	A5	45	C3	75	E1
16	A6	46	C4	76	E2
17	A7	47	C5	77	E3
18	A8	48	C6	78	E4
19	A9	49	C7	79	E5
20	AA	50	C8	80	E6
21	AB	51	C9	81	E7
22	AC	52	CA	82	E8
23	AD	53	CB	83	E9
24	AE	54	CC	84	EA
25	AF	55	CD	85	EB
26	B0	56	CE	86	EC
27	B1	57	CF	87	ED
28	B2	58	D0	88	EE
29	B3	59	D1	89	EF
30	B4	60	D2	90	F0
31	B5	61	D3	91	F1
32	B6	62	D4	92	F2
33	B7	63	D5	93	F3
34	B8	64	D6	94	F4
35	B9	65	D7	95	F5

36	BA	66	D8	96	F6
37	BB	67	D9	97	F7
38	BC	68	DA	98	F8
39	BD	69	DB	99	F9

A5.2 ATM Forum Well-known Group Addresses

Well-known group addresses are used to identify ATM groups that implement well-known services, e.g., LAN Emulation configuration server service. To support well-known group addresses, the network prefix "C50079" has been allocated to the ATM Forum. ATM Forum well known addresses will be assigned for use in specifications of the ATM Forum's technical committees. To request an ATM Forum well-known group address, a contribution shall be submitted to the technical committee stating the need.

A5.3 Membership Scope

Membership scope specifies the inclusive routing hierarchy in which the member's membership will be known. Members shall be able to specify their scope of membership during the ILMI client address registration procedure. This scope object represents a routing range such that calls made to a group address by an ATM endsystem within this routing range may reach the registered member and calls made to a group address by an ATM endsystem outside the routing range will not reach the registered member. The membership scope shall be structured according to the network's routing hierarchy. To allow flexibility in re-structuring a network's routing levels while not affecting user's membership scope control, the membership scope uses an indirect mapping from this membership scope to a network's routing scope. For example, this membership scope may be mapped to the routing level of ATM Forum PNNI's routing protocol. This mapping is network specific and shall be configurable.

The design of the membership scope control considers how it may be used in the real world. Most applications would like to control the reachability according to a human organization's hierarchy such as intra-network, intra-site, intra-organization, intra-community, and global. This model is adopted to design the membership scope for ATM networks. To allow other scoping models in the future, the scoping model will be indicated with the membership scope. The type of scoping model described in this Specification is 'organizational'.

To allow finer granularity between the identified organizational hierarchy and to allow growth, fifteen levels of scope hierarchy are defined as follows:

1 local network
2 localPlusOne
3 localPlusTwo
4 siteMinusOne
5 intraSite
6 intraSitePlusOne
7 organizationMinusOne
8 intraOrganization
9 organizationPlusOne
10 communityMinusOne
11 intraCommunity

12 communityPlusOne
13 regional
14 interRegional
15 global

The following defines the semantic of the identified organizations -

1. Local Network - this shall map to the concept of a physical network. Using Ethernet as an example, a single Ethernet segment and multiple Ethernet segments extended by repeaters or bridges may be treated as a local network. Therefore, the network operator shall configure the mapping of membership scope "local network" to map to the routing levels which provides the semantics as defined above. For example, the mapping may be to a bottom level peer group, or a peer group of higher level in PNNI's routing hierarchy to simulate extended physical networks.
2. The values 2-4 may be mapped to ATM sub-networks which do not use inter-building or wide-area links.
3. Intra-Site - this scope identifies the inclusive routing hierarchy which are not geographically separated. This is to allow the network operator to confine the traffic within a local location, therefore to avoid using wide-area links or inter-building links.
4. The values 6-7 can be used to identify ATM networks that may use inter-building links or wide-area links.
5. Intra-Organization - this scope identifies ATM networks which represent the inclusive routing hierarchy of an autonomous organization. An autonomous organization is defined to be an organization who has administrative authority of the network. The ATM networks identified by this membership scope therefore may use inter-building and wide-area links.
6. The values 9-10 can be used to identify union of more than one organizations.
7. The values 11-14 can be used to identify ATM networks which represent a collection of autonomous organizations that are organized by a provider or organizational partnership.
8. Global - this scope represents all autonomous organizations which form a connected private ATM network.

Annex 6: Connection Scope Selection

[Normative]

This Annex describes the processing of the Connection scope selection information element.

The ATM anycast capability allows a calling user to indicate to the network a connection scope such that the connection request containing a group address may reach a group member within this connection scope, but not any group member outside this connection scope. The connection scope is indicated to the network by including a Connection scope selection information element in the SETUP message of a point-to-point connection, as defined in section 7.2.2.1. Connection scope is represented as an organizational scope value, as described in Annex 5.

The user may identify the selected connection scope in the SETUP message. One instance of the Connection scope selection information element may be specified by the user in the SETUP message. If the user does not specify a Connection scope selection information element in the SETUP message and the SETUP message contains an ATM group address in the called party number information element, the network shall assume the default value of “localNetwork(1)”.

The procedures for selection of an ATM group member within the connection scope are not specified in this document. When a Connection scope selection information element is present in a received SETUP message, the call shall be progressed with the Connection scope selection information element.

A7: Procedures when Optional Capabilities are not supported

[Normative]

In Table 1-2, a number of capabilities are identified as optional. This annex specifies/clarifies the procedures that apply when the capabilities are not supported.

A7.1 Point-to-multipoint

When a terminal does not implement the point-to-multipoint procedures of section 5, the terminal will treat all the new messages and information elements defined in that section as unrecognized and follow the point-to-point procedures specified in section 2.

A7.2 Leaf Initiated Join (LIJ)

When a terminal or a network does not support the LIJ capability in section 6.0, the new information elements shall be treated as unrecognized according to the procedures of 5.6/Q.2931 and the point-to-point procedures specified in section 2 and/or the point-to-multipoint procedures specified in section 5 shall apply. The new messages that are sent with the dummy call reference shall be discarded and ignored by equipment not implementing the LIJ capability.

A7.3 ATM Anycast

When a terminal or network, which does not support the Anycast capability specified in section 7, receives a SETUP message with an Anycast address the call will be rejected with Cause #28, "*Invalid number format (incomplete number)*".

A7.4 Virtual UNIs

When a network does not support the Virtual UNIs capability specified in Annex 8, no new procedures are needed since no new messages or information elements are defined and when only the default signalling virtual channel is supported any signalling channel on a VPI other than 0 will not be recognized as such.

A7.4 Switched Virtual Path

When a terminal or a network, which does not support the Switched Virtual Path capability, receives a SETUP message for a Switched VP, it shall reject the call with Cause #65, *"bearer service not implemented"*.

A7.5 Proxy Signalling

When a terminal or a network does not support the Proxy Signalling capability specified in Annex 2, no new procedures are needed since no new messages or information elements are defined.

A7.6 Frame Discard

When a terminal does not support the Frame Discard capability specified in Section 2.2.1, no new procedures are need since no new messages or information elements are defined. However, the terminal must ignore the Frame Discard indicator bits in the ATM traffic descriptor information element (i.e. the terminal shall not take error action on the bits).

When a network does not support the Frame Discard capability, it shall transport the Frame Discard indicators in the setup and connect indications if the protocol on the egress interface supports the indicators.

A7.7 ABR

When a terminal or a network, which does not support the ABR capability, receives a SETUP message for an ABR call, it shall reject the call with Cause #65, *"bearer service not implemented"*.

A7.8 Generic Identifier Transport

When a terminal or a network, which does not support the Generic Identifier Transport capability specified in section 2.2.2, receives a message containing a Generic identifier transport information element, it shall treat the information element as an unrecognized information element according to the procedures specified in 5.6/Q.2931.

A7.9 Traffic Parameter Negotiation

When a terminal or a network, which does not support the Traffic Parameter Negotiation capability specified in section 8, receives a SETUP message containing either the Alternative ATM traffic descriptor or the Minimum ATM traffic descriptor information elements, it shall treat the information element as an unrecognized information element according to the procedures specified in 5.6/Q.2931.

A7.10 Supplementary Services

No new procedures are needed when the supplementary services defined in Annex 4 are not supported.

Annex 8: Virtual UNIs

[Normative]

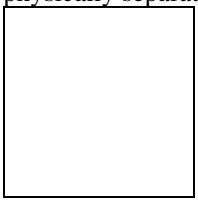
In this Specification, virtual UNIs are supported across a physical UNI by assigning each end user one or more VPCs and then using a VPC cross-connect to combine the user VPCs onto a single facility going to a switch. On the user side, signalling messages shall use VPI=0, VCI=5 and ILMI messages shall use VPI=0, VCI=16. On the switch side, a unique VPI would be used to distinguish between individual users.

Supporting multiple signalling channels implies supporting multiple users on a UNI which also then requires support for multiple ILMI channels (one for each signalling channel). See the ATM Forum ILMI Specification, Version 4.0.

A8.1 Signalling

As shown in this example configuration, end users use VPI=VPCI=0, VCI=5 for all signalling. In order to be backwards compatible with UNI 3.1 compliant end-systems, the network shall be able to associate VPIs with a unique combination of (VPCI, Signalling Channel VPI). This would allow end systems to set the VPCI equal to the VPI even when VP cross-connects are used in the access. The switch maintains a translation table between VPCI and VPI. For the user, the VPCI is equal to the VPI. The VPCI remains constant in the signalling message as it travels between the user and switch. The VPI associated with the VPCI is used at each end for the actual user traffic. The use of VPCIs is described in section 5.1.2.2/Q.2931.

As an example assume that a switch is connected to the VP mux with an OC3 and that three users are connected to the mux with 51 Mb/s twisted pair interfaces. On the user side, each user is assigned VPI 0 and 1. These are translated to the unique values shown in the table on the switch side. Signalling and ILMI would use the default VCI on VPI zero on the user side and would be translated to VPI values 1, 3 and 5 for users 1, 2 and 3, respectively. This is shown in the Figure below. Although this example figure shows a physically separate VP multiplexer, this functionality could be included in the end-user equipment.



A8.2 OAM cells

VC based OAM cells (both end-to-end and segment) shall not be processed at the VP cross-connect since this device does not have VC visibility. For VC services (i.e. the switch does VC processing), segment OAM cells shall be processed at the switch. End-to-end VP OAM cells shall not be processed at the VP cross connect or the switch (unless the switch is the endpoint for the VP). In order to allow the user to verify connectivity to the switch, the VP cross connect shall not process segment VP OAM cells, but rather let the switch do the processing. Loopbacks would then test the whole path from the user to the switch instead of only a portion of the path. This also helps hide the VP cross connect from the user. The VP cross connect shall generate fault management cells in the event of a failure.

A8.3 Management of the VPI Mux

Management of the VPI Mux is beyond the scope of this Specification.

Annex 9: Guidelines on the use of Bearer Class, Traffic Parameters, and QoS

[Normative]

A9.1 Bearer Class

The following provides a brief description of what is meant by the various BCOB classes in the Bearer capability information element.

A9.1.1 BCOB-A

This class is only used for requesting a virtual channel service. When the user specifies BCOB-A, the user is requesting more than an ATM only service. The network may look at the AAL information element to provide interworking based upon its contents. One example of such interworking would be between an ATM user calling a non-ATM user who has switched DS1 capability. In this case, the network interworking function would need to know the AAL used to be able to perform this interworking function. Another example is for interworking with N-ISDN circuit switching service.

A9.1.2 BCOB-C

This class is only used for requesting a virtual channel service. As for BCOB-A, when the user specifies BCOB-C, the user is requesting more than an ATM only service. The network may look at the AAL information element to provide interworking based upon its contents.

A9.1.3 BCOB-X

This class is only used for requesting a virtual channel service. When the user specifies BCOB-X, the user is requesting an ATM only service from the network. In this case, the network shall not process any higher layer protocols (e.g. AAL protocols).

The difference between BCOB-X and the other classes is what service is being requested from the network. For the VBR user that wants only a ATM cell relay service, the user should specify BCOB-X and Traffic Type VBR.

A user, that is placing a DS1 circuit emulation call but does not want to allow interworking, should specify BCOB-X and Traffic Type CBR. If the user wishes to allow interworking then the user should specify BCOB-A.

A9.1.4 Transparent VP Service

When the user specifies Transparent VP Service, the user is requesting an ATM only service from the network. This service differs from BCOB-X in that with the Transparent VP Service, both the VCI field (except for VCI values 0, 3, 4, and 6 through 15) and Payload Type field will be transported transparently by the network.

A9.2 Determination of ATM Service Category

The ATM service categories assigned to connections at UNI 4.0 are defined in the ATM Forum Traffic Management Specification, Version 4.0. An explicit way of requesting a particular ATM service category is not provided in UNI 4.0 signaling. Instead, the requested ATM service category must be derived from three pieces of information in a signaling message. The ATM service category is derived from -

1. the Broadband bearer class in octet 5 of the Broadband bearer capability (BBC) information element,

2. the absence or presence of the ATM transfer capability (ATC) octet (octet 5a) in the Broadband bearer capability information element,

3. and the value of the ATC if present, and the absence or presence of the Best effort indicator in octet 18 of the ATM Traffic Descriptor information element.

The octet representing ATC has been changed from containing two relevant fields in UNI 3.x to a single field in UNI 4.0. The two fields in UNI 3.x were "Traffic Type" which indicated whether the traffic was CBR or VBR, and "Timing Requirements" which indicated whether end-to-end timing was required or not. In UNI 4.0 the entire octet 5a was changed to a single field and named the ATM Transfer Capability. For reasons of backward compatibility valid pairs of codepoints from the previous two fields were maintained and incorporated into single-field codepoints for ATC. In addition, new codepoints for the ATC have been defined.

Table A9-1 summarizes the different combinations of Broadband bearer class, ATC, and Best effort indicator which define the ATM service categories. In addition the table provides a correlation between the single-field ATC codepoints and meaning of these codepoints in terms of the old two fields in octet 5a of the BBC information element in UNI 3.0/3.1.

Table A9-1: Derivation of ATM Service Categories from Signaling Information

ASC (a)	BC (b)	ATC (c)	BEI (d)	Equivalent UNI 3.0/3.1 Octet 5a Definitions	Comment
CBR	A	abs		absent	
		7	no	CBR traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
	X	4		CBR traffic type, timing not indicated	
		5		CBR traffic type, end-to-end timing required	
		6	no	CBR traffic type, end-to-end timing not required	
		7		CBR traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
	VP	5		CBR traffic type, end-to-end timing required	new in UNI 4.0
		7	no	CBR traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
rt-VBR	C	9		VBR traffic type, end-to-end timing required	
		19	no	undefined traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
	X	1		traffic type not indicated, end-to-end	

				timing required	
		9	no	VBR traffic type, end-to-end timing required	
		19		undefined traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
	VP	9		VBR traffic type, end-to-end timing required	new in UNI 4.0
		19	no	undefined traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
nrt-VBR	C	abs		absent	
		11	no	VBR traffic type, reserved timing requirement	new in UNI 4.0 invalid UNI 3.1 BBC octet 5a coding
	X	abs	no	absent	
		0	no	traffic type not indicated, timing not indicated	
		2	no	traffic type not indicated, end-to-end timing not required	
		8	no	VBR traffic type, timing not indicated	
		10	no	VBR traffic type, end-to-end timing not required	
		11	no	VBR traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
	VP	abs	no	absent	new in UNI 4.0
		10	no	VBR traffic type, end-to-end timing not required	new in UNI 4.0
		11	no	VBR traffic type, reserved timing requirement	new in UNI 4.0, invalid UNI 3.1 BBC octet 5a coding
UBR	C	abs	yes	absent	
	X	abs	yes	absent	
		0	yes	traffic type not indicated, timing not indicated	
		2	yes	traffic type not indicated,	
		8	yes	VBR traffic type, timing not indicated	
		10	yes	VBR traffic type, end-to-end timing not required	
	VP	abs	yes	absent	new in UNI 4.0
		10	yes	VBR traffic type, end-to-end timing not required	new in UNI 4.0
ABR	C	12	no	undefined traffic type, timing not indicated	new in UNI 4.0 invalid UNI 3.1 BBC octet 5a coding
	X				
	VP				

(a) ATM Service Category as defined by ATM Forum Traffic Management Specification, Version 4.0 Specification
(b) Broadband Bearer Class in octet 5 of Broadband bearer capability information element
(c) ATM Transfer Capability as defined in this Specification (octet 5a of the Broadband Bearer Capability information element)
(d) Best Effort Indicator - octet 18 of ATM Traffic descriptor information element (yes - present, no - not present)

A9.3 Allowed Combination of Bearer Capabilities, Traffic Parameters, and QoS

The parameters specified in the Broadband Bearer Capability information element, the ATM traffic descriptor information element, the Extended QoS parameters information element, the End-to-end transit delay information element, and the QoS parameter information element of the SETUP message should be consistent. Table A9-2 shows the allowable combinations of the Broadband Bearer Class, the ATM traffic descriptor parameters, the Extended QoS parameters, the End-to-end transit delay, and the QoS classes.

If a SETUP message is received containing a combination of Broadband Bearer Class, ATC and Best Effort Indicator that does not match an entry in Table A9-2, the call shall be cleared with Cause #65, "*Bearer capability not implemented*". If the combination of Traffic parameters, QoS parameters and QoS class in a SETUP message is not a combination allowed for the ATM Service Category, the call shall be cleared with Cause #73, "*Unsupported combination of traffic parameters*".

Table A9-2 Allowable Combinations of Traffic and QoS Related Parameters in the SETUP message

ATM service Category	**CBR**								
Conformance	CBR.1 (note 10)			(Note 4)			(Note 4)		
Bearer Capability									
Broadband Bearer Class	A	X	VP	A	X	VP (note 5)	A	X	VP (note 5)
ATM Transfer Capability (Note 1)	7			absent	4,5, or 6	5	absent	4,5, or 6	5
Traffic Descriptor for a given direction									
PCR (CLP=0)							S		
PCR (CLP=0+1)	S			S			S		
SCR , MBS (CLP=0)									
SCR , MBS (CLP=0+1)									
Best Effort									
Tagging	N			N			Y/N		
Frame Discard	Y/N			Y/N			Y/N		
QoS Classes	*			*			*		
transit delay (note 2)	O			O			O		
peak-to-peak CDV	O			O			O		
CLR (CLP=0) (Note 11)				O			O		
CLR (CLP=0+1) (Note 11)	O								

ATM service Category	**Real Time VBR**								
Conformance	VBR.1 (note 10)			VBR.2			VBR.3		
Bearer Capability									
Broadband Bearer Class	C	X	VP	C	X	VP	C	X	VP
ATM Transfer Capability	19			9	1 or 9	9	9	1 or 9	9
Traffic Descriptor for a given direction									
PCR (CLP=0)									
PCR (CLP=0+1)	S			S			S		
SCR , MBS (CLP=0)				S			S		

SCR , MBS (CLP=0+1)	S		
Best Effort			
Tagging	N	N	Y
Frame Discard	Y/N	Y/N	Y/N
QoS Classes	*	*	*
transit delay (note 2)	O	O	O
peak-to-peak CDV	O	O	O
CLR (CLP=0) (Note 11)		O	O
CLR (CLP=0+1) (Note 11)	O		

ATM service Category	**Real Time VBR**			
Conformance	(notes 4, 7)	(notes 4, 8)	(note 4)	
Bearer Capability				
Broadband Bearer Class	X	X	X	C or VP (note 5)
ATM Transfer Capability	1 or 9	1 or 9	1 or 9	9
Traffic Descriptor for a given direction				
PCR (CLP=0)	S			
PCR (CLP=0+1)	S	S	S	
SCR , MBS (CLP=0)				
SCR , MBS (CLP=0+1)			S	
Best Effort				
Tagging	Y/N	N	N	
Frame Discard	Y/N	Y/N	Y/N	
QoS Classes	*	*	*	
transit delay (note 2)	O	O	O	
peak-to-peak CDV	O	O	O	
CLR (CLP=0) (Note 11)	O	O	O	
CLR (CLP=0+1) (Note 11)				

ATM service Category	**Non-real Time VBR**								
Conformance	VBR.1 (note 10)			VBR.2			VBR.3		
Bearer Capability									
Broadband Bearer Class	C	X	VP	C	X	VP	C	X	VP
ATM Transfer Capability (note 1)	11			absent	absent, 0, 2, 8 or 10	absent, 10	absent	absent, 0, 2, 8 or 10	absent, 10
Traffic Descriptor for a given direction									
PCR (CLP=0)									
PCR (CLP=0+1)	S			S			S		
SCR , MBS (CLP=0)				S			S		
SCR , MBS (CLP=0+1)	S								
Best Effort									
Tagging	N			N			Y		
Frame Discard	Y/N			Y/N			Y/N		
QoS Classes	*			*			*		
transit delay (note 2)	(note 3)			(note 3)			(note 3)		

peak-to-peak CDV			
CLR (CLP=0) (Note 11)		O	O
CLR (CLP=0+1) (Note 11)	O		

ATM service Category	**Non-real Time VBR**						
Conformance	(notes 4, 7)		(notes 4, 8)		(note 4)		
Bearer Capability							
Broadband Bearer Class	C	X	C	X	C	X	VP (note 5)
ATM Transfer Capability (note 1)	absent	absent, 0, 2, 8 or 10	absent	absent, 0, 2, 8 or 10	absent	absent, 0, 2, 8 or 10	absent, 10
Traffic Descriptor for a given direction							
PCR (CLP=0)	S						
PCR (CLP=0+1)	S		S		S		
SCR , MBS (CLP=0)							
SCR , MBS (CLP=0+1)					S		
Best Effort							
Tagging	Y/N		N		N		
Frame Discard	Y/N		Y/N		Y/N		
QoS Classes	*		*		*		
transit delay (note 2)	(note 3)		(note 3)		(note 3)		
peak-to-peak CDV							
CLR (CLP=0) (Note 11)	O		O		O		
CLR (CLP=0+1) (Note 11)							

ATM service Category	**ABR**			**UBR**					
Conformance	ABR			UBR.1			UBR.2		
Bearer Capability									
Broadband Bearer Class	C	X	VP	C	X	VP	C	X	VP
ATM Transfer Capability (note 1)	12			absent	absent, 0, 2, 8 or 10	absent, 10	absent	absent, 0, 2, 8 or 10	absent, 10
Traffic Descriptor for a given direction									
PCR (CLP=0)									
PCR (CLP=0+1)	S			S			S		
SCR , MBS (CLP=0)									
SCR , MBS (CLP=0+1)									
ABR MCR	(note 6)								
Best Effort				S (note 9)			S (note 9)		
Tagging	N			N			Y		
Frame Discard	Y/N			Y/N			Y/N		
QoS Classes	0			0			0		
transit delay (note 2)									
peak-to-peak CDV									
CLR (CLP=0) (Note 11)									
CLR (CLP=0+1) (Note 11)									

Note 1 - Values 0, 1, 2, 4, 6, and 8 are not used on transmission but shall be understood on reception.
Note 2 - Maximum End-to-end transit delay objectives may only be specified for the forward direction.
Note 3 - Maximum End-to-end transit delay objectives may be specified for the ATM Service Category of Non-real Time VBR for reasons of backward compatibility with ITU-T Recommendations.
Note 4 - Included for reasons of backward compatibility with UNI 3.1 and ITU-T Recommendations. With these conformance definitions, the CLR commitment is only for the CLP=0 traffic stream.
Note 5 - Included to allow switched virtual paths to use the UNI 3.1 conformance definitions.
Note 6 - Optional in the user-to-network direction. Specified in the network-to-user direction.
Note 7 - This combination should be treated as if the received PCR (CLP=0) parameter were a SCR (CLP=0) parameter and a MBS (CLP=0) parameter with a value of 1.
Note 8 - This combination should be treated as if an additional SCR (CLP=0) were received with the same value as the received PCR (CLP=0+1) parameter with a MBS (CLP=0) parameter with a value of 1.
Note 9 - The Best Effort indication applies to both the forward and backward directions.
Note 10 - This combination should only be used when the CLR commitment on CLP=0+1 traffic is required versus CLR commitment on CLP=0 traffic, since these combinations are not supported by UNI 3.0/3.1 nor ITU-T Q.2931.
Note 11 - In this table, the CLR parameter is shown as two entries to indicate explicitly whether the CLR commitment is for the CLP=0 or for the CLP=0+1 cells.

Abbreviations:

PCR	Peak Cell Rate	SCR	Sustainable Cell Rate
MBS	Maximum Burst Size		
Y	Yes	N	No
S	Specified	(Blank)	Unspecified

O = Optional. May be specified using:

- an individual QoS parameter encoded in the Extended QoS parameters information element or the End-to-end transit delay information element; or,
- objectives implied from the QoS class

If an Extended QoS parameters information element is present and this parameter is not present in the message, then any value of this parameter is acceptable. If neither the parameter nor the Extended QoS parameters information element is present in the message, then the objective for this parameter is determined from the QoS class in the QoS parameter information element.

Y/N = either “Yes” or “No” is allowed.
* = allowed QoS class values are a network option. Class 0 is always supported for alignment with ITU-T.

Annex 10: Handling of the Cumulative RM fixed round trip time field

[Normative]

A10.1 General

This annex describes the use of the Cumulative RM fixed round trip time field in the ABR setup parameters information element. The support of the RM fixed round trip time field and the procedures described in this Annex are mandatory both for the network and the user when providing the ABR service.

The purpose of the Cumulative RM fixed round trip time field is to indicate the time taken by an RM cell to travel from the source to the destination and back under conditions of no congestion.

A10.2 Handling of the Cumulative RM fixed round trip time parameter

The calling user includes the Cumulative RM fixed round trip time field in the ABR setup parameters information element in the SETUP message.

The Cumulative RM fixed round trip time field in the ABR setup parameters information element shall be set to the calling user's RM cell delay contribution for the forward and the backward path. User's RM cell delay shall include the calling terminal equipment to network boundary link propagation delay.

If the network receives ABR setup parameters information element without Cumulative RM fixed round trip time field, the network shall handle the ABR setup parameters information element as a mandatory information element with content error.

The network shall adjust the Cumulative RM fixed round trip time field in the ABR setup parameters information element when forwarding a SETUP message for an ABR connection. The amount of the adjustment is the fixed portion of the RM cell delay through the network, including the link propagation delay. The adjustment value, expressed in microseconds encoded as an integer, is added to the Cumulative round trip time field.

The called user shall adjust the Cumulative RM fixed round trip time field in the ABR setup parameters information element. The amount of the adjustment is the called user's RM cell delay contribution for the forward and the backward path. User's cell delay may include the called user's user-to-network boundary link propagation delay.

Appendix A: Example Signalling Codings

[Informative]

This Appendix gives examples of typical codings for information elements. Selection of particular codings to appear in this Appendix is not intended endorse particular applications or higher layer protocols to the exclusion of other applications or higher layer protocols. The values relevant to the examples and their binary codings in the protocol are shown in **boldface** type.

Note - In the event of discrepancies between the text of section 4.0 and this Appendix, the text of section 4.0 takes precedence.

A.1 ATM Adaptation Layer Parameters

Example of information element coding for AAL1

This example shows how the ATM adaptation layer parameters information element may be coded for a DS1 logical unrestricted service with adaptive clock recovery method.

Bits								
8	7	6	5	4	3	2	1	Octet
ATM adaptation layer parameters								
0	**1**	**0**	**1**	**1**	**0**	**0**	**0**	1
Information element identifier								1
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field = **Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of AAL parameter contents								3
Length of AAL parameter contents (continued) = **5** octets								4
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**0**	**1**	**0**	**1**	
AAL Type **= AAL1**								5
0	**0**	**0**	**0**	**0**	**0**	**0**	**1**	
Subtype Identifier								6
1	**0**	**0**	**0**	**0**	**1**	**0**	**1**	
Subtype = **Circuit transport**								6.1
0	**0**	**0**	**0**	**0**	**0**	**1**	**0**	
CBR Rate Identifier								7
1	**0**	**0**	**0**	**0**	**1**	**1**	**0**	
CBR Rate **= 1544 kbit/s (DS1)**								7.1
0	**0**	**0**	**0**	**0**	**1**	**0**	**0**	

Example of information element coding for AAL5

This example shows how the ATM adaptation layer parameters information element may be coded for a typical data application using AAL5.

Bits								
8	7	6	5	4	3	2	1	Octet
ATM adaptation layer parameters								
0	**1**	**0**	**1**	**1**	**0**	**0**	**0**	1
Information element identifier								
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field = **Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of AAL parameter contents								3
Length of AAL parameter contents (continued) = **7** octets								4
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**0**	**1**	**1**	**1**	
AAL Type **= AAL5**								5
0	**0**	**0**	**0**	**0**	**1**	**0**	**1**	
Forward Maximum CPCS-SDU Size Identifier								6
1	**0**	**0**	**0**	**1**	**1**	**0**	**0**	
Forward Maximum CPCS-SDU Size								6.1
Forward Maximum CPCS-SDU Size (continued) **= 1542 octets**								6.2
0	**0**	**0**	**0**	**0**	**1**	**1**	**0**	
0	**0**	**0**	**0**	**0**	**1**	**1**	**0**	
Backward Maximum CPCS-SDU Size identifier								7
1	**0**	**0**	**0**	**0**	**0**	**0**	**1**	
Backward Maximum CPCS-SDU Size								7.1
Backward Maximum CPCS-SDU Size (continued) **= 1542 octets**								7.2
0	**0**	**0**	**0**	**0**	**1**	**1**	**0**	
0	**0**	**0**	**0**	**0**	**1**	**1**	**0**	

A.2 Broadband Bearer Capability

Example of information element coding for variable bit rate, connection oriented service with no timing requirements

This example shows how the Broadband bearer capability information element may be coded for a typical variable bit rate data application.

Bits 8	7	6	5	4	3	2	1	Octet
Broadband bearer capability								
0	**1**	**0**	**1**	**1**	**1**	**1**	**0**	1
Information element identifier								
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field **= Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of B-BC contents								3
Length of B-BC contents (continued) **= 2** octets								4
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**0**	**0**	**1**	**0**	
0/1 ext	0 Spare	0	Bearer class **= BCOB-C**					5
1	**0**	**0**	**0**	**0**	**0**	**1**	**1**	
1 ext	Susceptibility to clipping **= Not susceptible**		0	0 Spare	0	User plane connection configuration **= pt-to-pt**		6
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

A.3 Broadband Low Layer Information

Example of information element coding for multiprotocol interconnect using the LLC encapsulation

This example shows how the B-LLI information element may be coded when multiprotocol interconnection using the LLC encapsulation is to be used on the VCC (see Internet RFC draft, *Multiprotocol Encapsulation over ATM/AAL5*)

Bits								
8	7	6	5	4	3	2	1	Octet
Broadband low layer information								
0	**1**	**0**	**1**	**1**	**1**	**1**	**1**	1
Information element identifier								
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field = **Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of B-LLI contents								3
Length of B-LLI contents (continued) = **1** octet								4
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**0**	**0**	**0**	**1**	
0/1 ext	1	0	User information layer 2 protocol					6
1	Layer 2 id **1**	**0**	= **LAN logical link control (ISO 8802/2)** **0**	**1**	**1**	**0**	**0**	

Example of information element coding for transport of IP datagrams using the "Null encapsulation" over AAL5

This example shows how the B-LLI information element may be coded when IP datagrams are to be transported within an AAL service data unit without any multiprotocol encapsulation ("Null Encapsulation" — see Internet RFC draft, *Multiprotocol Encapsulation over ATM/AAL5*). Note that no encoding for User Information Layer 3 protocol exists for IP. Therefore, the ISO/IEC TR 9577 Network Layer Protocol Identifier (NLPID) value for IP is used instead.

Bits								
8	7	6	5	4	3	2	1	Octet
Broadband low layer information								
0	**1**	**0**	**1**	**1**	**1**	**1**	**1**	1
Information element identifier								
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field = **Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of B-LLI contents								3

Length of B-LLI contents (continued) = **3** octets								4
0 **0**	**0** **0**	**0** **0**	**0** **0**	**0** **0**	**0** **0**	**0** **1**	**0** **1**	
0/1 ext	1 Layer 3 id	1	User information layer 3 protocol **= ISO/IEC TR 9577**					7
0	**1**	**1**	**0**	**1**	**0**	**1**	**1**	
0 ext	ISO/IEC TR 9577 Initial Protocol Identification (IPI) (bits 8-2) **= Internet Protocol**							7a
0	**1**	**1**	**0**	**0**	**1**	**1**	**0**	
1 ext	IPI (bit1)	0	0	0	0	0	0	7b
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

Example of information element coding for transport of bridged frames using the "Null encapsulation" over AAL5

This example shows how the B-LLI information element may be coded when bridged LAN frames are to be transported within an AAL service data unit without any multiprotocol encapsulation ("Null Encapsulation — see Internet RFC draft, *Multiprotocol Encapsulation over ATM/AAL5*). Note that no encoding for User Information Layer 3 protocol exists for SNAP identifier. Therefore, the ISO/IEC TR 9577 Network Layer Protocol Identifier (NLPID) value for SNAP is used as an escape to include the SNAP identifier in the B-LLI information element. In this example, the SNAP identifier '00-80-C2-00-0A' indicates bridged FDDI frames without a preserved FCS. Similar coding principles apply for other kinds of bridged MAC frames and for routed frames which can only be identified using the SNAP convention.

Bits 8	7	6	5	4	3	2	1	Octet
Broadband low layer information								
0	**1**	**0**	**1**	**1**	**1**	**1**	**1**	1
Information element identifier								
1 ext	Coding Standard **= ITU-T Specified**		Information Element Instruction Field = **Not Significant**					2
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
Length of B-LLI contents								3
Length of B-LLI contents (continued) = **9** octets								4
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**1**	**0**	**0**	**1**	
0/1 ext	1	1	User information layer 3 protocol **= ISO/IEC TR 9577**					7
Layer 3 id								
0	**1**	**1**	**0**	**1**	**0**	**1**	**1**	
0 ext	ISO/IEC TR 9577 Initial Protocol Identification (IPI) (bits 8-2) **= SNAP Identifier**							7a
0	**1**	**0**	**0**	**0**	**0**	**0**	**0**	
1 ext	IPI (bit1)	0	0	0	0	0	0	7b
		Spare						
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
1 ext	0	0	0	0	0	0	0	8
SNAP ID			Spare					
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
SNAP Organization Unique Identifier (octet 1)								8.1
OUI octet 2								8.2
OUI octet 3 = **IEEE 802.1**								8.3
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
1	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
1	**1**	**0**	**0**	**0**	**0**	**1**	**0**	
PID (octet 1)								8.4
PID octet 2 = **FDDI without preserved FCS**								8.5
0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	
0	**0**	**0**	**0**	**1**	**0**	**1**	**0**	

Appendix B : Overview of Leaf Initiated Join Call Paradigm

[Informative]

The leaf initiated join (LIJ) capability allows users to independently join point-to-multipoint calls created by other parties in the network. The joining users are referred to as *Leaves* and they can request to join both active and inactive calls. The creator of the call is referred to as the *Root*. Two types of LIJ calls are supported: 1) *Network LIJ*, where the network automatically adds new leaves who request to be added to ongoing calls and 2) *Root LIJ*, where the Root adds all leaves manually. With *Network LIJ* calls, the Root does not receive notifications that new leaves have been added to or dropped from the call.

The remainder of this Appendix is organized as follows. Section B.1 explains how a *Network LIJ* call is created by the Root. Section B.2 discusses the steps that occur when a Leaf joins a *Network LIJ* call. Section B.3 examines the interactions that occur when a Leaf attempts to join a call that does not yet exist. Finally, Section B.4 describes the case where a Leaf joins an existing *Root LIJ* call.

Note that the LIJ capability is initially limited to UNIs since neither the ATM Forum PNNI Specification, Version 1.0 nor the ATM Forum B-ICI Specification, Version 2.0 support the LIJ capability.

B.1 Root Creation of *Network LIJ* Call

Figure B-1 shows an example of a Root creating a *Network LIJ* call. The procedures followed are identical to the procedures described in Section 5 for creation of a point-to-multipoint call. The only difference is that the SETUP messages contain additional information elements. The SETUP message shown in step (1) is required to contain the LIJ parameters and LIJ call identifier information elements. The LIJ parameters are used to set options for the call. The LIJ call identifier is used by the network to distinguish this LIJ call from any other LIJ calls that this Root creates, each LIJ call must have a unique LIJ call identifier. Inside the network, the LIJ call identifier is paired with the Root's address to form a common identifier that uniquely differentiates this *Network LIJ* call from all others.

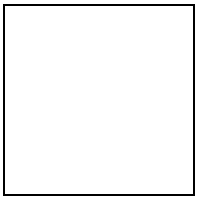


Figure B- 1. Root creation of Network LIJ call.

The LIJ call identifier and LIJ parameters information elements may be included in the SETUP message sent from the network to the user (step 3 in Figure B-1) so, for example, if the user is a PBX, it has sufficient information to support local LIJ access to the call.

The remaining steps in the *Network LIJ* call creation are identical to those of an ordinary point-to-multipoint call creation. After the call has been created, the Root can freely add additional endpoints using the point-to-multipoint procedures of Q.2971. As with the first endpoint, the SETUP messages to the new endpoints may contain the new LIJ call identifier and LIJ parameters information elements.

B.2 Leaf Join to Active *Network LIJ* Call

Figure B-2 shows an example of the procedures that are followed when a new Leaf adds itself to a Network-LIJ call. In step 1, the Leaf issues a LEAF SETUP REQUEST message containing the Root's address (in the Called party number and, optionally, the Called party subaddress), the LIJ call identifier and a Leaf sequence number. In step 2, the network responds with a SETUP message that echoes the Leaf sequence number from the Leaf's LEAF SETUP REQUEST message. This echoing allows the Leaf to associate the SETUP reply with its LEAF SETUP REQUEST request. The remaining steps are the same as for any other point-to-multipoint call setup. The Root does not get any notification of new leaves. It cannot determine how many leaves are receiving its transmissions and cannot selectively drop leaves that have added themselves. On the other hand, the Root does not become a bottleneck for rapidly changing calls since it does not participate in the join screening, join notification or drop procedures.

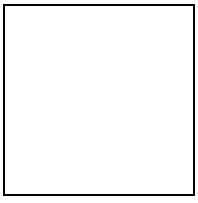


Figure B-2. Leaf initiated join to Network LIJ call

B.3 Leaf Join to Inactive Call

Figure B-3 shows the procedures that are followed when a new Leaf adds itself to a nonexistent call. As before, the Leaf issues a LEAF SETUP REQUEST message and the network uses the Root's address and LIJ call identifier to form a common identifier. The common identifier is used to identify and locate the indicated call. In this case, the call is not found and the network forwards the LEAF SETUP REQUEST message to the Root. Upon receiving the LEAF SETUP REQUEST message, the Root has the option of creating a new call to the Leaf by issuing a SETUP message or by sending a failure code back to the Leaf in a LEAF SETUP FAILURE message. Figure B-3 shows the case where the Root chooses to create the call. The call establishment follows the existing point-to-multipoint procedures. The SETUP message must contain the Leaf sequence number with a value equal to that given by the Leaf in the LEAF SETUP REQUEST message. Optionally, the SETUP message may contain the LIJ call identifier and the LIJ parameters (if the Root chooses to create a Network LIJ call, where automatic network joins are supported, as described in Sections B.2).

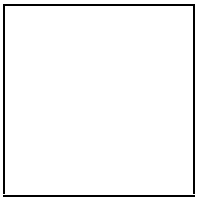


Figure B-3. Leaf join to inactive call, where Root connects Leaf

It is assumed that the LIJ call identifier is associated with call parameters by the Root. That is, the LIJ call identifier implies a certain traffic descriptor, quality of service, etc. If the Root creates a call to the Leaf with unacceptable call parameters, the Leaf rejects the SETUP message when it arrives.

If the Root rejects the Leaf's attempted join, it responds with a LEAF SETUP FAILURE message, as shown in Figure B-4. The LEAF SETUP FAILURE message contains the Leaf's address and the Leaf sequence number.

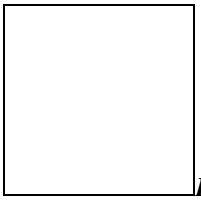


Figure B-4. Unsuccessful Leaf join to an inactive call.

B.4 Leaf Join to *Root LIJ* Call

Figure B-5 shows the interactions that occur when the Leaf attempts to join a *Root LIJ* call, using the LEAF SETUP REQUEST message. The network forwards the LEAF SETUP REQUEST message to the Root. When the Root receives the LEAF SETUP REQUEST message, it either rejects the request by sending a LEAF SETUP FAILURE, or adds the Leaf by issuing an ADD PARTY message (as shown in Figure B-5). In the latter case, the existing point-to-multipoint procedures are followed with a minor exception that the Leaf sequence number from the LEAF SETUP REQUEST message is echoed in the ADD PARTY message.

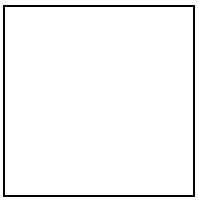


Figure B-5. Leaf join to active Root LIJ call, where Root connects Leaf

Appendix C: Point-to-Multipoint Connections - Cell Replication

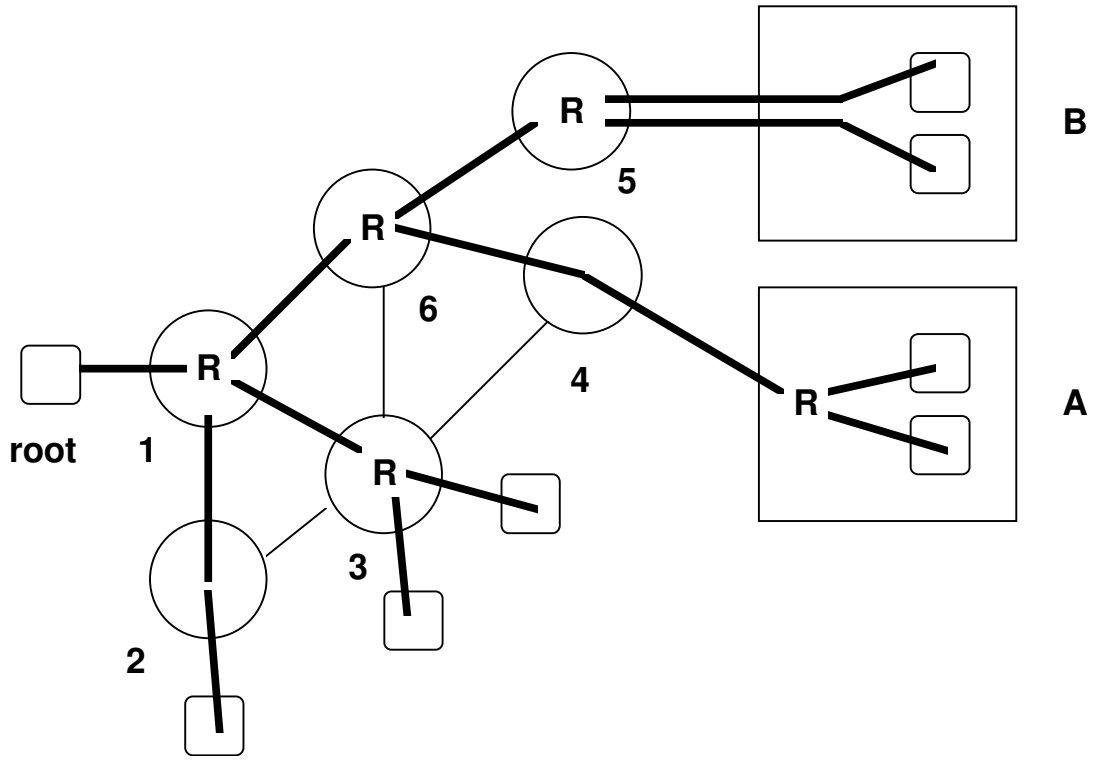
[Informative]

This Appendix attempts to clarify the cell replication concept by showing the replication points on an example point to multipoint connection tree. Consider a point-to-multipoint connection as shown in the figure below.

In this figure, seven leaves are shown joined to the point to multipoint connection. The root's switch (1) makes two copies of each cell received from the root on this VCC and forwards one cell down each of the three links which are part of the point-to-multipoint VCC. Switch 3 similarly replicates each cell received and forwards one copy to each of the two leaves which are joined to the connection.

Endsystems A and B each contain two leaves joined to the pt-mpt connection. At switch 4, Clause 10/Q.2971 procedures are in operation on A's UNI, and the second leaf has been added to the connection with an ADD PARTY message. In this case endsystem A performs the cell replication for the two leaves.

At the UNI between switch 5 and endsystem B, Clause 9/Q.2971 procedures are operating. In this case two separate connections are made across the UNI to join each the two leaves, and switch 5 replicates the cell stream forwarding one copy of each cell down each virtual channel.



Key:

R Cell replication point
Boxes represent the root and leaves of a point to multipoint connection;
Circles represent switches;
Bold lines represent paths followed by the point to multipoint connection;
Normal lines represent other UNI or NNI links.

Appendix D: Known Differences Between Section 8 and Q.2962

[Informative]

The following is a list of known (intentional) differences between Section 8, UNI 4.0 and Q.2962 negotiation procedures.

Note: this list may not include all of the differences.

1. The Alternative ATM traffic descriptor information element, in section 8.1.2.1, allows the Best Effort indication.
2. Procedures related to OAM traffic descriptor information element are not applicable.
3. In 8.3.3, the ATM traffic descriptor information element is optionally included in the CONNECT message.

Appendix E: Known Differences with UNI 3.1

[Informative]

The following is a list of known (intentional) differences between UNI 4.0 and UNI 3.1 for capabilities of UNI 3.1. This Appendix is intended as an aid to the implementers and is not represented as complete. In case of differences with the main body (the normative text) of this Specification, the main body of this Specification take precedence over items in this Appendix.

E.1 Overview of Changes

- Added procedures, information elements, and new ATM traffic descriptor parameters to support the ABR capability
- Addition of information elements and procedures to support parameterized QoS.
- Mandating the error handling procedures for the Instruction Indicators (for messages and information elements)
- Addition of the ALERTING and PARTY ALERTING messages and the associated procedures, timers, and protocol states
- Addition of the Notification information element (to most messages), NOTIFY message, and the associated procedures
- Addition of Tagging procedures which allow the use of the ATM traffic descriptor information element in the CONNECT message (no procedures were provided in UNI 3.1)
- Addition of End-to-end transit delay (to SETUP, ADD PARTY, CONNECT, and ADD PARTY ACKNOWLEDGE messages) and associated procedures
- Addition of the Generic identifier transport information element (to SETUP message) and associated procedures
- Allowed VC channel negotiation procedures
- User side Timer T310 is 30 to 120 sec. versus 10 sec.
- User side Timer T399 is 34 to 124 seconds (sum of T301 and T310) versus 14 seconds.
- In the ATM traffic descriptor information element the unused bits in the Traffic Management Options field are spare bits (i.e. ignored) versus reserved (i.e. considered a content error if non-zero).
- When AAL reset occurs calls in the establishment phase shall be cleared (versus maintained in UNI 3.1)
- For point-to-multipoint calls it is a subscription option whether an ADD PARTY or SETUP message is used for additional parties.
- Point-to-multipoint error handling procedures revised which can result in different cause being provided.
- Added procedures and allow the inclusion of Broadband low layer information and AAL Parameter information elements in the ADD PARTY ACKNOWLEDGE message to support the addition of leaves that do not support the point-to-multipoint procedures
- Allow the addition of parties after receiving the ALERTING message
- Made the use of endpoint reference value of 0 optional for the first party of a point-to-multipoint call

- Added procedures and revised codings to support switched VPs
- Added messages, procedures, and information elements to support narrowband services over ATM
- Added messages, procedures, timers, protocol states, and information elements to support the leaf initiated join capability
- Added procedures, Connection scope selection information element, group AFIs for IDP part of a private ATM address, and new MIB object to support the ATM Anycast capability
- Support NSAP addresses by allowing the Calling party subaddress and the Called party subaddress to be occur twice in the SETUP message
- Revised coding of the ATM traffic descriptor information element and added procedures to support the frame discard capability
- Added procedures to support the Proxy signalling capability
- Added procedures and information elements (Connected number and User to user information) to support the following supplementary services Direct Dialing In (DDI), Multiple Subscriber Number (MSN), Calling Line Identification Presentation (CLIP), Calling Line Identification Restriction (CLIR), Connected Line Identification Presentation (COLP), Connected Line Identification Restriction (COLR), Subaddressing (SUB), and User to User Signalling (UUS).
- Added procedures to support multiple virtual UNIs on a physical UNI.
- Added procedures and new information elements (Minimum ATM traffic descriptor and Alternate ATM traffic descriptor) to support bandwidth modification
- Modified the Broadband bearer capability information element to include an ATM Transfer Capability field

E.2 Specific Changes

2.1.1.4/Q.2931 Call Delivered (U4): New State.

2.1.1.6/Q.2931 Call Received (U7): New State.

2.1.2.4/Q.2931 Call Delivered (N4): New State.

2.1.2.6/Q.2931 Call Received (N7): New State.

3.1.1/Q.2931 ALERTING: New message

3.1.2/Q.2931 CALL PROCEEDING: New information element 'Notification Indicator' added.

3.1.3/Q.2931 CONNECT:
New information element 'End-to-end transit delay' added.
New information element 'Notification indicator' added.

3.1.4/Q.2931 CONNECT ACKNOWLEDGE: New information element 'Notification indicator' added.

3.1.5/Q.2931 RELEASE: New information element 'Notification indicator' added.

3.1.7/Q.2931 SETUP:
New information element 'End-to-end transit delay' added.
New information element 'Notification indicator' added.

New information element 'Generic identifier transport' added.
The QoS parameter information element is made optional.
'Connection Identifier' is optional in network-to-user direction and in the user-to-network direction.
The subaddress information elements may be repeated twice.

3.1.10/Q.2931 NOTIFY:
New message

3.2/Q.2931 Additional or modified messages related for the support of 64 Kbits/s based ISDN circuit-mode services
Exceptions noted for section 3.1 above apply to this section as well. In addition, the following changes apply:

3.2.2/Q.2931 CALL PROCEEDING
New information element 'Narrowband bearer capability' added.
New information element 'Narrowband high layer compatibility' added.
New information element 'Progress Indicator' added.

3.2.3/Q.2931 CONNECT
New information element 'Narrowband bearer capability' added.
New information element 'Narrowband high layer compatibility' added.
New information element 'Narrowband low layer compatibility' added.
New information element 'Progress Indicator' added.

3.2.5/Q.2931 PROGRESS:
New message

3.2.6/Q.2931 RELEASE: New information element 'Progress Indicator' added.

3.2.7/Q.2931 SETUP
New information element 'Narrowband bearer capability' added.
New information element 'Narrowband high layer compatibility' added.
New information element 'Narrowband low layer compatibility' added.
New information element 'Progress Indicator' added.

4.4.1/Q.2931 Message type
New message type '0 0 0 0 0 0 0 1 - ALERTING' defined.
New message type '0 0 0 0 0 0 1 1 - PROGRESS' defined.
New message type '0 0 0 0 1 1 1 0 - NOTIFY' defined.

4.5.1/Q.2931 Coding rules
New information element type '0 1 1 1 1 1 0 0 - Narrowband low layer compatibility' defined.
New information element type '0 1 1 1 1 1 0 1 - Narrowband high layer compatibility' defined.
New information element type '0 0 1 0 0 1 1 1 - Notification Indicator' defined.
New information element type '0 0 0 1 1 1 1 0 - Progress Indicator' defined.
New information element type '0 0 0 0 0 1 0 0 - Narrowband bearer capability' defined.
New information element type '1 1 1 0 1 0 0 0 - Leaf initiated join call identifier' defined.
New information element type '1 1 1 0 1 0 0 1 - Leaf initiated join parameters' defined.
New information element type '1 1 1 0 1 0 1 0 - Leaf sequence number' defined.
New information element type '0 1 0 0 0 0 1 0 - End-to-end Transit delay' defined.
New information element type '0 1 1 1 1 1 1 1 - Generic identifier transport' defined.
New information element type '1 1 1 0 1 0 1 1 - Connection scope selection' defined.
'Calling party subaddress' and 'Called party subaddress' can be repeated twice without a repeat indicator.

4.5.6/Q.2931 ATM traffic descriptor
'Frame Discard' fields added to Octet 17.1.

4.5.7/Q.2931 Broadband bearer Capability
New codepoint for bearer class '11000 - Transparent VP Service' added.
Restructured octet 5a to create the ATM Transfer Capability field.

4.5.8/Q.2931 Broadband high layer information
Allow the use of the codepoint '0000 100'.

4.5.9/Q.2931 Broadband low layer information
Added new codepoints in octet 7 to support the multimedia terminal capability (i.e., H.310, H.321).

4.5.10/Q.2931 Call state
New state '000100 - U4 - N4 - Call Delivered' added.
New state '000111 - U7 - N7 - Call Received' added.

4.5.16/Q.2931 Connection identifier
New codepoint '001 - Exclusive VPCI; any VCI' added for Pref./Ex field.
New codepoint '100 - Exclusive VPCI; no VCI' added for Pref./Ex field.

4.5.17/Q.2931 End-to-end transit delay: New information element.

4.5.19/Q.2931 Restart indicator
New codepoint '001 - All Virtual channels in the indicated VPC which are controlled via the signalling virtual channel on which the RESTART message is sent' added for Class field.

4.5.22/Q.2931 Notification indicator:
New information element.

4.6.2/Q.2931 Narrowband bearer capability:
New information element

4.6.3/Q.2931 Narrowband high layer compatibility:
New information element

4.6.4/Q.2931 Narrowband low layer compatibility:
New information element

4.6.5/Q.2931 Progress Indicator:
New information element

5.1.2.2/Q.2931 Non-Associated Signalling
The user may or may not include a connection identifier in the SETUP message to request a specified VPCI/VCI.
New procedures specified for Switched VPs (SVPs).

5.1.6/Q.2931 Call/Connection confirmation indication
New procedures specified for ALERTING message.

5.2.2.2/Q.2931 Non-Associated Signalling

The network may or may not include a connection identifier in the SETUP message to request a specified VPCI/VCI.
New procedures specified for Switched VPs (SVPs).

5.2.5.2/Q.2931 Receipt of CALL PROCEEDING and ALERTING
New procedures specified for ALERTING message.

5.5/Q.2931 Restart Procedures:
New procedures specified for Switched VPs (SVPs).

5.6.9/Q.2931 Signalling AAL reset:
Calls in the establishment phase shall be cleared.

5.7/Q.2931 Error procedures with explicit error indication
New procedures added for support of explicit error handling specified in the message compatibility instruction indicator or information element instruction field.

5.9/Q.2931 Notification procedures:
New procedures specified for NOTIFY message.

6/Q.2931 Procedures for the support of 64 Kbits/s based circuit mode ISDN services in B-ISDN and access signalling interworking between N-ISDN and B-ISDN
New section added to support N-ISDN (overlap sending and receiving not supported).

7.1/Q.2931 Timers in the network side
New timer T301 added.
New timer T304 added.

7.2/Q.2931 Timers in the user side
New timer T301 added.
New timer T304 added.

Annex E/Q.2931 Mapping functions to support 64 kbit/s based circuit-mode ISDN service in B-ISDN and interworking between N-ISDN and B-ISDN (DSS1/DSS2):
New annex.

Annex J/Q.2931 Definitions, Abbreviations and References
New annex. References are augmented by 1.3/UNI 4.0.

Appendix 1/Q.2931 Guidelines for the use of Instruction indicators:
New appendix.

2.1.1/UNI 4.0 Generic Identifier Transport Information Element:
New information element

3.3.4.2.3/UNI 4.0 ATM Address Organizational Membership Scope Indication:
Added new object 'atmfAddressOrgMemberScope' to support ATM anycast and group multicast.

7.2.1/Q.2971 B-ISDN party states:
New party state 'Party Alerting Delivered (P3)' added.
New party state 'Party Alerting Received (P4)' added.

8.1.1.1/Q.2971 ALERTING:
New message

8.1.1.7/Q.2971 NOTIFY:
New message

8.1.2.1/Q.2971 ADD PARTY:
New information element 'End-to-end Transit Delay' added.

8.1.2.2/Q.2971 ADD PARTY ACKNOWLEDGE:
New information element 'End-to-end Transit Delay' added.

8.1.2.3/Q.2971 PARTY ALERTING:
New message

8.2.2/Q.2971 Endpoint state
New codepoint '00 0100 - Party Alerting Delivered' added for Endpoint reference party state.
New codepoint '00 0111 - Party Alerting Received' added for Endpoint reference party state.

8.2.3/Q.2971 New message type code points
New codepoint '1000 0101 - PARTY ALERTING' added.

9.1.1/Q.2971 Set up of the first party:
New procedures specified for ALERTING message.

9.1.4/Q.2971 Party alerting:
New procedures specified for PARTY ALERTING message.

9.2/Q.2971 Add party establishment at the destination interface
Procedures are specified for network to add new parties using SETUP message, in place of ADD PARTY messages. These procedures may be used with bilateral arrangement between the user and the network.
New procedures specified for ALERTING message.

9.2.1/Q.2971 Leaf does not support multipoint procedures
New procedures specified for the network to support leaves that do not support point-to-multipoint procedures.

9.6/Q.2971 Notification procedure:
New procedures specified for NOTIFY message.

10/Q.2971 Procedures at the T_B reference point for interworking with private B-ISDNs
Exceptions specified in section 9 applies here also.

13.1/Q.2971 Timers at the user side:
New timer T397 added.
Value of T399 changed

13.2/Q.2971 Timers at the network side: New timer T397 added.

6.0/UNI 4.0 Leaf Initiated Join Capability:
New section.

6.1.1.1.1/UNI 4.0 SETUP
New information element 'LIJ Call Identifier' added.
New information element 'LIJ parameters' added.

New information element 'Leaf Sequence number' added.

6.1.1.1.1/UNI 4.0 ADD PARTY: New information element 'Leaf Sequence number' added.

6.1.1.3.1/UNI 4.0 LEAF SETUP FAILURE: New message

6.1.1.3.2/UNI 4.0 LEAF SETUP REQUEST: New message

6.1.2/UNI 4.0 Information Elements
Following new codepoints for information element Identifier defined:
1110 1000 - LIJ call identifier
1110 1001 - LIJ parameters
1110 1010 - Leaf sequence number

6.1.2.1/UNI 4.0 Leaf Initiated Join Call Identifier: New information element

6.1.2.2/UNI 4.0 Leaf Initiated Join Parameters: New information element

6.1.2.3/UNI 4.0 Leaf Sequence Number: New information element

6.2/UNI 4.0 Signalling Procedures in Support of the Leaf Initiated Join Capability
New procedures specified to support Leaf Initiated Join Capability.

6.3.1/UNI 4.0 Timers at the User Side: New timer T331 added.

7.0/UNI 4.0 ATM Anycast Capability
New procedures specified to support ATM anycast capability.
New AFIs added for the IDP part of private ATM addresses.
New information element '1110 1011 - Connection Scope Selection' added to SETUP message.

8.0/UNI 4.0 Connection Characteristics Negotiation During Establishment Phase
New section.

9.0/UNI 4.0 Signalling of Individual QoS Parameters
New section.

10.0/UNI 4.0 Available Bit Rate (ABR) Capability
New section.

Annex 2/UNI 4.0 Proxy Signalling Capability.
New procedures specified to support Proxy Signalling Capability.

Annex 3/UNI 4.0 Common Identification of Leaf Initiated Join Calls
New procedures specified to get a unique call identifier for a LIJ call.

Annex 4/UNI 4.0 Supplementary Services
Support added for the following supplementary services:
A4.1 Direct Dialling In (DDI)
A4.2 Multiple Subscriber Number (MSN)
A4.3 Calling Line Identification Presentation (CLIP)
A4.4 Calling Line Identification Restriction (CLIR)
A4.5 Connected Line Identification Presentation (COLP)

New information elements 'Connected number' and 'Connected subaddress' added to CONNECT and ADD PARTY ACKNOWLEDGE.

A4.6 Connected Line Identification Restriction (COLR)

A4.7 Subaddressing (SUB)

A4.8 User to User Signalling (UUS)

New information element 'User to user information' added to SETUP, ALERTING, CONNECT, RELEASE, RELEASE COMPLETE, ADD PARTY, PARTY ALERTING, ADD PARTY ACKNOWLEDGE, ADD PARTY REJECT, DROP PARTY and DROP PARTY ACKNOWLEDGE messages.

Annex 5/UNI 4.0 Guideline for assigning ATM Group addresses
Guidelines to ATM Group Addresses for ATM anycast and group multicast specified.

Annex 6/UNI 4.0 Connection Scope Selection
Guidelines to support Connection Scope Selection information element.

Annex 7/UNI 4.0 Procedure When Optional Capabilities Are Not Supported
New Annex.

Annex 8/UNI 4.0 Virtual UNIs
New Annex.

Annex 9/UNI 4.0 Guidelines on the Use of Bearer Class, Traffic Parameters and QoS
Revision of Appendix F/UNI 3.1.

Annex 10/UNI 4.0 Handling of the Cumulative RM fixed round trip time field
New Annex.

Appendix B/UNI 4.0 Overview of Leaf Initiated Join Call Paradigm
Overview of procedures for Leaf Initiated Join Call are specified.

Appendix C/UNI 4.0 Point-to-Multipoint Connections - Cell Replication
New Appendix, replaces Appendix C/UNI 3.1.

Appendix D/UNI 4.0 Known Differences Between Section 8 and Q.2962
New Appendix.