The ATM Forum

Technical Committee

ATM User-Network Interface (UNI) Specification Version 4.1

af-arch-0193.000
November 2002

Table of Contents:

1 Scope

The User-Network Interface Version 4.1 specification (UNI 4.1) is an umbrella specification. The intent is to remove any confusion around what the ATM Forum means when a User-Network Interface is defined using the latest versions of various specifications.

The UNI 4.1 is defined by the collection of specifications and standards listed in this document.

2 Capabilities at the UNI 4.1

This specification indicates that other specifications and standards are "applicable" at the UNI 4.1. The capabilities described in those specifications and standards are included as MANDATORY or OPTIONAL as those specifications and standards define them to be.

Table 2-1 shows the capabilities available within the ATM Forum UNI 4.1 Specification. 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 Specification Version 4.1, shall support the capabilities listed as Mandatory in table 2-1; i.e. by implementing the procedures of the applicable specification as referenced in Section 3.

Table 2-1 User-Network Interface 4.1 Capabilities

No.	Capability	Terminal Equipment	Switching System
1	Physical Layer	M(1)	M(1)
2	I.150	M	M
3	I.361	M	M
4	VPI / VCI Fields (as defined in Section 3.2.1)	M	M
5	OAM (as defined in Section 3.2.2)	M(2)	M(2)
6	Traffic Management Specification Version 4.1	M(3)	M(3)
7	Addendum to TM 4.1: Differentiated UBR	O	O
8	Addendum to TM 4.1: Optional MDCR for UBR	O	O
9	ILMI (as defined in Section 3.3)	O	M(3)
10	Signalling (as defined in Section 3.4)	O	M(3)
11	Security (as defined in Section 3.5)	O	O

Note 1 - At least one of the physical layers specified in the applicable specifications of Section 3.1 shall apply.

Note 2 - See Section 3.2.2 for further details on which sub-features are considered mandatory or optional.

Note 3 - See the applicable specification(s) for further details on which sub-features are considered mandatory or optional.

3 Specifications and Standards Applicable at the UNI 4.1

The ATM Forum Technical Committee continues to develop new specifications and maintain existing ones. The specifications listed below are current as of publication of this specification. The reader is directed to the ATM Forum's web site (see http://www.atmforum.com/pages/aboutatmtech/approved.html) for these specifications, as

well as any published subsequent to this specification[1]. The specifications for other bodies (e.g., the ITU-T, DSL Forum) may be found on their web sites.

The following sections list the specifications and standards that apply at a UNI 4.1.

3.1 Physical Layer

Any ATM Forum physical layer current specification on the Approved Specifications page is appropriate for use at the UNI. At the time of publication of this specification, the following ATM Forum physical layer specifications are in force.

- af-phy-0015.000, "ATM Physical Medium Dependent Interface Specification for 155 Mb/s over Twisted Pair Cable", September 1994
- af-phy-0016.000, "DS1 Physical Layer Specification", September 1994
- af-phy-0018.000, "Mid-range Physical Layer Specification for Category 3 Unshielded Twisted-Pair", September 1994
- af-phy-0029.000, "6312 Kbps UNI Specification Version 1.0", June 1995
- af-phy-0034.000, "E3 Public UNI", August 1995
- af-phy-0040.000, "Physical Interface Specification for 25.6 Mb/s over Twisted Pair Cable", November 1995
- af-phy-0046.000, "622.08 Mbps Physical Layer Specification", January 1996
- af-phy-0047.000, "155.52 Mb/s Physical Layer Specification for Category-3 Unshielded Twisted Pair", November 1995
- af-phy-0053.000, "Addendum to ATM Physical Medium Dependent Interface Specification for 155 Mb/s Over Twisted Pair Cable", January 1996
- af-phy-0054.000, "DS3 Physical Layer Interface Specification", January 1996
- af-phy-0062.000, "155.52 Mbps Physical Layer Interface Specification for Short Wavelength Laser", July 1996
- af-phy-0064.000, "E1 Physical Interface Specification", September 1996
- af-phy-0079.001, "155 Mb/s Plastic Optical Fiber and Hard Polymer Clad Fiber PMD Specification Version 1.1", January 1999
- af-phy-0086.001, "Inverse Multiplexing for ATM (IMA) Specification Version 1.1", March 1999
- af-phy-0128.000, "622 and 2488 Mbit/s Cell-Based Physical Layer", July 1999
- af-phy-0130.000, "ATM on Fractional E1/T1", October 1999
- af-phy-0133.000, "2.4 Gbps Physical Layer Specification", October 1999
- af-fbatm-0139.001, "Frame-based ATM Transport of Ethernet (FATE)", July 2002
- af-fbatm-0151.000, "Frame-based ATM over Sonet/SDH (FAST)", July 2000
- af-phy-0162.000, "Cell-based 1000Mbit/s (CB1G) Physical Layer Specification over Single-mode or Multi-mode Fiber and Category 6 Twisted Pair Copper Cabling", April 2001
- af-phy-0170.000, "PHY Specification for the 45Mbps and 155Mbps Rates", May 2001

In addition to these, the following specifications and standards MAY be used:

- ITU-T Recommendation G.804, "ATM cell mapping into Plesiochronous Digital Hierarchy (PDH)", February 1998
- ITU-T Recommendation G.991.1, "High bit rate Digital Subscriber Line (HDSL) transceivers", October 1998
- ITU-T Recommendation G.991.2, "Single-Pair High-Speed Digital Subscriber Line (SHDSL) transceivers", February 2001, including the changes and corrections specified in:

[1] The ATM Forum Approved Specifications web page contains information about updates to this specification.

- ITU-T Recommendation G991.2 Amendment 1, November 2001

- ITU-T Recommendation G.992.1, “Asymmetrical digital subscriber line (ADSL) transceivers”, July 1999, including the changes and corrections specified in:
  - ITU-T Recommendation G992.1 Annex H, October 2000
  - ITU-T Recommendation G.992.1 Corrigendum 1, November 2001
- ITU-T Recommendation G.992.2, “Splitterless asymmetric digital subscriber line (ADSL) transceivers”, July 1999
- ITU-T Recommendation G.993.1, "Very-high-speed digital subscriber line foundation", November 2001
- ITU-T Recommendation I.432.1, "B-ISDN user-network interface - Physical layer specification : General characteristics", February 1999
- ITU-T Recommendation I.432.2, "B-ISDN user-network interface - Physical layer specification : 155 520 kbit/s and 622 080 kbit/s operation", February 1999
- ITU-T Recommendation I.432.3, "B-ISDN user-network interface - Physical layer specification : 1544 kbit/s and 2048 kbit/s operation", February 1999
- ITU-T Recommendation I.432.4, " B-ISDN user-network interface - Physical layer specification : 51 840 kbit/s operation", February 1999
- ITU-T Recommendation I.432.5, "B-ISDN user-network interface - Physical layer specification : 25 600 kbit/s operation", June 1997
- ITU-T Recommendation I.761, "Inverse multiplexing for ATM (IMA)", March 2000
- ITU-T Recommendation I.762, "ATM over fractional physical links", March 2000
- ANSI T1.413, “Network to Customer Installation Interfaces – Asymmetric Digital Subscriber Line (ADSL) Metallic Interface”, 1998
- ETSI TS 101 135 v1.5.3, "High bit-rate Digital Subscriber Line (HDSL) transmission systems on metallic local lines; HDSL core specification and applications for combined ISDN-BA and 2 048 kbit/s transmission", September 2000
- ETSI TS 101 524 v1.1.3 , " Symmetrical single pair high bitrate Digital Subscriber Line (SDSL)" , November 2001
- ETSI TS 101 388 v1.3.1, " Asymmetric Digital Subscriber Line (ADSL) - European specific requirements [ITU-T Recommendation G.992.1 modified]", May 2002
- ETSI TS 101 270-1 v1.2.1, " Very high speed Digital Subscriber Line (VDSL); Part 1: Functional requirements", October 1999
- ETSI TS 101 270-2 v1.1.1, " Very high speed Digital Subscriber Line (VDSL);Part 2: Transceiver specification", February 2001

3.2 ATM Layer

The ATM layer is defined by a combination of ITU-T and ATM Forum specifications.

The cell formats and ATM layer generic services are defined in

- ITU-T Recommendation I.150, "B-ISDN asynchronous transfer mode functional characteristics", February 1999
- ITU-T Recommendation I.361, "B-ISDN ATM Layer Specification", February 1999

At the UNI 4.1, support of the UNI cell format as defined in clause 2/I.361 is mandatory. Support of the NNI cell format as defined in clause 2/I.361 is optional.

For the UNI cell format, the GFC field shall be set to all zeros upon transmission, i.e. only the "uncontrolled" GFC mode of operation shall be used at the UNI 4.1.

3.2.1 Virtual Path/Virtual Channel (VPI/VCI) Identifier

The actual number of routing bits in the VPI and VCI subfields used for routing is negotiated between the user and the network, e.g. on a subscription basis. This number is determined on the basis of the lower requirement of the user or the network.

Note: The number of VCI routing bits used in a user-to-user VP is negotiated between the users of the VP.

The bits within the VPI and VCI fields used for routing are allocated using the following rules:

- The allocated bits of the VPI subfield shall be contiguous;
- The allocated bits of the VPI subfield shall be the least significant bits of the VPI subfield, beginning at bit 5 of octet 2;
- The allocated bits of the VCI subfield shall be contiguous;
- The allocated bits of the VCI subfield shall be the least significant bits of the VCI subfield, beginning at bit 5 of octet 4;

Any bits of the VPI subfield that are not allocated shall be set to 0. For a given VP, any bits of the VCI subfield that are not allocated shall be set to 0.

3.2.2 OAM Cell Flows

The OAM cell flows supported at the UNI 4.1 are defined in ITU-T Recommendation I.610[2].:

- ITU-T Recommendation I.610, "B-ISDN operation and maintenance principles and functions", February 1999, including the changes and corrections specified in:
  - ITU-T Recommendation I.610 Amend.1, "Amendment 1 (03/00) to Recommendation I.610 - B-ISDN operation and maintenance principles and functions", March 2000
  - ITU-T Recommendation I.610 Corr.1, "Corrigendum 1 (03/00) to Recommendation I.610", March 2000

[2] The ATM Forum does not have an update specification covering OAM flows. The ITU-T recommendation defines capabilities beyond those defined in UNI 3.1.

The following table is derived from Table 3/I.610. It lists the OAM functions of the ATM layer as identified in Section 9.2 of I.610. The OAM functions are listed as applicable to a terminal equipment and a network node (switching system) and are categorized as mandatory (M) or optional (O) at the UNI 4.1.

Table 3-1 OAM Function at the UNI 4.1

OAM Function	Main Application	Terminal Equipment	Switching System
Alarm Indication Signal	For reporting defect indications in the forward direction	M	M
Remote Defect Indication	For reporting defect indication in the backward direction	M	M
Continuity Check	For continuously monitoring continuity	O	O
LoopBack	For on demand connectivity monitoring For fault localization For pre-service connectivity verification	M(1)	M(1)
Forward Performance Monitoring	For estimating performance in the forward direction	O	O
Backward reporting	For reporting performance estimations in the backward direction	O(2)	O(2)
Activation / Deactivation	For activating / deactivating Forward Performance Monitoring and Continuity Check.	O(3)	O(3)

Note 1 - Both end to end and segment LoopBack cells must be supported.

Note 2 - Mandatory if Forward Performance Monitoring is supported.

Note 3 - Mandatory if either Continuity Check or Forward Performance Monitoring are supported.

In addition to the OAM cell formats defined in I.610, the formats defined in the following specifications shall be allowed at the UNI 4.1:

- af-sec-0100.002, “ATM Security Specification Version 1.1”, March 2001
- af-sec-0180.000, “Security Services Renegotiation Addendum to Security Version 1.1”, March 2002.

In addition, the following ITU-T Recommendations may apply at the UNI 4.1:

- ITU-T Recommendation I.630, “ATM Protection Switching”, February 1999, including the changes and corrections specified in:
  - ITU-T Recommendation I.630 Corrigendum 1, March 2000
  - ITU-T Recommendation I.630 Amendment 1, March 2000

Finally, the following ITU-T Recommendation may apply at the user side of a UNI 4.1:

- ITU-T Recommendation O.191, “Equipment to measure the cell transfer performance of ATM connections”, February 2000

3.2.3 Traffic Management

Traffic Management is integral to the ATM Forum UNI 4.1 specification at the ATM layer. The specifications below shall apply at the UNI 4.1:

- af-tm-0121.000, "Traffic Management Specification Version 4.1", March 1999

In addition, the following specifications may apply:

- af-tm-0149.000, "Addendum to Traffic Management 4.1: Differentiated UBR", July 2000
- af-tm-0150.000, "Addendum to Traffic Management 4.1, Optional Minimum Desired Cell Rate Indication for UBR", July, 2000

3.3 Management Plane: Integrated Local Management Interface

The following ATM Forum specification shall apply at the UNI 4.1:

- af-ilmi-0065.000, "Integrated Local Management Interface (ILMI) Specification, Version 4.0", September 1996

In addition, the following specifications may apply:

- af-nm-0122.000, "Autoconfiguration of PVCs", May 1999
- af-nm-0165.000, "Addendum to Autoconfiguration of PVCs", February 2001

3.4 Control Plane: UNI Signalling

The following ATM Forum specification applies at the UNI 4.1:

- af-sig-0061.002, "ATM User-Network Interface (UNI) Signalling Specification Version 4.1", April 2002

Note: af-sig-0061.002 is itself an umbrella specification. For a detailed list of the UNI Signalling capabilities that it encompasses, See Table 1-2 of that document.

In addition, the following specification may apply:

- af-cs-0182.000, "Call Processing Priority Version 1.0", April 2002

3.5 Security

The following ATM Forum specifications may apply at the UNI 4.1:

- af-sec-0100.002, "ATM Security Specification Version 1.1", March 2001
- af-sec-0180.000, "Security Services Renegotiation Addendum to Security Version 1.1", March 2002.

4 Appendices

Appendix A Guidelines for Use of ATM Addresses (Informative)

The following specifications on ATM Forum addressing may be used as guides:

- ATM Forum Addressing: User Guide Version 1.0, af-ra-0105.000, January 1999.
- ATM Forum Addressing: Reference Guide, af-ra-0106.000, January 1999.