Reference Specification

for

B-ISDN User-Network Interface-Physical Layer

IDA RS BISDN 1
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CONTENTS

NOTICE

This Specification is subject to review and revision.

PART A B-ISDN USER-NETWORK INTERFACE - PHYSICAL LAYER SPECIFICATION: GENERAL CHARACTERISTICS

(ITU-T Recommendation I.432.1, August 1996)

1 SCOPE

1.1 This specification defines the Physical Layer interfaces to be applied to the S_B and T_B reference points of the reference configuration of the B-ISDN User-Network Interface (UNI). It comprises 5 Parts. **PART A** defines the scope, the reference configuration and the Physical Layer general characteristics for transporting ATM cells at the various bit rates. **PART B** to **PART E** describes each physical medium and transmission system used at the B-ISDN UNI for the specific bit rate and also describe the implementation of the UNI related OAM functions.

1.2 **PART A** is based on the ITU-T Recommendation I.432.1. It contains characteristics that are general to all B-ISDN systems at the UNI.

1.3 **PART B** is based on the ITU-T Recommendation I.432.2. It defines the relevant Physical Layer characteristics for transporting ATM cells at nominal bit rates of 155 520 and 622 080 kbit/s over coaxial cable and optical fibre interface at the S_B and T_B reference points of the B-ISDN UNI.

1.4 **PART C** is based on the ITU-T Recommendation I.432.3. It defines the relevant Physical Layer characteristics for transporting ATM cells using existing Primary Rate ISDN systems. It includes both 1544 and 2048 kbit/s interfaces at the S_B and T_B reference points of the B-ISDN UNI.

1.5 **PART D** is based on the ITU-T Recommendation I.432.4. It defines the relevant Physical Layer characteristics for transporting ATM cells at a nominal bit rate of 51 840 kbit/s over category 3 Unshielded Twisted Pair (UTP) cabling at the S_B reference point of the B-ISDN UNI.

1.6 **PART E** is based on the ITU-T Recommendation I.432.5. It defines the relevant Physical Layer characteristics for transporting ATM cells at a nominal bit rate of 25 600 kbit/s over 100 ohm UTP, 120 ohm and 150 ohm STP at the S_B reference point of the B-ISDN UNI.

2 REFERENCE CONFIGURATION

2.1 The reference configuration which this specification is based on is shown in Figure 1.1 The ATM Public UNI is modelling after the B-ISDN User-Network Interface as shown in Figure 1.2. It embraces the physical characteristics corresponding to T_B and U_B reference points as defined by the ATM Forum's ATM User-Network Interface (UNI) Specification Version 3.1. The ATM Public UNI specifies the criteria for Customer Premises Equipment (e.g. ATM end-points and private ATM switch) to a public service provider's ATM switch.

2.2 Interface location with respect to reference configuration

An interface point I_a is adjacent to the B-TE or the B-NT2 on their network side; interface point I_b is adjacent to the B-NT2 and to the B-NT1 on their user side (see Figure 1.1).

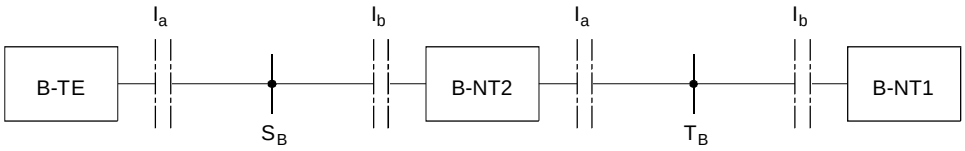


Figure 1.1
Reference configuration at reference point S_B/T_B

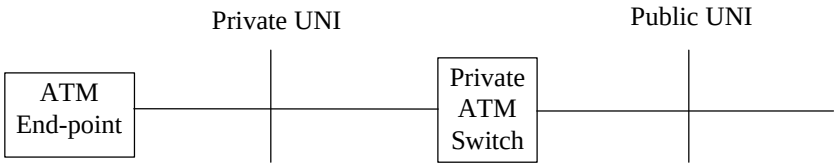
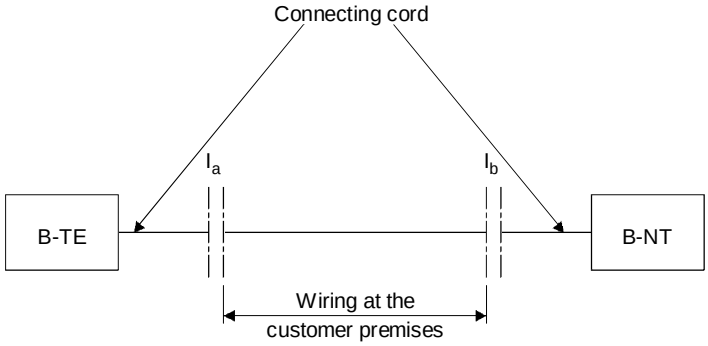


Figure 1.2
User-Network Interface Configuration

2.3 Interface location with respect to the customer installation

The interface points are located between the socket and the plug of the connector attached to the B-TE, B-NT2 or B-NT1. The location of the Interface point is shown in Figure 2.



NOTE – The length of the connecting cord can be zero.

Figure 2
Wiring configuration

In this specification, the term "B-NT" is used to indicate network terminating layer 1 aspects of B-NT1 and B-NT2 functional groups, and the term "TE" is used to indicate terminal terminating layer 1 aspects of B-TE1, B-TA and B-NT2 functional groups, unless otherwise indicated.

3 REFERENCES

- ITU-T Recommendation I.113 (1997), Vocabulary of terms for broadband aspects of ISDN.
- ITU-T Recommendation I.361 (1995), B-ISDN ATM layer specification.
- ITU-T Recommendation I.413 (1993), B-ISDN user-network interface.
- ITU-T Recommendation I.414 (1993), Overview of Recommendations on layer 1 for ISDN and B-ISDN customer access
- ITU-T Recommendation I.431 (1993), Primary rate user-network interface – layer 1 specification.
- ITU-T Recommendation I.432.1 (1996), B-ISDN user-network interface – Physical layer specification: General characteristics.
- ITU-T Recommendation I.432.2 (1996), B-ISDN user-network interface – Physical layer specification: 155 520 kbit/s and 622 080 kbit/s operation.
- ITU-T Recommendation I.432.3 (1996), B-ISDN user-network interface – Physical layer specification: 1544 kbit/s and 2048 kbit/s operation.
- ITU-T Recommendation I.432.4 (1996), B-ISDN user-network interface – Physical layer specification: 51 840 kbit/s operation.
- ITU-T Recommendation I.432.5 (1997), B-ISDN user-network interface – Physical layer specification: 25 600 kbit/s operation.
- ITU-T Recommendation I.610 (1995), B-ISDN operation and maintenance principles and functions.
- ITU-T Recommendation G.652 (1993), Characteristics of a single-mode optical fibre cable.
- CCITT Recommendation G.703 (1991), Physical/electrical characteristics of hierarchical digital interfaces.
- ITU-T Recommendation G.704 (1995), Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44 736 kbit/s hierarchical levels.
- CCITT Recommendation G.706 (1991), Frame alignment and Cyclic Redundancy Check (CRC) procedures relating to basic frame structures defined in Recommendation G.704.
- ITU-T Recommendation G.707 (1996), Network node interface for the Synchronous Digital Hierarchy (SDH).
- ITU-T Recommendation G.783 (1994), Characteristics of Synchronous Digital Hierarchy (SDH) equipment functional blocks.
- ITU-T Recommendation G.804 (1993), ATM cell mapping into Plesiochronous Digital Hierarchy (PDH).
- ITU-T Recommendation G.825 (1993), The control of jitter and wander within digital networks which are based on the Synchronous Digital Hierarchy (SDH).
- ITU-T Recommendation G.826 (1996), Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate.
- ITU-T Recommendation G.958 (1994), Digital line systems based on the synchronous digital hierarchy for use on optical fibre cables.
- ITU-T Recommendation G.957 (1995), Optical interfaces for equipment and systems relating to the synchronous digital hierarchy.
- CCITT Recommendation M.3604 (1992), Application of maintenance principles to ISDN primary rate access.
- IEC Publication 825 (1993), Safety of laser products.
- IEC Publication 60950 (1991), Safety of information technology equipment, including electrical business equipment.
- ISO/IEC 11801:1995, Information technology – Generic cabling for customer premises.
- ISO/IEC 8877:1992, Information technology – Telecommunications and information exchange between systems – Interface connector and contact assignments for ISDN Basic Access Interface located at 2 reference points S and T.
- ATM Forum, af-uni-0010.002, ATM User-Network Interface (UNI) Specification Version 3.1.
- ATM Forum, af-phy-0046.000, 622.08 Mbps Physical Layer Specification
- ATM Forum, af-phy-0064.000, E1 Physical Interface Specification

- ATM Forum, af-phy-0018.000, Mid-range Physical Layer Specification for Category 3 Unshielded Twisted-Pair
- ATM Forum, af-phy-0040.000, Physical Interface Specification for 25.6 Mbps over Twisted Pair Cable

4 ABBREVIATIONS

This specification uses the following abbreviations:

AIS	Alarm Indication Signal
ATM	Asynchronous Transfer Mode
AU	Administrative Unit
BER	Bit Error Ratio
BIP	Bit Interleaved Parity
B-ISDN	Broadband Integrated Services Digital Network
B-NT	Broadband Network Termination
B-NT1	Broadband Network Termination 1
B-NT2	Broadband Network Termination 2
B-TE	Broadband Terminal Equipment
B-UNI	Broadband User Network Interface
CATV	Community Antenna Television
CEC	Cell Error Control
CRC	Cyclic Redundancy Check
EB	Errored Blocks
EDC	Error Detection Code
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
FTP	Foiled Twisted Pair
HEC	Header Error Control
IEC	International Electrotechnical Commission
ISO	International Standards Organization
LCD	Loss of Cell Delineation
LOF	Loss of Frame
LOM	Loss of Maintenance Flow
LOS	Loss of Signal
LSB	Least Significant Bit
MBS	Maximum Block Size
MIC	Media Interface Connector
MPH	Management Physical Header
NEXT	Near End Crosstalk
NIC	Number of Included Cells
NNI	Network Node Interface
NMB-EB	Number of Monitored Blocks Errored Blocks
NMB-EDC	Number of Monitored Blocks Error Detection Code
NRZ	Non Return to Zero
NRZI	Non-Return to Zero Invert
OAM	Operations Administration and Maintenance
OCD	Out of Cell Delineation
PL	Physical Layer
PLL	Phase-Lock Loop
PM	Physical Medium
PMD	Physical Medium Dependent
POH	Path Overhead
ppm	parts per million
PRBS	Pseudo-Random Binary Sequence
PRNG	Pseudo-Random Number Generator
QAM	Quadrature Amplitude Modulation
RAI	Remote Alarm Indication
RAT	Receiver Acquisition Time
RDI	Remote Defect Indication

REI	Remote Error Indication
RL_r	Return Loss at the receiver interface
RL_t	Return Loss at the transmitter interface
RRL	Receiver Return Loss
SDH	Synchronous Digital Hierarchy
SOH	Section Overhead
SRL	Structural Return Loss
STI	Surface Transfer Impedance
STM	Synchronous Transport Module
STP	Shielded Twisted Pair
TC	Transmission Convergence
TDCD	Transmitter Duty Cycle Distortion
TEB	Total Errored Blocks
TEJ	Transmitter Edge Jitter
TFV	Terminal Failure Voltage
TLA	Transmitter Launch Amplitude
TP-AIS	Transmission Path Alarm Indication Signal
TP-FEBE	Transmission Path Far End Bit Error
TP-RDI	Transmission Path Remote Defect Indication
TRL	Transmitter Return Loss
UNI	User-Network Interface
UTP	Unshielded Twisted Pair
VC	Virtual Container
VCI	Virtual Channel Identifier
VPI	Virtual Path Identifier
4B5B	4 Bit/5 Bit line coding mechanism

NOTE

- The provision of physical media and transmission systems is network dependent. The conformance requirements defined for each Part (from Part B onwards) shall be applicable if that medium and transmission system are supported by the network.
- Functions that are not applicable will be shown by the addition of texts (in italic) or the deletion of texts (through strikeouts).
- The following notations are used in the Specification:

CR	Conformance requirement defines features and functions which must be supported at minimum.
M	Mandatory requirements
O	Optional requirements
NA	Not Applicable
GID	General Information and Definitions

5 GENERAL CHARACTERISTICS OF B-ISDN SYSTEMS AT THE UNI

TABLE 1 : GENERAL CHARACTERISTICS

TITLE	ITU-T REC I.432.1	COMMENTS	CR
ATM-specific TC functions	**4.3**	Heading	–
ATM cell format	4.3.1	The ATM cell is defined in ITU-T Rec. I.361	M
Header error control (HEC)	4.3.2	Heading	–
Header error control functions	4.3.2.1	Refer to Note 1	M
Header error control (HEC) sequence generation	4.3.2.2		M
Cell delineation	4.3.3	Heading	–
Cell delineation and scrambling objectives	4.3.3.1	Cell delineation is a process which allows the identification of cell boundaries. The cell header contains the HEC field which is used to achieve this. Scrambling is used to improve the security and robustness of the HEC cell delineation mechanism.	M
Cell delineation algorithm	4.3.3.2		M
~~Cell delineation performance~~	~~4.3.3.3~~	Understudy by ITU	NA
Scrambler operation	4.3.4	Heading	–
ATM cell level scrambler for the SDH-based systems	4.3.4.1	Refer to Note 2	O
Scrambler for the cell-based systems	4.3.4.2	Refer to Note 2	O
Scrambler for other systems	4.3.4.3	Refer to the relevant clause from Part B onwards	GID
Idle cells	4.3.5		M
Impact of random bit errors on cell delineation performance	**Appendix I**		GID
Distributed sample scrambler descrambler implementation example	**Appendix II**		GID

Note 1 The error detection of the HEC functions shall be implemented. However, the HEC receiver mode of the operation described in Figure 3/I.432.1 may be implemented.

Note 2 At least one of these options, SDH-based or cell-based, must be supported. However, cell-based systems are not supported presently by the local implementation.

PART B B-ISDN USER-NETWORK INTERFACE - PHYSICAL LAYER SPECIFICATION: 155 520 kbit/s AND 622 080 kbit/s OPERATION

(ITU-T Recommendation I.432.2, August 1996)

TABLE 1 : PHYSICAL MEDIUM CHARACTERISTICS OF THE UNI AT 155 520 kbit/s			
TITLE	**ITU-T REC I.432.2**	**COMMENTS**	**CR**
Bit rate and interface symmetry	3.1.1	Interface is symmetric i.e. same bit rate in both transmission directions. Nominal bit rate 155 520 kbit/s ± 20 ppm.	M
Timing	3.1.2	Heading	–
SDH-based	3.1.2.1	Note 1	O
Cell-based	3.1.2.2	Note 1	O
Jitter and wander	3.1.3	In accordance with ITU-T Rec. G.825 and G.958	M
Electrical interface	3.1.4	Refer to Note 2 Sub-clauses under clause 3.1.4 are mandatory conformance requirements if the electrical interface described under clause 3.1.4 is supported.	O
Interface range	3.1.4.1		O
Transmission medium	3.1.4.2	Two coaxial cables, one for each direction	O
Electrical parameters at interface points I_a and I_b	3.1.4.3	In accordance with ITU-T Rec. G.703	O
Electrical connectors	3.1.4.4		O
Line coding	3.1.4.5	CMI	O
EMC/EMI requirements	3.1.4.6		O
Optical interface	3.1.5	Refer to Note 2 Sub-clauses under clause 3.1.5 are mandatory conformance requirements if the optical interface described under clause 3.1.5 is supported.	O
Attenuation range	3.1.5.1	Refer to IDA RS SDH 3	O
Transmission medium	3.1.5.2	The transmission medium shall consist of 2 single mode fibres, one in each direction according to ITU-T Rec. G.652. Refer to IDA RS SDH 3	O
Line coding	3.1.5.3	Non Return to Zero (NRZ) Refer to IDA RS SDH 3	O

TABLE 1 : PHYSICAL MEDIUM CHARACTERISTICS OF THE UNI AT 155 520 kbit/s (CONTINUED)

TITLE	ITU-T REC I.432.2	COMMENTS	CR
Operating wavelength	3.1.5.4	Refer to IDA RS SDH 3	O
Input and output port characteristics	3.1.5.5	The optical parameters will be in accordance with IDA RS SDH 3.	O
Optical connectors	3.1.5.6	The presentation of interface point I_a at B-TE or B-NT2 is either : a) a socket or b) an integral connector cord with plug on the free end.	O
Safety requirements	3.1.5.7	IEC 825 class 1 should not be exceeded.	O

Note 1 At least one of these options, SDH-based or cell-based, must be supported. However, cell-based systems are not supported presently by the local implementation.

Note 2 At least one of these options, electrical or optical interface, must be supported. However, electrical interface is not supported presently by the local implementation.

TABLE 2 : PHYSICAL MEDIUM CHARACTERISTICS OF THE UNI AT 622 080 kbit/s

TITLE	ITU-T REC I.432.2	COMMENTS	CR
Bit rate and interface symmetry	3.2.1 a)	Refer to Note 1 An asymmetrical interface with 622 080 kbit/s in one direction and 155 520 kbit/s in the other direction	O
	3.2.1 b)	Refer to Note 1 A symmetrical interface with 622 050 kbit/s in both directions Nominal bit rate is 622 080 kbit/s ± 20 ppm	O
Timing	3.2.2	Heading	–
SDH-based	3.2.2.1		M
~~Cell based~~	~~3.2.2.2~~	Refer to Note 2	NA
Jitter and wander	3.2.3	In accordance with ITU-T Rec. G.825 and G.958	M
~~Electrical interface~~	~~3.2.4~~	Understudy by ITU	NA
Optical interface	3.2.5	Heading	–
Attenuation range	3.2.5.1	Refer to IDA RS SDH 3	M
Transmission medium	3.2.5.2	The transmission medium shall consist of 2 single mode fibres, one for each direction, according to ITU-T Rec. G.652. Refer to IDA RS SDH 3	M

TABLE 2 : PHYSICAL MEDIUM CHARACTERISTICS OF THE UNI AT 622 080 kbit/s (CONTINUED)

TITLE	ITU-T REC I.432.2	COMMENTS	CR
Line coding	3.2.5.3	NRZ Refer to IDA RS SDH 3	M
Operating wavelength	3.2.5.4	Refer to IDA RS SDH 3	M
Input and output port characteristics	3.2.5.5	The optical parameters shall be in accordance with IDA RS SDH 3.	M
Optical connectors	3.2.5.6	The presentation of interface point I_a at B-TE or B-NT2 is either : a) socket; or b) an integral connecting cord with plug on the free end.	M
Safety requirements	3.2.5.7	IEC 825 class 1 should not be exceeded	O

Note 1 At least one of these options, asymmetrical or symmetrical interface, must be supported. However, asymmetrical interface is not supported presently by the local implementation.

Note 2 Only the SDH-based Transmission Convergence sublayer shall be specified for the 622 080 kbit/s operation.

TABLE 3 : FUNCTIONS PROVIDED BY THE TRANSMISSION CONVERGENCE (TC) SUBLAYER

TITLE	ITU-T REC I.432.2	COMMENTS	CR
Transfer capability	**4.1**	Heading	–
SDH-based	4.1.1	Refer to Note 1 Sub-clauses under clause 4.1.1 are applicable if SDH-based is supported.	O
Interface at 155 520 kbit/s	4.1.1.1	Mandatory if 155 520 kbit/s operation is supported	O
Interface at 622 080 kbit/s	4.1.1.2	Mandatory if 622 080 kbit/s operation is supported	O
Cell-based	4.1.2	Refer to Note 1 Sub-clauses under clause 4.1.2 are applicable if cell-based is supported.	O
Interface at 155 520 kbit/s	4.1.2.1	Mandatory if 155 520 kbit/s operation is supported	O
Interface at 622 080 kbit/s	4.1.2.2	Mandatory if 622 080 kbit/s operation is supported	O

TABLE 3 : FUNCTIONS PROVIDED BY THE TRANSMISSION CONVERGENCE (TC) SUBLAYER (CONTINUED)

TITLE	**ITU-T REC I.432.2**	**COMMENTS**	**CR**
Transport-specific TC functions	**4.2**	Heading	–
SDH-based	4.2.1	Refer to Note 1 Sub-clauses under clause 4.2.1 are mandatory if SDH-based is supported.	O
Interface structure at 155 520 kbit/s	4.2.1.1	Mandatory if 155 520 kbit/s operation is supported Based on SDH as described in IDA RS SDH 1.	O
Interface structure at 622 080 kbit/s	4.2.1.2	Mandatory if 622 080 kbit/s operation is supported Based on SDH as described in IDA RS SDH 1.	O
OAM functionality	4.2.1.3	Transmission overhead allocation for SDH physical layer functions is given in Table 4/ I.432.2. Use of these overheads should be in accordance with IDA RS SDH 1.	M
Maintenance signals	4.2.1.3.1	– Alarm Indication Signal (AIS) – Remote Detect Indication (RDI) Generation and detection shall be in accordance with IDA RS SDH 1.	M
Transmission performance monitoring	4.2.1.3.2		M
~~Control communication~~	~~4.2.1.3.3~~	Understudy by ITU	NA
Cell-based	4.2.2	Refer to Note 1 Sub-clauses under clause 4.2.2 are mandatory if cell-based is supported.	O
Format structure	4.2.2.1		O
OAM functionality	4.2.2.2		O
OAM cell identification	4.2.2.3		O
Allocation of OAM functions in information field	4.2.2.4		O
Maintenance signals	4.2.2.5		O
Transmission performance monitoring	4.2.2.6		O
Error performance reporting	4.2.2.7		O
~~Control communication~~	~~4.2.2.8~~	Understudy by ITU	NA
ATM-specific TC functions	**4.3**	Refer to Part A	M

Note 1 At least one of these options, SDH-based or cell-based, must be supported. However, cell-based systems are not supported presently by the local implementation.

TABLE 4 : OAM OPERATIONAL FUNCTIONALITY			
TITLE	**ITU-T REC I.432.2**	**COMMENTS**	**CR**
SDH-based	**5.1**	Refer to Note 1 Sub-clauses under clause 5.1 are mandatory if SDH-based is supported.	O
Description of signals defined in Recommendation I.610	5.1.1		GID
Maintenance signals as defined in Recommendation I.610	5.1.2		O
Cell delineation signals	5.1.3		O
Maintenance state tables	5.1.4		O
Layer 1 states on the user side of the interface	5.1.4.1		O
Layer 1 states on the network side of the interface	5.1.4.2	Network side	GID
Definition of primitives	5.1.4.3		GID
State tables	5.1.4.4	Table 7/I.432.2 for the layer 1 states at the user side of the interface	O
~~**Cell-based**~~	~~**5.2**~~	Refer to Note 1 Understudy by ITU	NA
Note 1 At least one of these options, SDH-based or cell-based, must be supported. However, cell-based systems are not supported presently by the local implementation.			

TABLE 5 : POWER FEEDING			
TITLE	**ITU-T REC I.432.2**	**COMMENTS**	**CR**
Provision of power	**6.1**	The provision of power to the B-NT1 via UNI is optional. If provided, the following conditions should be considered. A separate pair of wires shall be used for the provision of power to B-NT1 via the T_B reference point.	O
Power available at B-NT1	**6.2**		O
Feeding voltage	**6.3**		O
Safety requirements	**6.4**	The protecting methods against electric shock as specified in IEC 60950 and the SS337 may be applied.	O

PART C B-ISDN USER-NETWORK INTERFACE - PHYSICAL LAYER SPECIFICATION: 1544 kbit/s AND 2048 kbit/s OPERATION

(ITU-T Recommendation I.432.3, August 1996)

TABLE 1 : INTERFACE AT 1544 kbit/s FOR ATM			
TITLE	**ITU-T REC I.432.3**	**COMMENTS**	**CR**
Characteristics of the Physical Media Dependent (PMD) sublayer	**3.1**	The PMD characteristics are as described in ITU-T Rec. I.431	M
Functions provided by the Transmission Convergence (TC) sublayer	**3.2**	Heading	–
Bit rate	3.2.1	The interface bit rate at the T_B and S_B reference point is 1544 kbit/s.	M
Transfer capability	3.2.2	1536 kbit/s	M
Transport-specific TC functions	3.2.3	The frame format is as defined in ITU-T Rec. I.431.	M
ATM-specific TC functions	3.2.4	Heading	–
ATM cell format	3.2.4.1	The ATM cell is defined in ITU-T Rec. I.361	M
Mapping of ATM cells	3.2.4.2	ATM cells are directly mapped into the frame structure according to ITU-T Rec. G.804	M
Header error control	3.2.4.3	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.2	M
Cell delineation	3.2.4.4	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.3	M
Scrambling	3.2.4.5	This interface does not use the self-synchronising scrambler $x^{43} + 1$ described under the General Characteristics in Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.4.1.	M
Idle cells	3.2.4.6	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.5	M
OAM specific functions	3.2.5		M
Power feeding	**3.3**	Refer to ITU-T Rec. I.431	O

TABLE 2 : INTERFACE AT 2048 kbit/s FOR ATM			
TITLE	**ITU-T REC I.432.3**	**COMMENTS**	**CR**
Characteristics of the Physical Media Dependent (PMD) sublayer	**4.1**	The PMD characteristics are as described in ITU-T Rec. I.431	M
Functions provided by the Transmission Convergence (TC) sublayer	**4.2**	Heading	–
Bit rate	4.2.1	The interface bit rate at the T_B and S_B reference point is 2048 kbit/s.	M
Transfer capability	4.2.2	1920 kbit/s	M
Transport-specific TC functions	4.2.3	The frame format is as defined in ITU-T Rec. I.431.	M
ATM-specific TC functions	4.2.4	Heading	–
ATM cell format	4.2.4.1	The ATM cell is defined in ITU-T Rec. I.361	M
Mapping of ATM cells	4.2.4.2	ATM cells are directly mapped into the frame structure according to ITU-T Rec. G.804	M
Header error control	4.2.4.3	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.2	M
Cell delineation	4.2.4.4	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.3	M
Scrambling	4.2.4.5	$x^{43} + 1$ scrambling function is used for ATM cells, as indicated in the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.4.1.	M
Idle cells	4.2.4.6	Refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.5	M
OAM specific functions	4.2.5		GID
OAM operational functionality	4.2.5.1		M
Layer 1 states on the user side of the interface	4.2.5.2		M
Layer 1 states on the network side of the interface	4.2.5.3	Network side	GID
Power feeding	**4.3**	Refer to ITU-T Rec. I.431	O

PART D B-ISDN USER-NETWORK INTERFACE - PHYSICAL LAYER SPECIFICATION: 51 840 kbit/s OPERATION

(ITU-T Recommendation I.432.4, August 1996)

TABLE 1: 51 840 kbit/s OPERATION			
TITLE	**ITU-T REC I.432.4**	**COMMENTS**	**CR**
Characteristics of the Physical Medium Dependent (PMD) sublayer	**3**	Heading	–
PMD characteristics at S_B for 51 840 kbit/s	**3.1**	Heading	–
Bit rates	3.1.1	The nominal bit rate is 51 840 kbit/s.	M
Bit rate symmetry	3.1.2		M
Bit Error Ratio (BER)	3.1.3		M
Timing	3.1.4	Heading	–
SDH-based	3.1.4.1	Refer to Note 1	O
Cell-based	3.1.4.2	Refer to Note 1	O
Medium characteristics	3.1.5		M
Transmitter functionality	3.1.6		M
Symbol encoding	3.1.6.1		M
Impulse response for the transmit filters	3.1.6.2		M
Signal spectrum	3.1.6.3		M
Voltage output	3.1.6.4		M
Return loss	3.1.6.5		M
Jitter	3.1.6.6		M
PMD scrambler/descrambler	3.1.7		M
Receiver characteristics	3.1.8	Heading	–
Receiver functionality	3.1.8.1		M
Start-up	3.1.8.2		M
Receiver return loss at the received interface (RL_r)	3.1.8.3		M
Connectors for category 3 UTP cabling	3.1.9	Heading	–
UTP-Media Interface Connector (MIC) modular jack	3.1.9.1		M
UTP-MIC receptacle	3.1.9.2		M

TABLE 1: 51 840 kbit/s OPERATION (CONTINUED)			
TITLE	**ITU-T REC I.432.4**	**COMMENTS**	**CR**
Functions provided by the Transmission Convergence (TC) sublayer	**4**		M
Transfer capability	**4.1**	The transfer capability for ATM cells is 48 384 kbit/s.	M
Transport-specific TC functions	**4.2**	Heading	–
SDH-based	4.2.1	Refer to Note 1 Sub-clauses under 4.2.1 are mandatory conformance requirements if SDH-based is supported.	O
SDH-based frame format structure	4.2.1.1		O
Overhead functions	4.2.1.2		O
Cell-based	4.2.2	Refer to Note 1 Sub-clauses under 4.2.2 are mandatory conformance requirements if cell-based is supported.	O
Transfer capability	4.2.2.1		O
Format structure	4.2.2.2		O
ATM specific TC functions	**4.3**	For information on ATM cell formatting, header error control, cell delineation, scrambling and idle cells, refer to the General Characteristics under Part A, Table 1, ITU-T Rec. I.432.1 clause 4.3.	M
OAM procedures	**4.4**	Heading	–
SDH-based OAM	4.4.1	Refer to Note 1 Refer to Part B, Table 3, ITU-T Rec. I.432.2 clause 4.2.1	O
Cell-based OAM	4.4.2	Refer to Note 1 Sub-clauses under 4.4.2 are mandatory conformance requirements if cell-based is supported.	O
Transmission overhead allocation	4.4.2.1		O
OAM implementation	4.4.2.2		O
Allocation of OAM functions in information field	4.4.2.3		O
~~**Power feeding**~~	~~**5**~~	Understudy by ITU-T	NA
Note 1 At least one of these options, SDH-based or cell-based, must be supported. However, their provision is local implementation dependent.			

PART E B-ISDN USER-NETWORK INTERFACE - PHYSICAL LAYER SPECIFICATION: 25 600 kbit/s OPERATION

(ITU-T Recommendation I.432.5, June 1997)

TABLE 1: 25 600 kbit/s OPERATION			
TITLE	**ITU-T REC I.432.5**	**COMMENTS**	**CR**
Physical media characteristics at the S_B reference point for 25 600 kbit/s physical layer interface	**2**	Heading	–
Transmission link requirements	**2.1**	Heading	–
Line and bit rates	2.1.1	Nominal line symbol rate is 32 Mbaud. Using 4B5B block code, the bit rate is 25 600 kbit/s.	M
Bit rate symmetry	2.1.2	Interfaces are symmetric.	M
Bit Error Ratio (BER)	2.1.3		M
Transmission link timing	2.1.4		M
Free running timing configurations	2.1.5		M
Transmitter requirements	**2.2**		M
Transmitter zero-crossing distortion	2.2.1		M
Duty cycle distortion	2.2.1.1		M
Edge jitter	2.2.1.2		M
Transmitter wave shapes	2.2.2		M
Transmitter launch amplitude	2.2.3		M
Transmitter return loss	2.2.4		M
Receiver requirements	**2.3**	Heading	–
Receiver acquisition timing	2.3.1		M
Receiver return loss	2.3.2		M
Copper link segment characteristics	**2.4**	The physical layer interface shall support at least one of the copper link segment defined under clause 2.4.	M
100 ohm link segment	2.4.1		O
100 ohm UTP link segment	2.4.1.1		O
Reference model configuration for 100 ohm UTP systems	2.4.1.2		O
Examples of 100 ohm UTP compliant channels	2.4.1.3		O
100 ohm UTP attenuation	2.4.1.4		O
100 ohm UTP NEXT loss	2.4.1.5		O

TABLE 1: 25 600 kbit/s OPERATION (CONTINUED)			
TITLE	**ITU-T REC I.432.5**	**COMMENTS**	**CR**
Characteristic impedance and structural return loss	2.4.1.6		O
100 ohm connecting hardware	2.4.1.7		O
UTP media interface connector	2.4.1.8		O
120 ohm link segment	2.4.2		O
120 ohm link segment	2.4.2.1		O
Reference model configuration for 120 ohm segments	2.4.2.2		O
Examples of 120 ohm compliant channels	2.4.2.3		O
120 ohm connecting hardware and media interface connector	2.4.2.4		O
150 ohm link segment	2.4.3		O
150 ohm STP link segment	2.4.3.1		O
Reference model configuration for 150 ohm STP segments	2.4.3.2		O
Examples of 150 ohm compliant channels	2.4.3.3		O
STP media interface connector	2.4.3.4		O
Functions provided by the transmission convergence sublayer	**3**		M
Cell scrambling and descrambling	**3.1**		M
PRNG sequence	3.1.1		M
4B5B block coding and decoding	**3.2**		M
Symbol-pair level code structure	3.2.1		M
Cell delineation	3.2.2		M
Support for a timing signal	3.2.3		M
NRZI coding and decoding	**3.3**		M
HEC generation and verification	**3.4**		M