The ATM Forum
Technical Committee

E3 Public UNI

af-phy-0034.000

August 1995

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2.5 E3 (34,368 kbps) Physical Layer Interface

The purpose of this specification is to define the ATM physical layer interface with a bit rate of 34,368 kbps that is based on ITU-T Recommendations and ETSI specifications. This specification applies to the public UNI only and is intended to operate over clear channel facilities.

2.5. 1 Acronyms

AIS - Alarm Indication Signal
AMI - Alternate Mark Inversion
BER - Bit Error Rate
BIP - Bit Interleaved Parity
BPS - Bits Per Second
ETSI - European Telecommunications Standards Institute
FEBE - Far End Block Error
HDB3 - High Density Bipolar 3
HEC - Header Error Control
ITU-T - International Telecommunication Union - Telecommunication Standardization Sector
LCD - Loss of Cell Delineation
LOS - Loss of Signal
MA - Maintenance and Adaptation
OAM - Operations, Administration, Maintenance
OOF - Out of Frame
PMD - Physical Media Dependent
RDI - Remote Defect Indication (replaces FERF terminology)
TC - Transmission Convergence
TR - Trail Trace

2.5.2 General Physical Layer Definition

(R) The functions and primitives of the physical layer shall be as specified in section 4 of ITU-T Recommendation 1.32 1 [1].

(R) The information flows and interface functions of the physical layer shall be as specified in section 3 of ITU-T Recommendation 1.413 [2].

2.5.3 Physical Media Dependent (PMD) Specification

(R) The PMD characteristics shall comply with section 8 of ITU-T Recommendation G.703 [3].

2.5.3.1 Physical/Electrical Characteristics

(R) The output signal shall have the pulse characteristics, test load impedance, and jitter specification specified in section 8.2 of Recommendation G.703 [3].

(R) The signal presented at the input port shall be as defined above but with the jitter tolerance and return loss as specified in section 8.3 of Recommendation G.703 [3].

2.5.3.2 Bit Rate

(R) The nominal bit rate shall be 34,368 kbps as specified in section 8.1 of G.703 [3].

The bit rate accuracy shall be +/- 20 ppm when there is no synchronization to a network clock. When there is network clock synchronization, the accuracy shall be that of the network clock.

2.5.3.3 Line Code

(R) The line code shall be the High Density Bipolar of order 3 (HDB3) code as specified in section 8.1 of G.703 [3].

This code is a modified AMI code where 4 consecutive zeros are replaced with a code containing bipolar violations.

2.5.4 Transmission Convergence (TC) Sublayer Specification

2.5.4.1 Transport-Specific TC Functions - Frame Format

(R) The transport frame format shall conform to the basic frame structure for 34,368 kbps as specified in section 2.1 of Recommendation G.832 [4], section 5.1 of prETS 300 337 [5], and section 8 of prETS 300 417-5 [6].

The frame structure is shown in Figure 1. There are 7 bytes of overhead and 530 bytes of payload capacity per 125 microsecs. Figure 1 also gives a brief definition of the overhead bytes. For a full description of the overhead, see G.832 [4], prETS 300 337 [5], or prETS 300 417-5 [6].

It has been shown that there is the possibility of false frame alignment if the framing pattern is emulated by the contents of the ATM cell header. Therefore, when implementing this frame structure, care should be taken to ensure that the performance of the frame alignment mechanism is not compromised by the payload content.

2.5.4.2 ATM-Specific TC Functions

(R) The ATM-specific TC functions shall be based on Recommendation G.804 [7] section 6 and I.432 [8] section 4.

2.5.4.2.1 ATM Cell Mapping

(R) The ATM cells shall be mapped into the 530 bytes of payload directly as specified in Recommendation G.804 [7] section 6.1.

The bytes of the cells are aligned with the bytes of the frame. The mapping is shown in Figure 1.

2.5.4.2.2 Cell Rate Adaptation

(R) Cell rate adaptation shall be performed by inserting and discarding idle cells as specified in Recommendation G.804 [7] section 6.2 and Recommendation I.432 [8] section 4.4.

2.5.4.2.3 Cell Delineation (HEC)

(R) Cell delineation shall be performed using the HEC mechanism specified in Recommendation G.804 [7] section 6.5 and Recommendation I.432 [8] section 4.5.

2.5.4.2.4 ATM Cell Scrambling

(R) The ATM cell payload shall be scrambled using the self-synchronizing scrambler specified in Recommendation G.804 [7] section 6.4 and Recommendation I.432 [8] section 4.5.

2.5.4.2.5 Header Error Control (HEC) Generation/Verification

(R) The transmitter shall calculate the HEC value for the first four bytes of the ATM header and insert the results in the HEC byte as specified in Recommendation G.804 [7] section 6.6 and Recom-mendation I.432 [8] section 4.3.

(R) The receiver shall support both the single-bit error correction mode and the multiple-bit error detection mode for header error control using the procedures specified in Recom-mendation I.432 [8] section 4.3. The single-bit error correction mode shall be the default mode.

2.5.5 Physical Layer Operations and Maintenance (OAM)

2.5.5.1 B-ISDN-Independent OAM Functions

2.5.5.1.1 Defects and Failures

(R) Out of Frame (OOF) detection and removal shall be implemented according to ITU-T Recommendation G.783 [9] section 2.2.2 and prETS 300 417-2 [10], section 4.3.

If in the in-frame state, the maximum OOF detection time is 625 microsecs for a random unframed signal. The framing algorithm used to check the alignment is such that, under normal operation, a 10^{-3} (Poisson type) BER does not cause a false OOF more than once every 6 minutes. If in the OOF state, the maximum frame alignment time must be 250 microseconds for an error signal with no emulated framing patterns. The algorithm used to recover from OOF must be such that the probability for false frame recovery with a random unframed signal is no more than 10^{-5} per 250 microseconds time interval.

(R) Loss of Signal (LOS) detection and removal shall be implemented according to ITU-T Recommendation G.775 [11] section 4.2 and prETS 300 417- 1 [12], section 8.2.

LOS is detected when the incoming signal is less than or equal to a signal level of 35 dB below nominal for N consecutive pulse intervals, where N is between 10 and 255, inclusive, LOS is cleared when the incoming signal level is greater than or equal to a signal level of 15 dB below nominal for N consecutive pulse intervals, where N is between 10 and 255, inclusive.

(R) Alarm Indication Signal (AIS) shall be implemented according to Recommendation G.751 [13] section 2.5.2, Notes 1 and 2 only, and section 2.5.3.

The physical layer AIS signal is an unframed all l's signal. The AIS detection strategy is such that AIS is detectable even in the presence of a 10^{-3} BER and that AIS fault detection and subsequent actions are completed within 1 ms.

(R) The incoming signal shall be tested for a Trail Trace mismatch, Unequipped signal, Degraded signal, and RDI signal as specified in prETS 300 417-5 [6], section 8.2 and prETS 300 417- 1 [12], section 8.2.1.

The Trail Trace byte (TR) is part of the overhead as shown in Figure 1. Its implementation is described in Recommendation G.832 [4], section 2.1.2 and prETS 300 337 [5], section 5.1.2.

(R) The incoming signal shall be tested for Signal Label Mismatch as specified in prETS 300 417-1 [12], section 8.2.1.

(R) Failures shall be declared based on the persistence of defects as specified in prETS 300 417- [12], section 8.3.

2.5.5.1.2 Maintenance Signals

(R) The maintenance signals defined in Recommendation G.832 [4] section 2.1.2 and prETS 300 337 [5], section 5.1.2 shall be implemented according to section 6.1 of Recommendation 1.432 [8] and section 8.2 of prETS 300 417-5 [6].

(R) The RDI (FERF) signal shall be sent upstream when an LOS, LOF, Trail Trace mismatch, AIS, Unequipped, or Signal Label Mismateh defect is detected in the received line as specified in section 6.1 of Recommendation I.432 [8] and prETS 300 417-5 [6], section 8.2.

(R) The FEBE signal shall be sent upstream when 1 or more errors are detected by the BIP-8 error monitoring as specified in section 2.1.2 of Recommendation G.832 [4], section 5.1.2 of prETS 300 337 [5] and section 8.2 of prETS 300 417-5 [6].

Figure 1 shows the overhead for the frame. The generation of the RDI (FERF) and FEBE maintenance signals are supported using the MA overhead byte. The following table shows the definitionof the MA overhead byte.

1	2	3	4	5	6	7	8
RDI	FEBE	Payload Type 010 (ATM)			Payload Dep		Timing Marker

Table 1: MA Byte Definition

2.5.5.1.3 Performance Monitoring

(R) The error performance events monitored shall be as described in ITU-T Recommendation G.826 [14] and prETS 300 417-1 [12].

The performance events that are monitored are Errored Blocks (EB), Errored Seconds (ES).

Severely Errored Seconds (SES), and Background Block Error (BBE). The incoming (near end) signal error events are based on the BIP-8 error monitoring in the EM overhead byte and the received defects (LOS, etc.). The outgoing (far end) signal error events are based on the FEBE signals received and the RDI (FERF) defects received.

The definitions for the events are given in section 5 of G.826 [14] and section 8.4 of prETS 300 417- 1 [12]. For the E3 interface the block size corresponds to the frame size, which is 4296 bits.

2.5.5.2 B-ISDN-Specific OAM Functions

2.5.5.2.1 General

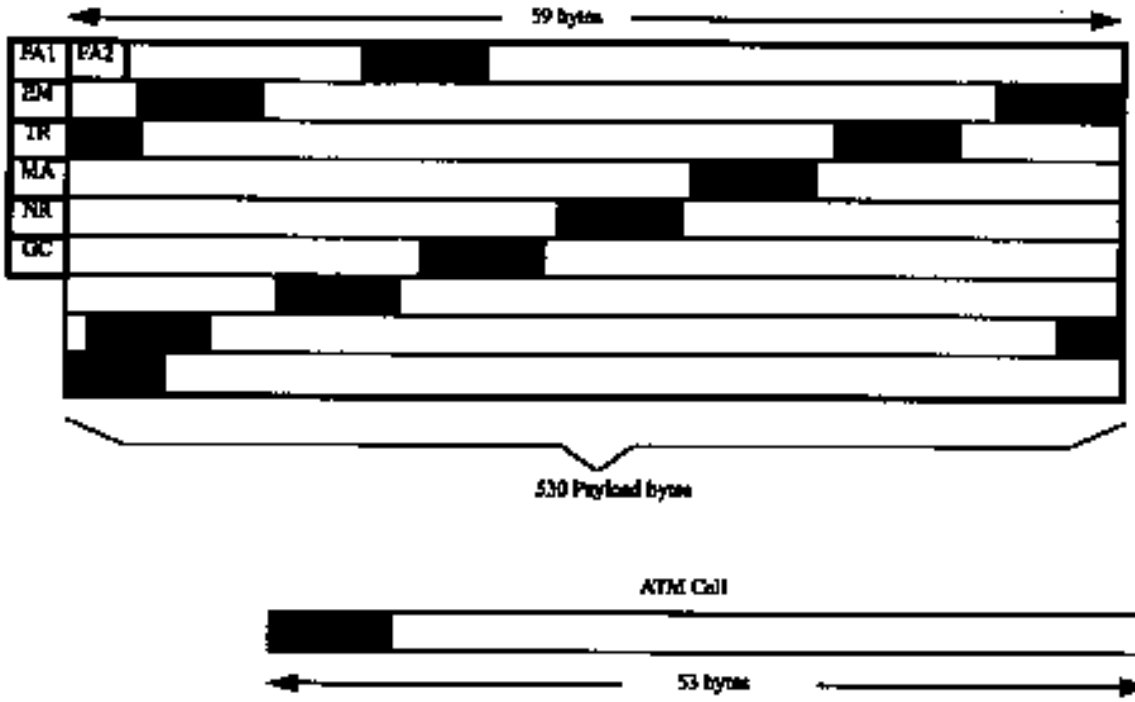
(R) The OAM functions for the TC sublayer shall be as described in the relevant parts of ITU-T Recommendation I.610 [15].

2.5.5.2.2 Failure States

(R) The Loss of Cell Delineation (LCD) failure shall be detected and removed as specified in section 6.1 of Recommendation I.432 [8].

2.5.5.2.3 Maintenance Signals

(R) The RDI (FERF) signal contained within the MA overhead byte shall be sent to the upstream equipment when the LCD failure occurs as specified in section 6.1 of Recommendation I.432 [8].



Overhead Definitions

FA1 - Frame Alignment 1
FA2 - Frame Alignment 2
EM - Error Monitor, BIP-8
TR - Trail Trace
MA - Maintenance and Adaptation
NR - Network Operator
GC - General Purpose Communications Channel

Figure 1: Frame Format and Overhead

2.5.6 References

[1] B-ISDN Protocol Reference Model and Its Application, ITU-T Recommendation 1.321, April 1991.

[2] B-ISDN User-Network Interface, ITU-T Recommendation 1.413, March 1993.

[3] Physical/Electrical Characteristics of Hierarchical Digital Interfaces, ITU-T Recommendation G.703, 1991.

[4] Transport of SDH Elements on PDH Networks: Frame and Multiplexing Structures, ITU-T Recommendation G.832, November 1993.

[5] Transmission and Multiplexing; Generic frame structures for the transport of various signals at the CCITT Recommendation G.702 hierarchical rates of 2048 kbit/s, 34 368 kbit/s and 139 264 kbit/s, ETSI Draft prETS 300 337, November 1994.

[6] Transmission and Multiplexing (TM); Generic Functional Requirements for SDH Transmission Equipment, Part 5: PDH Path Layer Functions, ETSI Draft prETS 300 417-5, November 1994.

[7] ATM Cell Mapping into Plesiochronous Digital Hierarchy (PDH), ITU-T Recommendation G.804, November 1993.

[8] B-ISDN User-Network Interface - Physical Layer Specification, ITU-T Draft Recommendation I.432, November 1994.

[9] Characteristics of Synchronous Digital Hierarchy (SDH) Equipment Functional Blocks, ITU-T Recommendation G.783, January 1994.

[10] Transmission and Multiplexing (TM); Generic Functional Requirements for SDH Transmission Equipment, Part 2: Physical Section Layer Functions, ETSI Draft prETS 300 417-2, November 1994.

[11] Loss of Signal (LOS) and Alarm Indication Signal (AIS) Defect Detection and Clearance Criteria, ITU-T Draft Recommendation G.775, October 1993.

[12] Transmission and Multiplexing; Generic functional requirements for Synchronous Digital Hierarchy (SDH) transmission equipment Part 1: Generic processes and performance, ETSI Draft prETS 300 417-1, July 1994.

[13] Digital Multiplex Equipments Operating at the Third Order Bit Rate of 34 368 kbit/s and the Fourth Order Bit Rate of 139 264 kbit/s and Using Positive Justification, ITU-T Recommendation G.751, 1976.

[14] Error Performance Parameters and Objectives for International Constant Bit Rate digital Paths at or Above the Primary Rate, ITU-T Draft Recommendation G.826, November 1994.

[15] B-ISDN Operation and Maintenance Principles and Functions, ITU-T Draft Recomendation I.610, November 1994.