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Contents

Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

   x   the first digit:

      1   presented to TSG for information;

      2   presented to TSG for approval;

      3   or greater indicates TSG approved document under change control.

   y   the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

   z   the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The present document specifies the standards allowed to implement Layer 1 on the Iu interface.

The specification of transmission delay requirements and O&M requirements are not in the scope of the present document.

In the following 'Layer 1' and 'Physical Layer' are assumed to be synonymous.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   ITU-T Recommendation I.432.2 (1996-08): "ISDN User-Network interfaces, Layer 1 Recommendations, 155 520 kbit/s and 622 080 kbit/s operation".

[2]   Void.

[3]   ITU-T Recommendation G.703 (1998-10): "Physical/electrical characteristics of hierarchical digital interfaces".

[4]   ITU-T Recommendation G.704 (1998-10): "Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels".

[5]   ITU-T Recommendation G.957 (1995-07): "Optical interfaces for equipments and systems relating to the synchronous digital hierarchy".

[6]   ITU-T Recommendation I.432.1 (1996-08): "ISDN User-Network interfaces, Layer 1 Recommendations, General characteristics".

[7]   ITU-T Recommendation G.823 (2000-03): "The control of jitter and wander within digital networks which are based on the 2048 kbit/s hierarchy".

[8]   ITU-T Recommendation G.824 (2000-03): "The control of jitter and wander within digital networks which are based on the 1544 kbit/s hierarchy".

[9]   ITU-T Recommendation G.825 (2001-08): "The control of jitter and wander within digital networks which are based on the synchronous digital hierarchy (SDH)".

[10]   ITU-T Recommendation G.826 (1996-08): "Error performance parameters and objectives for international, constant bit rate digital paths at or above the primary rate".

[11]   ITU-T Recommendation I.361 (1995-11): "B-ISDN ATM layer specification".

[12]   ATM Forum AF-PHY-0016.000 (1994-09): "DS1 Physical Layer Specification".

[13]   ATM Forum AF-PHY-0064.000 (1996-09): "E1 Physical Layer Interface Specification".

[14]   ATM Forum AF-PHY-0086.001 (1999-02): "Inverse Multiplexing for ATM (IMA) Specification Version 1.1".

[15]   ITU-T Recommendation G.751 (1988-11): "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".

[16]   ITU-T Recommendation G.811 (1997-02): "Timing Characteristics of Primary Reference Clocks".

[17]   ITU-T Recommendation G.804 (1998-02): "ATM cell mapping into plesiochronous digital hierarchy (PDH)".

[18]   Standard ECMA-226: "Private Integrated Services Network (PISN) - Mapping Functions for the Employment of Dedicated Circuit Mode Connections as Inter-PTNX Connections (MAPPING-CM-STATIC)".

[19]   ITU-T Recommendation I.431 (1988-11): "Primary rate user-network interface - Layer 1 specification".

3   Abbreviations

For the purposes of the present document, the following abbreviations apply:

ATM	Asynchronous Transfer Mode
HEC	Header Error Control
IMA	Inverse Multiplexing on ATM
IP	Internet Protocol
PDH	Plesiochronous Digital Hierarchy
PMD	Physical Media Dependent
PHY-SAP	Physical Service Access Point
SDH	Synchronous Digital Hierarchy
SDU	Service Data Unit
SONET	Synchronous Optical Networking

4   Iu Layer 1

4.1   Introduction

The main functions of Layer 1 are summarised in the following:

- Interface to physical medium;
- [ATM-Cell delineation];
- Line clock extraction capability;
- Layer 1 alarms extraction and generation;
- In-sequence delivery;
- Transmission quality control.

4.2   Layer 1 Description

4.2.1   Layer 1 Synchronised

When the Layer 1 Synchronised option is used (i.e. PDH/SDH/SONET links), the following requirements shall be met:

Layer 1 reference configuration shall be according to ITU-T Rec. I.432.1 [6].

The physical layer is divided into:

- Physical Media Dependent (PMD) sublayer;

- Transmission Convergence (TC) sublayer defined according to ITU-T Rec. I.432.1 [6].

The PMD shall comply with at least one of the following standards:

- ETSI STM-4 (622 Mb/s) interface according to ITU-T Rec. I.432.2 [1] with optical S-4.1 interface according to ITU-T Rec. G.957 [5].

- SONET STS-12c (622 Mb/s) interface according to ANSI, T1.105-1995 with optical multimode.

- SONET STS-3c (155 Mb/s) interface according to ANSI, T1.105-1995 with optical multimode.

- ETSI STM-1 (155 Mb/s) interface according to ITU-T Rec. I.432.2 [1] with electrical interface (CMI) to ITU-T Rec. G.703 [3].

- ETSI STM-1 (155 Mb/s) interface according to ITU-T Rec. I.432.2 [1] with optical S-1.1 interface according to ITU-T Rec. G.957 [5].

- ITU STS-1 (51 Mb/s) interface according to ANSI, T1.105-1995 with electrical interface.

- ITU STM-0 (51 Mb/s) interface according to ETSI/TTC with electrical interface.

- ITU STM-0 (51 Mb/s) interface according to ETSI/TTC with optical S-1.1 interface according to ITU-T Rec. G.957 [5].

- J2, 6.3 Mb/s interface according to Japanese standard JT-G.703 (ITU-T Rec. G.703 [3]) and JT-G.704 (ITU-T Rec. G.704 [4]) (75 Ohm).

  NOTE: J2 requires that the ATM cells be mapped into the physical layer according to HEC based mapping in ITU-R Rec. G.804 [17].

- E2, 8Mb/s according to ETSI/ITU G.703 (ITU-T Rec. G.703 [3]) and G.704 (ITU-T Rec. G.704 [4]) (75 Ohm).

- E3, 34 Mb/s interface according to ETSI/ITU G.751 (ITU-T Rec. G.751 [15]) (75 Ohm).

- T3, 45 Mb/s interface according to ANSI/ITU G.703 (ITU-T Rec. G.703 [3]) and G.704 (ITU-T Rec. G.704 [4]) (75 Ohm).

- E1, 2Mb/s interface balanced 120 Ohm symmetrical according to ETS 300 420 (Standard ECMA-226 [18]), ITU-T Rec. G.704 [4] and TBR 013 (ITU-T Rec. G.703 [3]), and AF-PHY-0064.000 [13].

- E1, 2Mb/s according to ITU-T Rec. G.703 [3] and ITU-T Rec. G.704 [4] (75 Ohm), and AF-PHY-0064.000 [13].

- J1, 1.5 Mb/s interface according to JT-I.431-a (ITU-T Rec. I.431 [19]) (100 Ohm).

- J1, 1.5 Mb/s interface according to JT-G.703 (ITU-T Rec. G.703 [3]) and JT-G.704 (ITU-T Rec. G.704 [4]) (110 Ohm).

- T1, 1.5 Mb/s interface according to AF-PHY-0016.000 [12] and ITU-T Rec. G.703 [3] and ITU-T Rec. G.704 [4] (100 Ohm).

Services provided to the upper layer shall be independent from the used underlying technology.

The support of intervening transport networks - like PDH or SDH terrestrial links, Point-to-point or Point-to-Multipoint radio links - shall not be prevented.

When using E1, T1, or J1, it shall be possible to use inverse multiplexing of ATM (IMA) (ATM Forum AF-PHY-0086.001 [14]) within suitable subsets of the physical ports on the respective Exchange Termination (ET).

The jitter and wander performance requirements on the interface shall be in accordance with network limits for output wander at traffic interfaces of either Reference ITU-T Rec. G.823 [7], ITU-T Rec. G.824 [8] or network limits for the maximum output jitter and wander at any hierarchical interface of Reference ITU-T Rec. G.825 [9], whichever is applicable.

The synchronisation reference extracted from the Iu may be used as UTRAN synchronisation reference. A general recommendation is to supply a traceable synchronisation reference according to reference ITU-T Rec. G.811 [16].

Transmission quality control shall be provided according to ITU-T Rec. G.826 [10].

4.2.2 [IP – Layer 1 Unsynchronised]

When Layer 1 unsynchronised option is used, the following requirements shall be met:

The support of any suitable physical layer - like Ethernet L1 or other suitable point-to-point or point-to-multipoint techniques - shall not be prevented.

4.3 Requirements from higher layer

No specific requirements beyond the ones listed in the introduction have been identified.

4.4 Services Provided by Layer 1

4.4.1 ATM Transport

The physical layer provides services to the upper layer via the Physical Service Access Point (PHY-SAP) according to ITU-T I.361 [11], as described in the following figure:
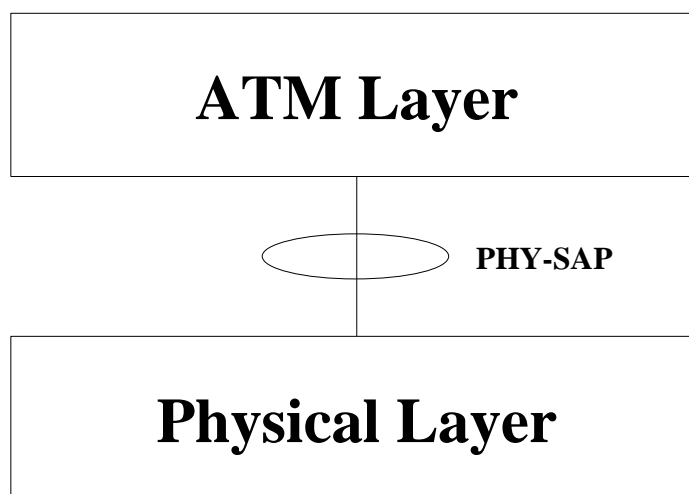

Figure 1: SAP between Physical Layer and ATM Layer

According to ITU-T Rec. I.361 [11], subclause 3.2, the following primitives are provided over PHY-SAP:

- PHY-DATA request (PHY-SDU);

- PHY-DATA indication (PHY-SDU).

The parameter PHY-SDU contains one ATM cell as defined in ITU-T I.361 [11] received or to be transferred over the physical medium.

4.5 Interface to Management Plane

The description of the interface towards Management Plane is out of scope of this document, anyhow at least the following O&M functions should be foreseen:

- Performance Monitoring Functions;

- Alarm Status Reporting Functions;

- Synchronisation Source Management.

Annex A (informative):
Change History

Date / TSG	TSG Doc.	CR	Rev	Subject/Comment	New
12/2008	-	-	-	Creation of Rel-8 version based on v7.1.0	8.0.0
12/2009	-	-	-	Creation of Rel-9 version based on v8.0.0	9.0.0
03/2011	SP-100629			Clarification on the use of References (TS 21.801 CR#0030)	9.0.1
03/2011				Creation of Rel-10 version based on v9.0.1	10.0.0
06/2011	RP-110684	0019		Correction of references	10.1.0
09/2012				Update to Rel-11 version (MCC)	11.0.0