

Contents

1 Introduction

1.1 Scope and Objectives	1-1
1.1.1 Intra-Network Connections	1-1
1.1.2 Network Access Connections	1-1
1.2 Primary Source Documents	1-2
1.3 Document Organization	1-2
1.4 Requirements Terminology	1-3
1.5 Requirement Labeling Conventions	1-4
1.5.1 Numbering of Requirement and Related Objects	1-5
1.5.2 Requirement, Conditional Requirement, and Objective Identification	1-5

2 B-ISDN Reference Configuration and Associated Interfaces

2.1 Functional Groups and Reference Points	2-1
2.2 Physical Interfaces Associated With the B-ISDN Reference Configuration	2-1
2.2.1 Standards Terminology	2-1
2.2.2 The UNI	2-2
2.2.3 The NNI	2-3

3 Asynchronous Transfer Mode Description and Terminology

3.1 ATM Protocol Fundamentals	3-1
3.2 Cell Structure, Format, and Field Use	3-1
3.2.1 Format and Field Mapping Conventions	3-1
3.2.2 Cell Structure	3-2
3.2.3 Cell Header Structure at the UNI	3-2
3.2.4 Cell Header Structure at the NNI	3-2

4 The 155.520 Mbit/s UNI

4.1 Bit Rate	4-1
4.2 Interface Symmetry	4-1
4.3 Signal Format	4-2
4.3.1 Transport Signal Format	4-2
4.3.2 SONET Frame Synchronous Scrambler	4-2
4.3.3 ATM Cell Mapping	4-2
4.3.4 Framing Information	4-2
4.3.5 Overhead Bytes Active Across the UNI	4-3
4.4 Cell Rate Decoupling	4-5
4.5 Powering Arrangements	4-5
4.6 HEC Generation and HEC Check	4-5
4.7 Self-Synchronous Scrambler	4-5
4.8 Cell Delineation	4-5
4.9 Physical Layer Maintenance	4-6
4.9.1 Failure States	4-6

4.9.2	Maintenance Signals	4-7
4.9.2.1	Path Remote Defect Indication	4-7
4.9.2.2	Path Remote Failure Indication	4-8
4.9.2.3	Line Far End Block Error	4-8
4.9.3	Maintenance State Tables	4-8
4.9.3.1	Fault Conditions	4-9
4.9.3.2	User Side State Table Notes and Legend	4-12
4.9.3.3	Network Side State Table Notes and Legend	4-15
4.9.3.4	User Side Physical Layer States	4-15
4.9.3.5	Network Side Physical Layer States	4-16
4.9.3.6	Definition of Primitives	4-18
4.9.4	Performance Monitoring	4-18
4.9.4.1	Incoming Line Signal	4-18
4.9.4.2	Outgoing Line Signal	4-19
4.9.4.3	Path Performance Monitoring	4-19
4.10	Target PMD Characteristics of the 155.520 Mbit/s UNI	4-19
4.10.1	Transmission Medium	4-20
4.10.2	Line Code	4-20
4.10.3	Characteristics at Point TX	4-20
4.10.3.1	Central Wavelength	4-20
4.10.3.2	Spectral Width	4-20
4.10.3.3	Mean Launched Power	4-21
4.10.3.4	Extinction Ratio	4-21
4.10.3.5	Eye Diagram Mask	4-21
4.10.4	Characteristics at Point RX	4-22
4.10.4.1	Minimum Received Power	4-22
4.10.4.2	Maximum Received Power	4-22
4.10.4.3	Optical Path Power Penalty	4-22
4.11	Alternative PMD Characteristics of the 155.520 Mbit/s UNI	4-23
4.11.1	Alternative Single-Mode Optical 155.520 Mbit/s UNI	4-24
4.11.1.1	Fiber Specification (Single-mode)	4-24
4.11.1.2	Line Code	4-24
4.11.1.3	Characteristics at Point TX	4-24
4.11.1.4	Characteristics at Point RX	4-26
4.11.2	Alternative Multi-mode Optical 155.520 Mbit/s UNI	4-27
4.11.2.1	Fiber Specification (Multi-mode)	4-27
4.11.2.2	Line Code	4-28
4.11.2.3	Characteristics at Point TX	4-28
4.11.2.4	Characteristics at Point RX	4-29
4.11.3	Alternative Electrical 155.520 Mbit/s UNI	4-30
4.12	Synchronization, Timing and Jitter	4-31
4.12.1	Synchronization and Timing	4-31
4.12.2	Jitter	4-31
4.12.2.1	B-ISDN UNI Jitter Specification	4-32
4.12.2.2	Receiver Jitter Tolerance	4-32
4.12.2.3	Jitter Transfer	4-32
4.13	Connectors	4-32

4.13.1 Optical Connector	4-32
4.13.2 Electrical Connector	4-33

5 The 622.080 Mbit/s UNI

5.1 Bit Rate	5-1
5.2 Interface Symmetry	5-1
5.3 Signal Format	5-2
5.3.1 Transport Signal Format	5-2
5.3.2 SONET Frame Synchronous Scrambler	5-2
5.3.3 ATM Cell Mapping	5-2
5.3.4 Framing Information	5-2
5.3.5 Overhead Bytes Active Across the B-ISDN UNI	5-3
5.4 Cell Rate Decoupling	5-3
5.5 Powering Arrangements	5-4
5.6 HEC Generation and HEC Check	5-4
5.7 Self-Synchronous Scrambler	5-4
5.8 Cell Delineation	5-4
5.9 Physical Layer Maintenance	5-4
5.10 Target PMD Characteristics of the 622.080 Mbit/s UNI	5-4
5.10.1 Transmission Medium	5-5
5.10.2 Line Code	5-5
5.10.3 Characteristics at Point TX	5-5
5.10.3.1 Central Wavelength	5-6
5.10.3.2 Spectral Width	5-6
5.10.3.3 Mean Launched Power	5-6
5.10.3.4 Extinction Ratio	5-6
5.10.3.5 Eye Diagram Mask	5-6
5.10.4 Characteristics at Point RX	5-7
5.10.4.1 Minimum Received Power	5-7
5.10.4.2 Maximum Received Power	5-7
5.10.4.3 Optical Path Power Penalty	5-7
5.11 Alternative PMD Characteristics of the 622.080 Mbit/s UNI	5-8
5.11.1 Alternative Single-Mode Optical 622.080 Mbit/s UNI	5-8
5.11.1.1 Fiber Specification (Single-Mode)	5-9
5.11.1.2 Line Code	5-9
5.11.1.3 Characteristics at TX	5-9
5.11.1.4 Characteristics at RX	5-11
5.12 Synchronization, Timing and Jitter	5-12
5.12.1 Synchronization and Timing	5-12
5.12.2 Jitter	5-13
5.12.2.1 B-ISDN UNI Jitter Specification	5-13
5.12.2.2 Receiver Jitter Tolerance	5-13
5.12.2.3 Jitter Transfer	5-13
5.13 Connector	5-14

6 The 51.840 Mbit/s UNI

6.1 Bit Rate	6-1
6.2 Interface Symmetry	6-1
6.3 Signal Format	6-1
6.3.1 Transport Signal Format	6-1
6.3.2 SONET Frame Synchronous Scrambler	6-2
6.3.3 ATM Cell Mapping	6-2
6.3.4 Framing Information	6-2
6.3.5 Overhead Bytes Active Across the B-ISDN UNI	6-2
6.4 Cell Rate Decoupling	6-3
6.5 Powering Arrangements	6-3
6.6 HEC Generation and HEC Check	6-3
6.7 Self-Synchronous Scrambler	6-3
6.8 Cell Delineation	6-4
6.9 Physical Layer Maintenance	6-4
6.10 Target PMD Characteristics of the 51.840 Mbit/s UNI	6-4
6.10.1 Transmission Medium	6-4
6.10.2 Line Code	6-5
6.10.3 Characteristics at Point TX	6-5
6.10.3.1 Central Wavelength	6-5
6.10.3.2 Spectral Width	6-5
6.10.3.3 Mean Launched Power	6-5
6.10.3.4 Extinction Ratio	6-5
6.10.3.5 Eye Diagram Mask	6-6
6.10.4 Characteristics at Point RX	6-6
6.10.4.1 Minimum Received Power	6-6
6.10.4.2 Maximum Received Power	6-6
6.10.4.3 Optical Path Power Penalty	6-6
6.11 Alternative PMD Characteristics of the 51.840 Mbit/s UNI	6-7
6.11.1 Alternative Single-Mode Optical 51.840 Mbit/s UNI	6-8
6.11.1.1 Fiber Specification (Single-mode)	6-8
6.11.1.2 Line Code	6-8
6.11.1.3 Characteristics at Point TX	6-8
6.11.1.4 Characteristics at Point RX	6-10
6.11.2 Alternative Electrical 51.840 Mbit/s UNI	6-11
6.12 Synchronization, Timing and Jitter	6-11
6.12.1 Synchronization and Timing	6-11
6.12.2 Jitter	6-12
6.12.2.1 B-ISDN UNI Jitter Specification	6-12
6.12.2.2 Receiver Jitter Tolerance	6-13
6.12.2.3 Jitter Transfer	6-13
6.13 Connectors	6-13
6.13.1 Optical Connector	6-13
6.13.2 Electrical Connector	6-13

7 The 44.736 Mbit/s UNI

7.1 Bit Rate	7-1
7.2 Interface Symmetry	7-1
7.3 Signal Format	7-1
7.3.1 Transport Signal Format	7-1
7.3.2 ATM Cell Mapping	7-2
7.3.3 PLCP Format	7-2
7.3.3.1 Framing Bytes (A1, A2)	7-3
7.3.3.2 BIP-8 (B1)	7-3
7.3.3.3 Cycle/Stuff Counter (C1)	7-3
7.3.3.4 PLCP Path Status (G1)	7-4
7.3.3.5 Path Overhead Identifier (P0-P11)	7-4
7.3.3.6 Growth Bytes (Z1-Z6)	7-5
7.3.3.7 Trailer Nibbles	7-5
7.4 Cell Rate Decoupling	7-5
7.5 Powering Arrangements	7-5
7.6 HEC Generation and HEC Check	7-5
7.7 Self-Synchronous Scrambler	7-5
7.8 Cell Delineation	7-6
7.9 Physical Layer Maintenance	7-6
7.9.1 DS3 Layer Maintenance	7-6
7.9.2 DS3 PLCP Performance Monitoring	7-6
7.9.3 DS3 PLCP Path RF1 (Yellow)	7-7
7.10 PMD Characteristics of the 44.736 Mbit/s UNI	7-7
7.10.1 Optical Interface Characteristics	7-7
7.10.2 Electrical Interface Characteristics	7-8
7.11 Synchronization, Timing and Jitter	7-8
7.11.1 Synchronization and Timing	7-8
7.11.2 Jitter	7-8
7.12 Connector	7-8

8 1.544 Mbit/s Access Interface

8.1 Bit Rate	8-1
8.2 Interface Symmetry	8-2
8.3 Signal Format	8-2
8.3.1 Transport Signal Format	8-2
8.3.2 ATM Cell Mapping	8-2
8.4 Cell Rate Decoupling	8-2
8.5 Powering Arrangements	8-2
8.6 HEC Generation and HEC Check	8-3
8.7 Self-Synchronous Scrambler	8-3
8.8 Cell Delineation	8-3
8.9 Physical Layer Maintenance	8-3
8.10 PMD Characteristics of the 1.544 Mbit/s UNI	8-3
8.11 Synchronization and Timing	8-4
8.12 Connector	8-4

9 Physical Layer Characteristics of the NNI

9.1	General NNI Characteristics	9-1
9.2	155.520 Mbit/s NNT	9-2
9.2.1	Bit Rate	9-2
9.2.2	Interface Symmetry	9-2
9.2.3	Signal Format	9-3
9.2.3.1	NNI Active Overhead Bytes	9-3
9.2.3.2	ATM Cell Mapping	9-6
9.2.3.3	Framing	9-6
9.2.4	Cell Rate Decoupling	9-6
9.2.5	Powering Arrangements	9-6
9.2.6	HEC Generation and HEC Check	9-6
9.2.7	Self-Synchronous Scrambler	9-7
9.2.8	Cell Delineation	9-7
9.2.9	Physical Layer Maintenance	9-7
9.2.10	PMD Characteristics of the 155.520 Mbit/s NNI	9-8
9.2.11	Synchronization, Timing and Jitter	9-8
9.2.11.1	Synchronization and Timing	9-8
9.2.11.2	Jitter	9-9
9.2.12	Connectors	9-9
9.3	622.080 Mbit/s NNI	9-9
9.3.1	Bit Rate	9-9
9.3.2	Interface Symmetry	9-10
9.3.3	Signal Format	9-10
9.3.3.1	NNI Active Overhead Bytes	9-10
9.3.3.2	ATM Cell Mapping	9-10
9.3.3.3	Framing Information	9-10
9.3.4	Cell Rate Decoupling	9-11
9.3.5	Powering Arrangements	9-11
9.3.6	HEC Generation and HEC Check	9-11
9.3.7	Self-Synchronous Scrambler	9-11
9.3.8	Cell Delineation	9-11
9.3.9	Physical Layer Maintenance	9-12
9.3.10	PMD Characteristics of the 622.080 Mbit/s STS-12C Based NNI	9-12
9.3.11	Synchronization, Timing and Jitter	9-12
9.3.11.1	Synchronization and Timing	9-12
9.3.11.2	Jitter	9-12
9.3.12	Connectors	9-13
9.4	44.736 Mbit/s NNI	9-13
9.4.1	Bit Rate	9-13
9.4.2	Signal Format	9-13
9.4.2.1	ATM Cell Mapping	9-13
9.4.2.2	PLCP Format	9-14
9.4.3	Cell Rate Decoupling	9-15
9.4.4	Powering Arrangements	9-15
9.4.5	HEC Generation and HEC Check	9-16

9.4.6 Self-Synchronous Scrambler	9-16
9.4.7 Cell Delineation	9-16
9.4.8 Physical Layer Maintenance	9-16
9.4.9 PMD Characteristics of the 44.736 Mbit/s NNI	9-16
9.4.9.1 Optical Interface Characteristics	9-16
9.4.9.2 Electrical Interface Characteristics	9-16
9.4.10 Synchronization, Timing and Jitter	9-17
9.4.10.1 Synchronization and Timing	9-17
9.4.10.2 Jitter	9-17
9.4.11 Connector	9-17

10 HEC Functionality, Scrambling and Cell Delineation

10.1 HEC-generation	10-1
10.2 HEC-check	10-1
10.3 Self-Synchronizing Scrambler	10-2
10.4 Cell Delineation	10-2

11 Acronyms

Appendix A: References

Requirement-Object Index

List of Figures

Figure 2-1	B-ISDN UNI Reference Configuration	2-4
Figure 2-2	The I_a interface Associated with the U_B Reference Point	2-4
Figure 2-3	Interfaces Associated with the T_B Reference Point	2-4
Figure 2-4	The B-MN UNI Associated with the U_B Reference Point	2-5
Figure 2-5	Alternative B-ISDN UNI Access Arrangement	2-5
Figure 3-1	PDU Structure at the UNI/NNI	3-3
Figure 3-2	ATM Cell Header Format at the UNI	3-3
Figure 3-3	ATM Cell Header Format at the NNI	3-4
Figure 4-1	Logical Frame Structure of the 155.520 Mbit/s UNI	4-34
Figure 4-2	Fault Conditions at the B-ISDN UNI	4-34
Figure 4-3	The Target SMF UNI Associated with the U_B Reference Point	4-35
Figure 4-4	Eye Pattern Mask for the SMF UNI at Point TX	4-36
Figure 4-5	An Alternative SMF UNI Access Arrangement	4-37
Figure 4-6	An Alternative MMF UNI (155 Mbit/s) Access Arrangement	4-37
Figure 4-7	The 155.520 Mbit/s Electrical UNI Based on STSX-3	4-38
Figure 5-1	Logical Frame Structure of the 622.080 Mbit/s UNI	5-15
Figure 6-1	Logical Frame Structure of the 51.640 Mbit/s UNI	6-14
Figure 7-1	DS3 PLCP Frame (125 μ s)	7-9
Figure 8-1	Direct ATM Cell Mapping on the DS1 Frame	8-4
Figure 9-1	Physical Realization Example of the NNI	9-17
Figure 9-2	Physical Realization Example of NNI' and NNI''	9-18
Figure 10-1	Receiver HEC Bistate Operation	10-4
Figure 10-2	Cell Header Error Analysis	10-5
Figure 10-3	Cell Delineation Diagram	10-6

List of Tables

Table 4-1	SONET Overhead Active Across the UNI (STS-1, -3c, -12)	4-4
Table 4-2	B-ISDN State Matrix at User Side of the UNI	4-10
Table 4-3	User Side State Matrix (Cont.)	4-11
Table 4-4	B-ISDN State Matrix at Network Side of the UNI	4-13
Table 4-5	Network Side State Matrix (Cont.)	4-14
Table 4-6	Target Single-Mode 155.520 Mbit/s UNI (Intermediate Reach) . . .	4-23
Table 4-7	Alternative Single-Mode 155.520 Mbit/s UNI (Short-Reach)	4-27
Table 4-8	Alternative Multi-mode 155.520 Mbit/s UNI	4-30
Table 5-1	Target Single-Mode 622.080 Mbit/s UNI (Intermediate Reach) . . .	5-8
Table 5-2	Alternative Single-Mode 622.080 Mbit/s UNI (Short-Reach)	5-12
Table 6-1	Target Single-Mode 51.840 Mbit/s UNI (Intermediate Reach) . . .	6-7
Table 6-2	Alternative Single-Mode 51.840 Mbit/s UNI (Short-Reach)	6-11
Table 7-1	DS3 C-Bit Channel Usage	7-2
Table 7-2	DS3 PLCP Cycle/Stuff Counter Definition	7-3
Table 7-3	DS3 PLCP POI Code Definitions	7-4
Table 7-4	DS3 PLCP Layer Maintenance	7-7
Table 9-1	SONET Overhead Requirements for the NNI	9-4