Reference Specification

for

Single-pair High-Speed Digital Subscriber Line (SHDSL) Transceivers

IDA RS SHDSL
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Contents

NOTICE

This Reference Specification is subject to review and revision.

Reference Specifications and Guides are informative documents, and are not used for type approval of customer equipment. They are either one of the following types of documents:

i. Informative and interim documents on customer equipment standards which are yet to be adopted by the network operators and where standardisation is still in progress.

ii. Informative documents describing the network standards adopted by the Public Telecommunication Networks in Singapore.

PART A INTRODUCTION

1. SCOPE

1.1 Part B of this Specification provides an outline of the Single-pair High-speed Digital Subscriber line technology, which is a physical layer standard based on the ITU-T Recommendation G.991.2. It describes a versatile transmission method for data transport in the telecommunication access networks, capable of supporting whichever network protocol deployed currently while enabling higher bandwidth and reach (e.g. TDM, ATM, Frame Relay and so on).

1.2 SHDSL transceivers are designed primarily for duplex operation over mixed gauges of two-wire twisted metallic pairs. Four-wire operation is included as an option for extended reach. The use of signal regenerators for both the two-wire and four-wire operations is optional.

1.3 SHDSL transceivers are capable of supporting selected symmetric user data rates ranging from 192 kbit/s to 2312 kbit/s, using Trellis Coded Pulse Amplitude Modulation (TCPAM) line code. They are designed to be spectrally compatible with other transmission technologies deployed in the access network, including other DSL technologies.

1.4 SHDSL transceivers do not support the use of analogue splitting technology for coexistence with either POTS or ISDN. However, POTS transport can be supported by means of either VoDSL or channelized VoDSL.

1.5 Regional requirements, including both operational differences and performance requirements, are defined in Part B with reference to G.991.2 Annexes A, B and C (e.g. test loops, performance tests, PSD masks and regional-specific functional requirements such as data rate, return loss, span powering, longitudinal balance and longitudinal output voltage. Requirements for signal regenerators are also as specified in G.991.2 Annex D.

1.6 Application-specific framing modes that may be supported by SHDSL transceivers are as described in G.991.2 Annex E. They are as follows:

a) Clear channel data
b) Clear channel byte-oriented data
c) Unaligned DS1 transport
d) Aligned DS1/fractional DS1 transport
e) European 2048 kbit/s digital unstructured leased line (D2048U)
f) Unaligned European 2048 kbit/s digital structured leased line (D2048S)
g) Aligned European 2048 kbit/s digital structured leased line (D2048S) and fractional
h) Synchronous ISDN BRA
i) ATM transport
j) Dual bearer TPS-TC mode

2. REFERENCE MODELS

2.1 STU-x Functional Model

2.1.1 Figure 1 is a block diagram of an SHDSL Transceiver Unit (STU) transmitter showing the functional blocks and interfaces that are referred to in this Specification. It illustrates the basic functionality of the STU-R and the STU-C. Each STU contains both an application invariant section (describing the core functions) and an application specific section. The application invariant section consists of the PMD and PMS-TC layers, while the application

specific aspects are confined to the TPS-TC layer and device interfaces. Management functions (not shown in Figure 1) are controlled by the operator's network management system. Details on management are as specified in G.991.2 § 9.

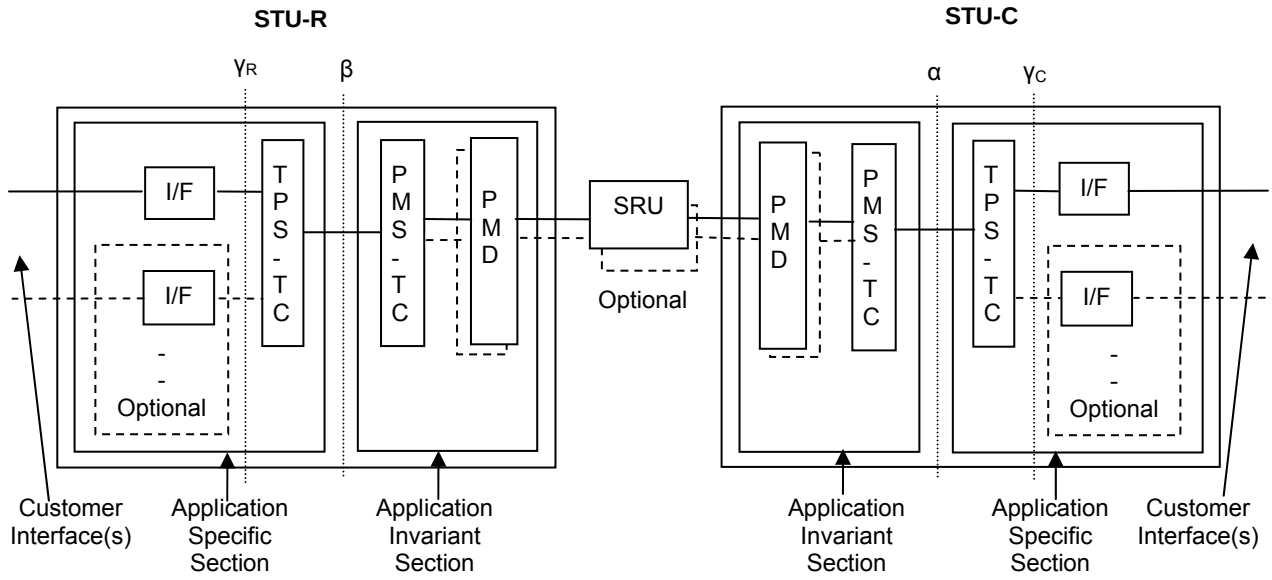

Figure 1 (Figure 4-1/G.991.2):
STU-x Functional Model

2.1.2 The PMD layer functionality is described in detail in G.991.2 § 6. The principal functions are:

a) Symbol timing generation and recovery
b) Coding and decoding
c) Modulation and demodulation
d) Echo cancellation
e) Line equalization
f) Link startup

2.1.3 The PMS-TC layer contains the framing and frame synchronization functions, as well as the scrambler and descrambler. The PMS-TC layer is described in G.991.2 § 7.

2.1.4 The TPS-TC is application specific and consists largely of the packaging of user data within the SHDSL frame. Details are given in G.991.2 § 8. This may include multiplexing, de-multiplexing, and timing alignment of multiple user data channels. Supported TPS-TC user data framing formats are described in G.991.2 Annex E.

2.2 User Plane Protocol Reference Model

The user plane protocol reference model, shown in Figure 2, is an alternate representation of the information shown in Figure 1. This model emphasizes the layered nature of the SHSDL specification, and provides a view that is consistent with the generic xDSL models given in the ITU-T RecommendationG.995.1.

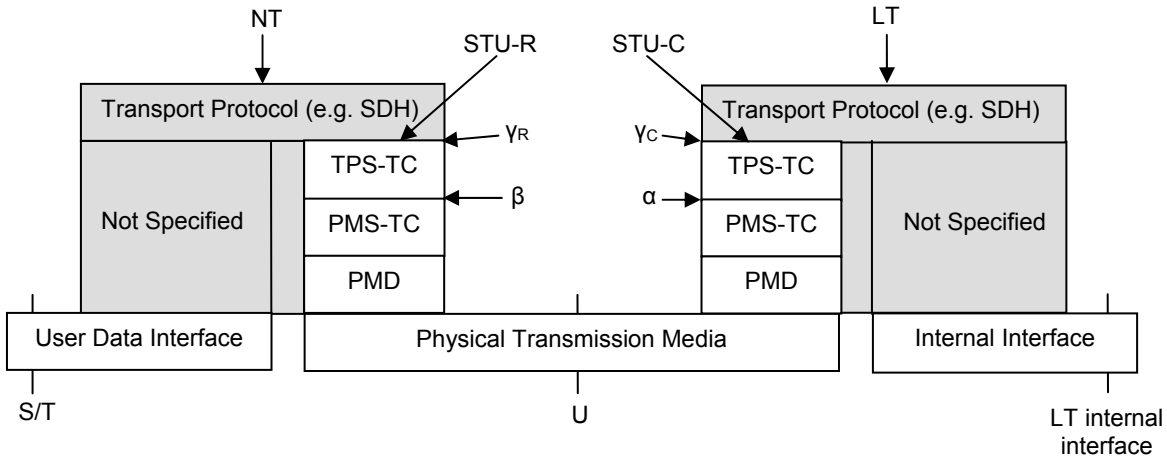

Figure 2 (Figure 4-2/G.991.2):
User Plane Protocol Reference Model

2.3 Application Models

Figure 3 is an application model for a typical SHDSL system, showing reference points for equipment attachment. In such an application, an STU-R will connect to one or more user terminals, which may include data terminals, telecommunications equipment, or other devices. Connections to terminal equipment are at the S/T reference points. Connection between the STU-R and STU-C may optionally contain one or more SHDSL signal regenerators (SRUs).

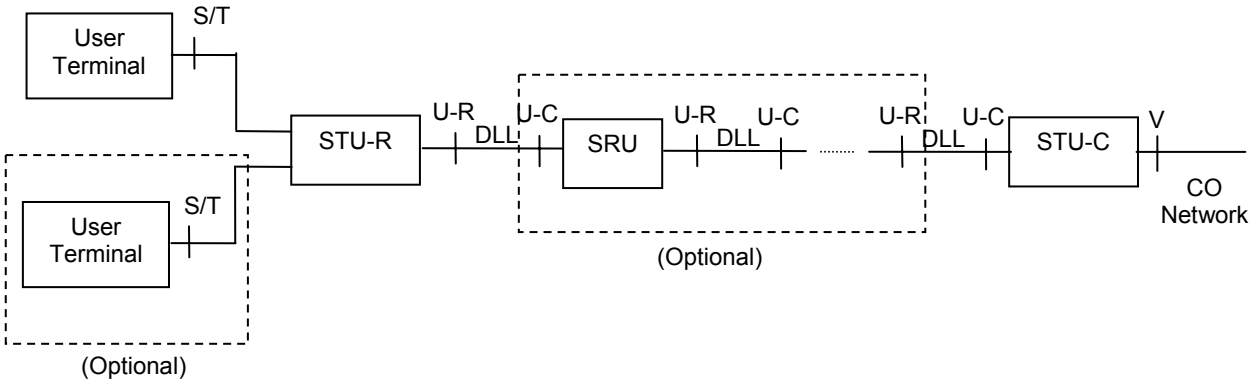

Figure 3 (Figure 4-3/G.991.2):
Application Model

3. GENERAL REQUIREMENTS

3.1 Power Supply

The SHDSL equipment may be a.c. powered or d.c. powered. For an a.c. powered equipment, the Specification shall be complied with when operating from an a.c. mains supply of voltage, 230V ± 10% and frequency, 50 Hz ± 2%. Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the equipment to meet the Specification.

3.2 Identification of Equipment

The SHDSL equipment shall be marked with the supplier or manufacturer's name or identification mark, and the supplier or manufacturer's model or type reference. The markings required shall be legible, indelible and readily visible.

3.3 Safety Requirements

The SHDSL equipment shall be tested for compliance with the Singapore Standards SS 337[1] or the International Electrotechnical Commission IEC 60950 safety standard. The requirements in SS 337/IEC 60950 that are applicable to the equipment (e.g. class of equipment, type of TNV circuit and types of components) shall be identified and complied with.

3.4 Electromagnetic Compatibility (EMC) Requirements

The SHDSL equipment shall comply with the "EMC requirements for Telecommunication Equipment" (IDA TS EMC).

4. REFERENCES

ITU-T Rec. G.991.2 (02/2001)	Single-pair High-speed Digital Subscriber Line Transceivers
ITU-T Rec. G.994.1 (05/2003)	Handshake procedures for digital subscriber line (DSL) transceivers
ITU-T Rec. G.995.1 (02/2001)	Overview of digital subscriber line (DSL) Recommendations
ITU-T Rec. G.997.1 (05/2003)	Physical layer management for digital subscriber line (DSL) transceivers
IEC CISPR 22: 1997	Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement
IDA TS EMC	EMC requirements for Telecommunication Equipment
IEC 60950	International Electrotechnical Commission - Safety of Information Technology Equipment
SS 337: 2001	Singapore Standards - Safety of Information Technology Equipment

[1] The safety standard includes, among others, protection of telecommunications network service personnel and users of other equipment connected to the network from hazards in the PLC equipment.

5 ABBREVIATIONS

α	The interface between the PMS-TC and TPS-TC layers in an STU-C
β	The interface between the PMS-TC and TPS-TC layers in an STU-R
γ_C	The interface between the TPS-TC layer and the application specific section in an STU-C
γ_R	The interface between the TPS-TC layer and the application specific section in an STU-R
ATM	Asynchronous Transfer Mode
CMRR	Common Mode Rejection Ratio
CO	Central Office
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
CRC-6	CRC of Order 6 (used in SHDSL frame)
DSL	Digital Subscriber Line
I/F	Interface
LT	Line Termination
NT	Network Termination
PAM	Pulse Amplitude Modulation
PMD	Physical Media Dependent
PMMS	Power Measurement Modulation Session (Line Probe)
PMS-TC	Physical Media-Specific TC Layer
PSD	Power Spectral Density
S/T	Logical interface between the STU-R and attached user terminal equipment
STU	SHDSL Transceiver Unit
STU-C	STU at the Central Office
STU-R	STU at the Remote End
TC	Transmission Convergence layer
TCM	Trellis Coded Modulation
TCM-ISDN	Time-Compression Multiplexed ISDN (specified in ITU-T G.961)
TCPAM	Trellis Coded PAM (used in data mode)
TDM	Time Division Multiplexing
TPS-TC	Transmission Protocol-Specific TC Layer
U-C	Loop Interface – Central Office end
U-R	Loop Interface – Remote Terminal end
V	Logical interface between STU-C and a digital network element such as one or more switching systems
xDSL	A collective term referring to any of the various types of DSL technologies

Note:
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 Functionality if implemented, the requirements become “M”.
NA	Not Applicable
GID	General Information and Definitions

PART B SINGLE-PAIR HIGH-SPEED DIGITAL SUBSCRIBER LINE TRANSCEIVERS

(Based on ITU-T Rec. G.991.2, 02/2001)

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DEFINITIONS AND ABBREVIATIONS	**3**		GID
REFERENCE MODELS	**4**		GID
TRANSPORT CAPACITY	**5**	In the two-wire operational mode, SHDSL supports user (payload) data rates from 192 kbps to 2.312 Mbps in increments of 8 kbps. In the optional four-wire operational mode, user data rates supported are from 384 kbps to 4.624 Mbps in increments of 16 kbps.	GID
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PMD pre-activation sequence	**6.3**		GID
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PMD pre-activation sequence description	6.3.2		M
Scrambler	6.3.3		M
Mapper	6.3.4		M
Spectral shaper	6.3.5		M
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Title	ITU-T Rec. G.991.2	Comments	CR
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G.994.1 code point definitions	6.4.1		M
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Severely errored second (SES)	9.3.3		M
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Unavailable second (UAS)	9.3.5		M
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Micro-interruptions	**12.1**		M

Title	ITU-T Rec. G.991.2	Comments	CR
Regional requirements – Region 1	**Annex A**		O
Regional requirements – Region 2	**Annex B**		O
Regional requirements – Region 3	**Annex C**	Refer to ITU-T Rec. G.992.1, Annex H for specifications of transceivers for use in networks with existing TCM-ISDN service (as specified in ITU-T G.961, Appendix IV).	O
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