



Telecommunications
Standards Advisory
Committee (TSAC)

Technical Specification

Asymmetrical Digital
Subscriber Line
Modems

**IMDA TS ADSL
Issue 1, 1 October 2016**

Info-communications Media Development Authority
Resource Management & Standards
10 Pasir Panjang Road
#10-01 Mapletree Business City
Singapore 117438

© Copyright of IMDA, 2016

This document may be downloaded from the IMDA website at <http://www.imda.gov.sg> and shall not be distributed without written permission from IMDA

Acknowledgement

The Info-communications Media Development Authority (IMDA) and the Telecommunications Standards Advisory Committee (TSAC) would like to acknowledge the following members of the TSAC Special Working Group (TSAC SWG) for their invaluable contributions to the preparation of this Technical Specification:

| | |
|--|--|
| IDA TS ADSL Issue 2, October 2013 re-issued as IMDA TS ADSL Issue 1, 1 October 2016 | Technical Specification for Asymmetrical Digital Subscriber Line Modems |
| TSAC SWG/TF Chairpersons | Tay Wee Chin, Senior Manager (Voice Engineering, Next Gen IP Networks), Singapore Telecommunications Ltd. |
| | Pyai Phyo Aung, Senior Engineer (Business Solutions & Fixed Services, StarHub Information Services and Network Engineering), StarHub Ltd |
| TSAC SWG/TF Editors | Tay Wee Chin, Senior Manager (Voice Engineering, Next Gen IP Networks), Singapore Telecommunications Ltd |
| | Woo Yim Leng, Senior Manager (Resource Management & Standards), Info-communications Development Authority of Singapore |

List of TSAC SWG Members

| SN | Organisation | Name |
|----|--|---|
| 1 | Singapore Telecommunications Ltd | Mr Tay Wee Chin Senior Manager |
| 2 | StarHub Ltd | Mr Pyai Phyo Aung Senior Engineer |
| 3 | | Mr Chow Yew Weng Manager |
| 4 | | Mr Jason Ng Wee Peng Senior Engineer |
| 5 | Info-communications Development Authority of Singapore | Ms Woo Yim Leng Senior Manager |
| 6 | | Mr Ian Teo Manager |

Telecommunications Standards Advisory Committee (TSAC)

The TSAC advises IMDA on the setting of ICT standards as well as on the development and recommendation of specifications, standards, information notes, guidelines and other forms of documentation for adoption and advancement of the standardisation effort of the Singapore ICT industry (hereafter termed “IMDA Standards”).

Telecommunications standards-setting in Singapore is achieved with the assistance of TSAC, where professional, trade and consumer interest in telecommunications standards is represented on the TSAC with representatives from network and service operators, equipment suppliers and manufacturers, academia and researchers, professional bodies and other government agencies.

List of TSAC Members (2012-2014)

TSAC Chairman:

Mr Raymond Lee Director (Resource Management & Standards)
Info-communications Development Authority of Singapore

TSAC Members:

| | |
|--|---|
| Mr Lim Yuk Min (TSAC Vice-Chairman) | Senior Executive Consultant (Resource Management and Standards) Info-communications Development Authority of Singapore |
| Dr Tan Geok Leng | Acting Executive Director Institute for Infocomm Research (I2R) Agency for Science, Technology and Research |
| Mr Darwin Ho Kang Ming | Vice President, Association of Telecommunications Industry of Singapore |
| Mr Yip Yew Seng | Honorary Secretary Association of Telecommunications Industry of Singapore |
| Mr Goh Kim Soon | SVP Technology Support / Technology Support (IMD) Mediacorp Pte Ltd |
| Mr Lim Chin Siang | Director (Interactive Digital Media Programme Office) Media Development Authority |
| Ms Tan Sze Siang | Deputy Director (Digital Broadcasting Deployment Office) Media Development Authority |
| Mr Patrick Scodeller | Chief Technical Officer, M1 Limited |
| Mr Lee Wing Kai | General Manager Engineering Radio Planning M1 Limited |
| Assoc Prof Li Kwok Hung | Nanyang Technological University School of Electrical & Electronic Engineering |
| Assoc Prof Xiao Gaoxi | Nanyang Technological University School of Electrical & Electronic Engineering |
| Assoc Prof Hari Krishna Garg | National University of Singapore Department of Electrical & Computer Engineering |
| Prof Ko Chi Chung | National University of Singapore Department of Electrical & Computer Engineering |
| Assoc Prof Tham Chen Khong | National University of Singapore Department of Electrical & Computer Engineering |
| Mr Chong Siew Loong | Vice President (Network and Systems) Nucleus Connect Pte Ltd |
| Mr Tiong Onn Seng | Director – Project Opennet Pte Ltd |

| | |
|--------------------|---|
| Mr Daniel Teo | Director – Technical Services Opennet Pte Ltd |
| Mr Aw Peng Soon | Chairman of SiTF Wireless Chapter VP, ANTLabs Singapore Infocomm Technology Federation |
| Mr Huang Ee Choon | Deputy Director Communications & Information Technology Singapore Institute of Technology |
| Mr Lee Siak Kwee | Director (Radio Network Access & Quality) Singapore Telecommunications Ltd |
| Mr Lim Yong Nam | Director (Voice Engineering, Next Gen IP Networks) Singapore Telecommunications Ltd |
| Mr Lee Yeu Ching | Director (Outside Plant Engineering) Singapore Telecommunications Ltd |
| Mr Soh Keng Hock | Director (Private IP Engineering) Singapore Telecommunications Ltd |
| Dr Wong Woon Kwong | Director of the Office of Research and Industry Collaborations Singapore University of Technology and Design |
| | Standards Division Spring Singapore |
| Mr Tay Wei Kiang | Assistant Vice President Business Solutions & Fixed Services StarHub Integrated Network Engineering StarHub Ltd |
| Mr Liong Hang Chew | Assistant Vice President Personal Solutions & Integrated Applications StarHub Integrated Network Engineering StarHub Ltd |
| Ms Woo Yim Leng | Senior Manager Info-communications Development Authority of Singapore |

Content

| Section | Title | Page |
|---------|--|------|
| 1. | Scope | 2 |
| 2. | References | 4 |
| 3. | Abbreviations | 5 |
| 4. | General Requirements | 6 |
| 5. | Asymmetric Digital Subscriber Line Transceivers 2 (ADSL2) & ADSL Transceivers – Extended Bandwidth (ADSL2+) | 8 |
| Annex | Corrigendum / Addendum | 16 |
| | <ul style="list-style-type: none">▪ Changes to IDA TS ADSL Issue 2 (Oct 13)▪ Changes to IDA TS ADSL Issue 1 Rev 2 (May 11)▪ Changes to IDA TS ADSL Issue 1 Rev 1 (Apr 06)▪ Changes to IDA TS ADSL Issue 1 (Jul 05)▪ Changes to IDA TS ADSL 1 and TS ADSL 2 | |

NOTICE

THE INFO-COMMUNICATIONS MEDIA DEVELOPMENT AUTHORITY (“IMDA”) MAKES NO WARRANTY OF ANY KIND WITH REGARD TO THE MATERIAL PROVIDED HEREIN AND EXCLUDES ANY EXPRESS OR IMPLIED WARRANTIES OR CONDITIONS OF NON-INFRINGEMENT, MERCHANTABILITY, SATISFACTORY QUALITY AND FITNESS FOR A PARTICULAR PURPOSE. SUBJECT TO THE MAXIMUM EXTENT PERMITTED UNDER LAW, IMDA SHALL NOT BE LIABLE FOR ANY ERRORS AND/OR OMISSIONS CONTAINED HEREIN OR FOR ANY LOSSES OR DAMAGES (INCLUDING ANY LOSS OF PROFITS, BUSINESS, GOODWILL OR REPUTATION, AND/OR ANY SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES) IN CONNECTION WITH THE USE OF THIS MATERIAL.

IMDA DRAWS ATTENTION TO THE POSSIBILITY THAT THE PRACTICE OR IMPLEMENTATION OF THIS STANDARD MAY INVOLVE THE USE OF INTELLECTUAL PROPERTY RIGHTS AND TAKES NO POSITION CONCERNING THE EXISTENCE, VALIDITY AND/OR APPLICABILITY OF ANY SUCH INTELLECTUAL PROPERTY RIGHTS, WHETHER ASSERTED BY TSAC MEMBERS OR ANY THIRD PARTY.

AS OF THE DATE OF APPROVAL OF THIS STANDARD, IMDA HAS NOT RECEIVED WRITTEN NOTICE OF ANY PATENT RIGHTS WHICH MAY BE RELEVANT IN RELATION TO THE IMPLEMENTATION OF THIS STANDARD. HOWEVER, IMPLEMENTERS ARE CAUTIONED THAT THIS MAY NOT REPRESENT THE LATEST INFORMATION AND ARE THEREFORE STRONGLY URGED TO CHECK WITH THE RELEVANT DATABASE IN ITU, ISO, IEC OR THE RELATED STANDARDS DEVELOPMENT ORGANISATION FOR INFORMATION OF PATENT RIGHTS. IMPLEMENTERS ARE ADVISED TO OBTAIN THEIR OWN LEGAL AND/OR TECHNICAL ADVICE IN RELATION TO THE IMPLEMENTATION OF THE STANDARD IF REQUIRED.

Technical Specification for Asymmetrical Digital Subscriber Line (ADSL) Modems

1 Scope

- 1.1 This Specification defines the physical layer characteristics of the Asymmetrical Digital Subscriber Line (ADSL) interface for the second generation ADSL modems. The purpose of the Specification is to ensure proper inter-working of ADSL modems at the customer end (ATU-R) and network operator end (ATU-C) in terms of interaction and electrical characteristics. It defines a variety of frame bearers in connection with or without an underlying service. For example:
- (a) ADSL transmission simultaneously on the same metallic twisted pair with voice band services;
 - (b) ADSL transmission without any underlying service, optimised for deployment with ADSL over voice band services in the same binder cable;
 - (c) ADSL transmission with specific requirements for Reach Extended ADSL2, simultaneously on the same metallic twisted pair with voice band services; and
 - (d) ADSL transmission with extended upstream bandwidth, simultaneously on the same pair with voice band services.
- 1.2 This Specification outlines the second generation ADSL (ADSL2 and ADSL2plus) in accordance with the ITU-T Rec. G.992.3 for “Asymmetric digital subscriber line transceivers 2 (ADSL2)”, and the ITU-T Rec. G.992.5 for “Asymmetric Digital Subscriber Line (ADSL) transceivers – Extended bandwidth ADSL2 (ADSL2+)”, which have been developed with reference to the first generation ADSL defined in the ITU-T Rec. G.992.1. More features have been added, which include the support of data rates exceeding 8 Mbit/s downstream and 800 kbit/s upstream, the enhanced on-line reconfiguration capabilities, the new line diagnostics procedures and conformance testing, and so on.
- 1.3 The use of the Broadband Forum’s ADSL2/ADSL2plus Functionality Test Plan (TR-105) is recommended for verifying implementation of the transceiver functional requirements in the ADSL modems, for conformity with the ITU-T Rec. G.992.3 and G.992.5. The TR-105 has been developed in relation to the physical layer management for ADSL defined in the ITU-T Rec. G.997.1, for operations, administration and maintenance (OAM) configuration, and performance monitoring, which enables the deployment of interoperable ADSL2/ADSL2+ services.
- 1.4 It is intended that ADSL modems are designed for multi-mode operation, capable of supporting ADSL2 and/or ADSL2+ standards that provide for backward compatibility, for interworking with network equipment of the first generation ADSL standards.
- 1.5 The application models for ITU-T Rec. G.992.3/G.992.5 are based on the generic reference configurations as shown in Figures 1 and 2 (Figures 5-4 and 5-5/G.992.3). The application models for ADSL data service only and ADSL data service with underlying POTS services shall be applicable.

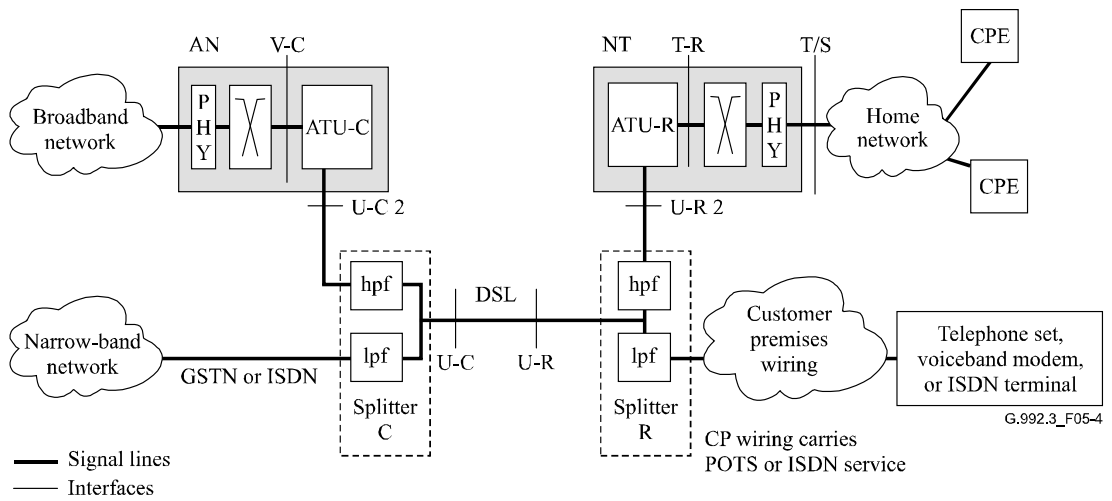


Figure 1 (Figure 5-4/G.992.3): Generic application reference model for remote deployment with splitter

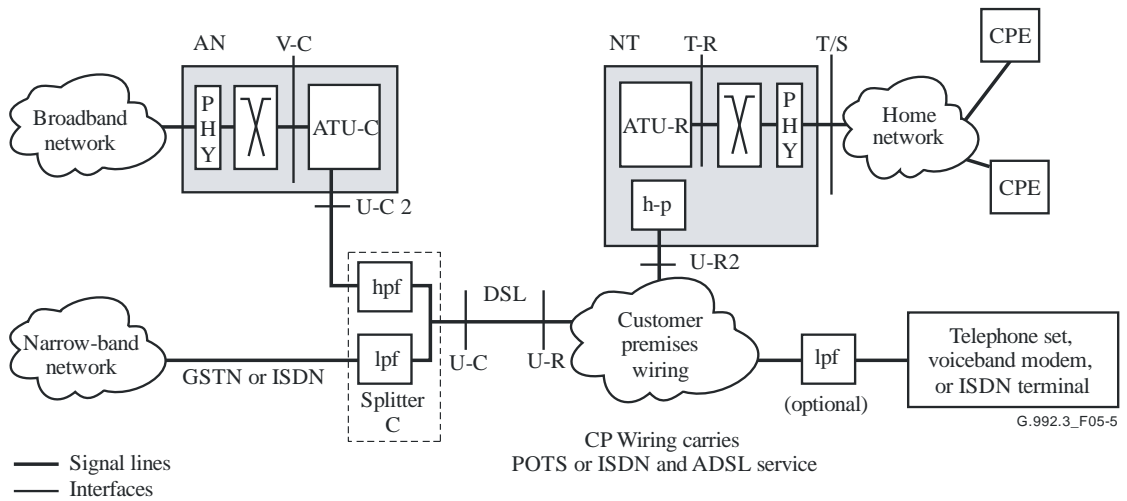


Figure 2 (Figure 5-5/G.992.3): Generic application reference model for splitterless remote deployment

2 References

2.1 For the technical requirements captured in this Specification, reference has been made to the following standards. Where versions are not indicated, implementation of this Specification shall be based on current and valid versions of these standards published by the respective Standards Development Organisations.

| | |
|--------------------|---|
| ITU-T Rec. G.992.3 | Asymmetric Digital Subscriber Line Transceivers 2 (ADSL2) |
| ITU-T Rec. G.992.4 | Splitterless Digital Subscriber Line Transceivers 2 (Splitterless ADSL2) |
| ITU-T Rec. G.992.5 | Asymmetric Digital Subscriber Line (ADSL) Transceivers – Extended Bandwidth (ADSL2+) |
| ITU-T Rec. G.997.1 | Physical layer management for digital subscriber line transceivers |
| IEC 60950-1 | Information Technology Equipment – Safety |
| IEC 62368-1 | Audio/video, information and communication technology equipment – Part 1: Safety requirements |
| IEC CISPR 32 | Electromagnetic compatibility of multimedia equipment – Emission requirements |
| | Note: Validity of the IEC CISPR 22, EMC standard for information technology equipment, will lapse by 31 March 2017, in sync with IEC's timeline for withdrawing this CISPR standard, and replacing it with the CISPR 32 standard. |
| IEC CISPR 24 | Information technology equipment – Immunity characteristics – Limits and methods of measurement |
| IMDA TS PSTN | Technical Specification for Terminal Equipment connected to the Network Terminating Equipment (NTE) or the Public Switched Telephone Network (PSTN) for access to voice band services |
| BBF TR-105 | ADSL2/ADSL2plus Functionality Test Plan |

BBF Broadband Forum
 IEC International Electro-technical Commission
 ITU-T International Telecommunication Union – Telecommunication Sector

3 Abbreviations

| | |
|--------|--|
| AC | Alternating Current |
| AN | Access Node |
| ATM | Asynchronous Transfer Mode |
| ATU-C | Asymmetric digital subscriber line Transceiver Unit at the central office end (i.e., network operator) |
| ATU-R | Asymmetric digital subscriber line Transceiver Unit at the remote terminal end (i.e., customer premises) |
| CP | Customer Premises |
| CPE | Customer Premises Equipment |
| DC | Direct Current |
| DSL | Digital Subscriber Line |
| GSTN | General Switched Telephone Network |
| HPF | High-Pass Filter |
| ISDN | Integrated Services Digital Network |
| LPF | Low-Pass Filter |
| MPS | Management Protocol Specific |
| NT | Network Termination |
| NTR | Network timing reference: 8 kHz reference to be transmitted downstream |
| PHY | Physical layer |
| PMD | Physical Media Dependent (sublayer) |
| PMS-TC | Physical Media-Specific Transmission Convergence |
| POTS | Plain Old Telephone Service (one of the services using the voice band; sometimes used as a descriptor for all voice band services) |
| PSD | Power Spectral Density |
| PTS | Packet Transport Specific |
| STM | Synchronous Transfer Mode |
| T/S | Interface(s) between asynchronous digital subscriber line network termination and customer premises equipment or home network |
| TC | Transmission Convergence (sublayer) |
| TPS-TC | Transmission Protocol-Specific Transmission Convergence layer |
| T-R | Interface(s) between ATU-R and switching layer (ATM or STM or Packet) |
| U-C | Loop interface – Central office end |
| U-R | Loop interface – Remote terminal end |
| V-C | Logical interface between ATU-C and a digital network element such as one or more switching systems |

4 General Requirements

4.1 Power Supply

The equipment may be AC powered or DC powered. For AC powered equipment, the Specification shall be complied with when operating from an AC mains supply of voltage, $230V \pm 10\%$ and frequency, $50 \text{ Hz} \pm 2\%$. Where external power supply is used, e.g. AC adaptor, it shall not affect the capability of the equipment to meet the Specification.

4.2 Electromagnetic Compatibility and Safety Requirements

4.2.1 Electromagnetic Compatibility (EMC) Assessment

4.2.1.1 Electromagnetic Interference (EMI) or Emission Measurements

The following emissions measurements shall be performed on the ADSL modem, where applicable:

- (a) Radiated emissions from the ADSL modem shall be measured to Class B requirements defined in §4 and Tables A.4 and A.5 of CISPR 32;
- (b) Conducted emission at the DC power port of the ADSL modem shall be measured to Class B requirements defined in §4 and Table A10 of CISPR 32;
- (c) Conducted emission at the AC mains port shall be measured for ADSL modem with dedicated AC/DC power converter to Class B requirements defined in §4 and Table A.10 of CISPR 32 (equipment with DC power port which is powered by a dedicated AC/DC power converter or adapter is defined as AC mains powered equipment [§3.1.1 of CISPR 32]); and
- (d) Conducted emission at the wired network port¹ of the ADSL modem shall be measured to Class B requirements defined in Table A.12 of CISPR 32.

4.2.1.2 Electromagnetic Susceptibility (EMS) or Immunity Testing

The following immunity tests may be performed on the ADSL modem to requirements defined in CISPR 24, where applicable:

- (a) RF electromagnetic field (80 MHz to 1 GHz) at the enclosure of equipment;
- (b) Electrostatic discharge at the enclosure of equipment;
- (c) Fast transients (common mode) at DC power and AC main power ports that have cables longer than 3 m;
- (d) RF common mode 0.15 MHz to 80 MHz at DC power and AC mains power ports that have cables longer than 3 m;
- (e) Voltage dips and interruptions at AC mains power port of equipment with dedicated AC/DC power converter; and
- (f) Surges, common and differential mode at AC mains power port of equipment with dedicated AC/DC power converter.

4.2.2 Equipment Safety Testing

4.2.2.1 Equipment safety testing or assessment shall be performed to requirements defined in IEC 60950-1 or IEC 62368-1, based on the following assumptions:

¹ Wired network port is used for voice, data and signaling transfers intended for connection to a communication network, e.g. CATV, PSTN, ISDN, ADSL and LAN (§3.1.32).

- (a) ADSL modem is powered by a dedicated external power supply (AC/DC converter or power adapter/charger); and
- (b) ADSL modem operates with SELV in environments where overvoltage from telecommunication networks is not possible. SELV refers to voltages not exceeding 42.4 V peak or 60 V DC.

4.2.2.2 For ADSL modem safety assessment performed with the hazard-based approach, the processes defined in IEC 62368-1 shall be used:

- (a) Identify energy sources in the ADSL modem;
- (b) Classify energy sources (effect on the body or combustible material, e.g. possibility of injury or ignition);
- (c) Identify safeguards for protection against energy sources; and
- (d) Consider the effectiveness of safeguards with respect to compliance criteria or requirements defined in the IEC 62368-1 standard.

5 Asymmetric Digital Subscriber Line Transceivers 2 (ADSL2) & ADSL Transceivers – Extended Bandwidth (ADSL2+)

- 5.1 ADSL modems shall comply with mandatory requirements set out in the ITU-T Rec. G.992.3/ G.992.5.

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|----------|--|--|
| Scope | 1 | | |
| References | 2 | | |
| Definitions | 3 | | |
| Abbreviations | 4 | | |
| Reference models | 5 | Application models for data service application model, and data with POTS service application model are with reference to Figures 1 and 2 (Figures 5-4 and 5-5/G.992.3). | See § 5 of G.992.3, adding "G.992.5 provides tools for the operator of the access network to control the ADSL transmit PSD and aggregate power in the downstream and upstream directions." |
| Transport Protocol Specific Transmission Convergence (TPS-TC) function | 6 | Heading | ADSL modem shall support the TPS-TC transport capabilities and functions, interfaces and procedures as defined in § 6/G.992.3 and the relevant clauses in Annex K/G.992.3. |
| Transport capabilities | 6.1 | ADSL modem (ATU-R) shall support the procedures for transport of the output frame bearers of one to four unidirectional TPS-TC functions in both the upstream and downstream directions. ADSL modem shall support at least one combination of a TPS-TC function (of a type defined in Annex K/G.992.3 and Annex K/G.992.5). STM-TC (K.1/G.992.3) is not applicable. ATM-TC (K.2/G.992.3) is supported. PTM-TC (K.3/G.992.3) is optional. | |
| Interface signals and primitives | 6.2 | | |
| Control parameters | 6.3 | Control parameters of the TPS-TC function as defined in Table 6-1/G.992.3, shall be supported. All the mandatory control parameters for the ATM-TC type described in K.2/G.992.3 shall also be supported. | |
| Data plane procedures | 6.4 | | |
| Management plane procedures | 6.5 | Each TPS-TC function may provide local management primitives as defined in Annex K/G.992.3. | |
| Initialization procedure | 6.6 | | |
| On-line reconfiguration | 6.7 | On-line reconfiguration procedures are defined uniquely for each TPS-TC type in Annex K/G.992.3. | |
| Power management mode | 6.8 | | |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|------|--|---|
| Physical Media Specific Transmission Convergence (PMS-TC) function | 7 | Heading | Heading |
| Transport capabilities | 7.1 | ADSL modem shall support the PMS-TC function for multiplexing and transporting several channels of information. | See § 7.1 of G.992.3. |
| Additional functions | 7.2 | | See § 7.2 of G.992.3. |
| Block interface signals and primitives | 7.3 | | See § 7.3 of G.992.3. |
| Block diagram and internal reference point signals | 7.4 | | See § 7.4 of G.992.3. |
| Control parameters | 7.5 | All mandatory control parameter configurations described in § 7.6.3 of ITU-T Rec. G.992.3 shall be supported by each ATU. | See § 7.5 of G.992.3. |
| Frame structure | 7.6 | | See § 7.6 of G.992.3, except for modifications shown in § 7.6.2 of G.992.5, and Tables 7-8 and 7-9/G.992.5. |
| Data plane procedures | 7.7 | | See § 7.7 of G.992.3. |
| Control plane procedures | 7.8 | An ATU-C may optionally transport an 8-kHz timing marker as NTR to support the transport of a timing reference from a voice PSTN access network to equipment located with the ATU-R. | See § 7.8 of G.992.3. |
| Management plane procedures | 7.9 | | See § 7.9 of G.992.3. |
| Initialization procedures | 7.10 | | See § 7.10 of G.992.3, except for modifications shown in § 7.10 of G.992.5 and Table 7-18/G.992.5. |
| On-line reconfiguration | 7.11 | | See § 7.11 of G.992.3. |
| Power management mode | 7.12 | | See § 7.12 of G.992.3. |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|----------|--|--|
| Physical media dependent function | 8 | Heading | Heading |
| Transport capabilities | 8.1 | ADSL modem shall support the PMD function for transporting a bitstream over the physical medium (i.e. over the copper pairs) in both the upstream and downstream directions. | See § 8.1 of G.992.3. |
| Additional functions | 8.2 | | See § 8.2 of G.992.3. |
| Block interface signals and primitives | 8.3 | | See § 8.3 of G.992.3. |
| Block diagram and internal reference point signals | 8.4 | | See § 8.4 of G.992.3. |
| Control parameters | 8.5 | The valid control parameter settings for the transmit PMD function are shown in Tables 8-7 and 8-9 of ITU-T Rec. G.992.3 for the ATU-C and ATU-R, respectively. The mandatory control parameter settings for the transmit PMD function are shown in Tables 8-8 and 8-10 of ITU-T Rec. G.992.3 for the ATU-C and ATU-R, respectively. | See § 8.5 of G.992.3, and additional text given in § 8.5.1 and § 8.5.3 of G.992.5. |
| Constellation encoder for data symbols | 8.6 | | See § 8.6 of G.992.3. |
| Constellation encoder for synchronization and L2 exit symbols | 8.7 | | See § 8.7 of G.992.3. |
| Modulation | 8.8 | | See § 8.8 of G.992.3, and modifications shown in § 8.8.3, § 8.8.4 and § 8.8.5 of G.992.5. |
| Transmitter dynamic range | 8.9 | | See § 8.9 of G.992.3, and additional text given in § 8.9 of G.992.5. |
| Transmitter spectral masks | 8.10 | ADSL modem shall operate within the spectral mask(s) for the service option(s) it is supporting, as defined in the corresponding Annexes to the ITU-T Rec. G.992.3. | See § 8.10 of G.992.3, and modifications shown in § 8.10 of G.992.5. Annex L is not defined in G.992.5. |
| Control plane procedures | 8.11 | | See § 8.11 of G.992.3. |
| Management plane procedures | 8.12 | | See § 8.12 of G.992.3, and modifications shown in § 8.12.5.1 of G.992.5. |
| Initialization procedures | 8.13 | ADSL modem may implement FDM or EC to separate upstream and downstream signals. | See § 8.13 of G.992.3, and additional text given in § 8.13 of G.992.5. |
| Short initialization procedures | 8.14 | Short Initialization Sequence shall be optional. If the Short Initialization Sequence is supported, the ADSL modem should also support unbalanced bitswap. | See § 8.14 of G.992.3, replacing Figure 8-34/G.992.3 with Figure 8-34/G.992.5. |
| Loop diagnostics mode procedures | 8.15 | | See § 8.15 of G.992.3, and modifications shown in § 8.15 of G.992.5 for Tables 8-43, 8-46 and 8-47, § 8.15.5.2 of G.992.5 and Tables 8-55 to 8-63. |
| On-line reconfiguration of the PMD function | 8.16 | | See § 8.16 of G.992.3. |
| Power management in the PMD function | 8.17 | | See § 8.17 of G.992.3. |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|-----------|---|--|
| Management Protocol Specific Transmission Convergence (MPS-TC) functions | 9 | ADSL modem (ATU-R) provides procedures to facilitate management of the ATUs. The MPS-TC functions communicate with the physical layer management functions as described the ITU-T Rec. G.997.1. | See § 9 of G.992.3. |
| Transport functions | 9.1 | As a management plane element, the MPS-TC provides transport of the clear eoc and command messages and ATU-R management defects and anomalies. | See § 9.1 of G.992.3. |
| Additional functions | 9.2 | | See § 9.2 of G.992.3. |
| Block interface signals and primitives | 9.3 | | See § 9.3 of G.992.3. |
| Management plane procedures | 9.4 | | See § 9.4 of G.992.3, and modifications shown in § 9.4.1 of G.992.5. |
| Power management | 9.5 | | - |
| Dynamic behaviour | 10 | ATUs contain dynamic behaviours, which include features for initialization, on-line reconfigurations and power management transitions. | See § 10 of G.992.3. |
| Initialization | 10.1 | | |
| On-line Reconfiguration (OLR) | 10.2 | | |
| Power management | 10.3 | | |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|----------------|---|---|
| Specific requirements for an ADSL system operating in the frequency band above POTS | Annex A | Heading (See Notes 1 and 2, for splitterless ADSL2 modems based on G.992.4.) | Heading |
| ATU-C functional characteristics (pertains to § 8) | A.1 | For the ATU-C downstream, with overlapped spectrum, the widest possible band used is 25.875 to 1104 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 1104 kHz. | For the ATU-C downstream, with overlapped spectrum, the widest possible band used is 25.875 to 2208 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 2208 kHz. |
| ATU-R functional characteristics (pertains to § 8) | A.2 | ADSL modem shall comply with the ATU-R upstream transmit spectral mask specified in Figure A.3/G.992.3. The widest possible band used is 25.875 to 138 kHz. The PSD template nominal passband transmit PSD level is -38 dBm/Hz, and aggregate transmit power is 12.5 dBm. | ADSL modem shall comply with the ATU-R upstream transmit spectral mask specified in Figure A.3/G.992.5. The widest possible band used is 25.875 to 138 kHz. The PSD template nominal passband aggregate transmit power is 12.5 dBm. |
| Initialization | A.3 | | See A.3 of G.992.3. |
| Electrical characteristics | A.4 | | See A.4 of G.992.3, and modifications shown in A.4.3.3.1 of G.992.5: "The ATU-R shall have a longitudinal conversion loss (LCL) of at least 40 dB in the frequency range from 1104 kHz to 2208 kHz". |
| Specific requirements for an ADSL system operating in the frequency band above ISDN as defined in ITU-T Rec. G.961 Appendices I and II | Annex B | Not applicable | Not applicable |
| Specific requirements for an ADSL system operating in the same cable as ISDN as defined in ITU-T Rec. G.961 Appendix III | Annex C | Not applicable | Not applicable |
| ATU-C and ATU-R state diagrams | Annex D | General information and description | General information and description (See Annex D of G.992.3.) |
| POTS and ISDN Basic Access Splitters | Annex E | Optional requirement (See Note 3, for splitterless ADSL2 modems based on G.992.4.) | See Annex E of G.992.3. Where applicable, operation according to Annexes A and I, the G.992.3 requirements applying over frequency band up to 1104 kHz, shall be met by frequency band up to 2208 kHz. |
| Type 1 – POTS splitter – Europe | E.1 | Where applicable, ADSL/POTS splitters shall comply with ETSI TS 101 952-1 (see Annex L of IDA TS PSTN Issue 2), and the total (across tip and ring at the POTS port) impedance in the 2 to 10 MHz frequency band should be at least 160 Ω. | |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|---|----------------|---|---|
| Type 2 – POTS splitter – North America | E.2 | Where applicable, the customer premises POTS splitter shall comply with ATIS-0600016, and the total (across tip and ring at the POTS port) impedance in the 2 to 10 MHz frequency band should be at least 160 Ω. | |
| Type 3 – ISDN (ITU-T Rec. G.961 Appendix I or II) Splitter – Europe | E.3 | Not applicable | Not applicable |
| Type 4 – POTS splitter – Japan | E.4 | Optional requirement | Optional requirement |
| ATU-x performance requirements for region A (North America) | Annex F | Optional requirement | Further study by ITU-T |
| ATU-x performance requirements for region B (Europe) | Annex G | Optional requirement | Further study by ITU-T |
| Specific requirements for a synchronized symmetrical DSL (SSDSL) system operating in the same cable binder as ISDN as defined in ITU-T Rec. G.961 Appendix III | Annex H | Not applicable | Further study by ITU-T |
| All digital mode ADSL with improved spectral compatibility with ADSL over POTS | Annex I | <p>Optional requirement (See Note 4, for splitterless ADSL2 modems based on G.992.4.)</p> <p>Where applicable, for ATU-C downstream with overlapped spectrum, the widest possible band used is 3 to 1104 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 1104 kHz.</p> <p>Where applicable, the ADSL modem shall comply with the ATU-R upstream transmit spectral mask specified in Figure I.2/G.992.3. The widest possible band used is 3 to 138 kHz. The PSD template nominal passband transmit PSD level is -38 dBm/Hz, and aggregate transmit power is 13.3 dBm.</p> | <p>Optional requirement</p> <p>Where applicable, for ATU-C downstream with overlapped spectrum, the widest possible band used is 3 to 2208 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 2208 kHz.</p> <p>Where applicable, the ADSL modem shall comply with the ATU-R upstream transmit spectral mask specified in Figure I.2/G.992.5. The widest possible band used is 3 to 138 kHz. The PSD template nominal passband transmit PSD level is -38 dBm/Hz, and aggregate transmit power is 13.3 dBm.</p> |
| <p>Note 1: The requirements defined for splitterless ADSL2 modems in ITU-T Rec. G.992.4, are largely the same as those defined for ADSL2 modems in ITU-T Rec. G.992.3, except for the specific requirements set out in Annexes A, E and I of G.992.4.</p> <p>Note 2: Where applicable, for the ATU-C downstream (A.1.2 and A.1.3 of G.992.4), with overlapped spectrum, the widest possible band used is 25.875 to 552 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 552 kHz.</p> <p>Note 3: G.992.4 is intended for installation without splitters. However, if splitters are provided for operation with POTS they shall be as described in Annex E/G.992.3.</p> <p>Note 4: Where applicable, for the ATU-C downstream with overlapped spectrum, the widest possible band used is 3 to 552 kHz, and with non-overlapped spectrum, the widest possible band used is 138 to 552 kHz.</p> | | | |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|--|----------------|---|---|
| All Digital Mode ADSL with improved spectral compatibility with ADSL over ISDN | Annex J | Not applicable | Not applicable |
| TPS-TC functional descriptions | Annex K | General information and description (For splitterless ADSL2 modems based on G.992.4, see Annex K of G.992.3, and exceptions given in § 6 of G.992.4.) | General information and description See Annex K of G.992.3, and changes given in Annex K of G.992.5. |
| STM Transmission Convergence (STM-TC) function | K.1 | Not applicable | Not applicable |
| ATM Transmission Convergence (ATM-TC) function | K.2 | Mandatory requirement | Mandatory requirement |
| Packet transmission convergence function (PTM-TC) | K.3 | Optional requirement | Optional requirement |
| Specific requirements for a Reach Extended ADSL2 (READSL2) system operating in the frequency band above POTS | Annex L | Optional requirement For an ATU supporting Annex L, support of Annex A is mandatory. For an ATU supporting Annex A, support of Annex L is optional. | Intentionally left blank |
| Specific requirements for an ADSL system with extended upstream bandwidth, operating in the frequency band above POTS | Annex M | Optional requirement | Optional requirement |
| 64/65-octet PTM-TC sublayer functional specifications | Annex N | Optional requirement | Intentionally left blank |
| - | Annex O | Intentionally left blank. | Intentionally left blank |
| Reduced downstream aggregate transmit power requirements | Annex P | Optional requirement | See Annex P of G.992.3. |
| Note 5: Annexes L to P of G.992.3 are not applicable to splitterless ADSL2 modems. | | | |

| Title | § | ITU-T Rec. G.992.3 | ITU-T Rec. G.992.5 |
|--|-------------------------------|-------------------------------------|-------------------------------------|
| ATM layer to physical layer logical interface | Appendix I | General information and description | See Appendix I of G.992.3. |
| Compatibility with other customer premises equipment | Appendix II | General information and description | See Appendix II of G.992.3. |
| The impact of primary protection devices on line balance | Appendix III | General information and description | See Appendix III of G.992.3. |
| Example overlapped PSD masks for use in a TCM-ISDN crosstalk environment | Appendix IV of G.992.3 | General information and description | - |
| PSD template to be used in capacity calculations with in-band transmit spectrum shaping | Appendix IV of G.992.5 | - | General information and description |
| Constraints on delay, impulse noise protection, overhead rate, and net data rate when bonding | Appendix V | General information and description | General information and description |
| Packet layer to physical layer logical interface | Appendix VI | General information and description | See Appendix VI of G.992.3. |
| ADSL2 automoding | Appendix VII | General information and description | See Appendix VII of G.992.3. |
| Impact of loop and ATU impedance mismatch on the Hlog accuracy | Appendix VIII | General information and description | See Appendix VIII of G.992.3. |

Annex Corrigendum / Addendum

| Revised TS | | Items Changed | Date of Issue |
|---|---------|---|---------------|
| Page | Section | | |
| Changes to IDA TS ADSL Issue 2, October 2013 | | | |
| 6 | §4.2 | <p>The IMDA TS ADSL Issue 1 (October 2016) has replaced the IDA TS ADSL Issue 2 (October 2013).</p> <p>Changes are largely editorial to provide updates and clarity in the application of EMC and safety requirements, in line with standards development that has taken place in the Standards Development Organisation concerned.</p> | 1 Oct 16 |

| Changes to IDA TS ADSL Issue 1 Rev 2 (May 11) | | | |
|--|---------|---|---------------|
| Page | TS Ref. | Items Changed | Date of Issue |
| — | — | <p>This Specification has been streamlined for the second generation ADSL modems – ADSL2/ADSL2+, based on ITU-T Rec. G.992.3/G.992.5 (2009). Implementation of the functional requirements conforming to G.992.3/G.992.5 may be verified, using the BBF TR-105 (2011).</p> <p>It is intended that ADSL modems are designed for multi-mode operation, capable of supporting ADSL2 and/or ADSL2+ standards that provide for backward compatibility, for interworking with network equipment of the first generation ADSL standards (based on the ITU-T Rec. G.992.1).</p> <p>References to the first generation ADSL standards are no longer required, as G.992.3 has been developed in relation to G.992.1.</p> <p>This Specification has been re-issued as the IDA Technical Specification for ADSL modems (IDA TS ADSL Issue 2).</p> | 29 Oct 13 |

| Changes to IDA TS ADSL Issue 1 Rev 1 (Apr 06) | | | |
|--|---------|---|---------------|
| Page | TS Ref. | Items Changed | Date of Issue |
| — | — | Change of IDA's address at cover page to Mapletree Business City. | 1 May 11 |

| Changes to IDA TS ADSL Issue 1 (Jul 05) | | | |
|--|---------|--|---------------|
| Page | TS Ref. | Items Changed | Date of Issue |
| — | — | The Specification has included the technical requirements for the second generation ADSL modems (G.992.3 and G.992.4) as well as for the ADSL 2+ modems (G.992.5). | Apr 06 |

| Changes to IDA TS ADSL 1 and TS ADSL 2 | | | |
|---|---------|--|---------------|
| Page | TS Ref. | Items Changed | Date of Issue |
| — | — | The IDA TS ADSL Issue 1 (Jul 05) has superseded the IDA TS ADSL 1 Issue 1 Rev 1 (Jun 2000) and TS ADSL 2 Issue 1 (Sep 2000). | 21 Jul 05 |
| — | — | <p>Title of Specification has been renamed as "Technical Specification for Asymmetric Digital Subscriber Line Modems" (IDA TS ADSL Issue 1).</p> <p>There are no changes to the technical requirements for the first generation ADSL modems (G.992.1 and G.992.2).</p> | 21 Mar 05 |