



**GOVERNMENT OF INDIA  
MINISTRY OF RAILWAYS**

**TITLE:**

**Draft Specification  
for  
IP-DSLAM and ADSL modem**

Specification No.

RDSO/ SPN/ TC/89/2008

*TELECOM DIRECTORATE*

*RESEARCH DESIGN & STANDARDS ORGANISATION*  
**MANAK NAGAR, LUCKNOW – 226001**

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Author  Shri K. P. ARYA <b>Director/ Telecom-III/ RDSO</b>		
Approved by  Shri M. Alam <b>Executive Director/ Telecom/ RDSO</b>		
<p>Abstract</p> <p><b>This document specifies technical specification of IP-DSLAM and ADSL modem equipment for use in Indian Railways</b></p>		

**DOCUMENT CONTROL SHEET**

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<b>IP-DSLAM and ADSL modem</b>			

**I. SUMMARY :**

This document sets forth general, operational, technical, performance, type test & acceptance test requirements of **IP-DSLAM equipment and ADSL modem** for use in Indian Railways.

**II. SOURCE :**

Draft specification no. RDSO/SPN/TC/89/2008 has been prepared by RDSO, Lucknow on advice of Railway Board vide their letter no.2006/Tele/TC/1 dated 14.10.2008 .

**III. FOREWORD :**

Research Designs and Standards Organisation (RDSO) is an attached office of Ministry of Railways, engaged in design and standardization of equipment for use on Indian Railways.

RDSO/ SPN specification is issued as draft specification for discussion. This specification is circulated to customers/ Railways and field inspection units for comments.

RDSO/ SPN along with comments received from various quarters is discussed in Telecom Standards Committee Meeting (TCSC). Recommendation made by TCSC is put up to Railway Board for approval. After approval from Railway Board, the specification is given an IRS number and issued as Indian Railway Standard Specification.

In the absence of IRS specification, procurement may be made as per RDSO/ SPN specification.

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**1 SCOPE:**

This document sets forth general, operational, technical, performance, type test & acceptance test requirements of **IP DSLAM equipment and ADSL modem** for use in Indian Railways.

**2 REFERENCE:**

This specification requires the reference to the following documents:

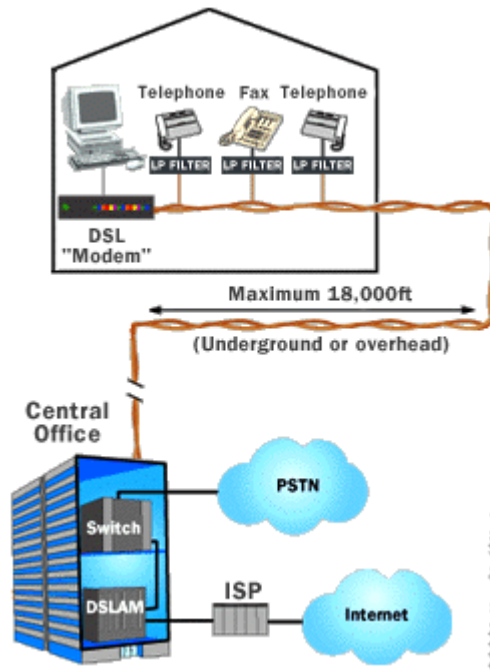
ITU-T Rec.G.991.2	Transmission System and Media Digital System & Network for ADSL. Describes Asymmetrical Subscriber Line (ADSL) Transceivers on a metallic twisted pair.
ITU-T Rec.G.992.3	Transmission System and Media Digital System & Network for ADSL2. Describes Asymmetrical Subscriber Line (ADSL) Transceivers on a metallic twisted pair.
ITU-T Rec.G.992.5	Transmission System and Media Digital System & Network for ADSL2+. Describes Asymmetrical Subscriber Line (ADSL) Transceivers on a metallic twisted pair.
ITU-T Rec.G.994.1	Hand Shake Procedure for Digital Subscriber Line DSL Trans Receiver

Wherever, reference to any specifications appears in this document, it shall be taken as a reference to the latest version of that specification unless the year of issue of the specification is specifically stated.

**3 INTRODUCTION:**

ADSL stands for Asynchronous Digital Subscriber Line and IP-DSLAM for Internet Protocol DSL Access Multiplexer. A set of IP-DSLAM equipment (ATU-C at central office end) and ADSL modem (ATU-R at remote end- customer end) allow telephone line to make faster connection to the Internet than a dial up connection. This system also does not tie up the telephone line i.e. the telephone line can be used to make regular telephone calls without disturbing or being disturbed by the ADSL internet connection. ADSL modem is installed at subscriber premises. IP-DSLAM is a network device, located in the telephony exchanges of the service providers, that connects multiple customers Digital Subscriber Lines (DSL) to a high-speed [Internet backbone](#) line using multiplexing techniques.

## IP-DSLAM and ADSL modem



#### 4 FUNCTIONAL AND TECHNICAL REQUIREMENTS OF IP-DSLAM AND ADSL MODEMS:

4.1 **General**-The IP Digital Subscriber Line Access Multiplexer (IP-DSLAM) Equipment and ADSL modems shall comply with the technical specification set forth herein and shall comply with the latest relevant ITU-T and other recognized standards.

The equipment shall be of modern design, proven capability, high-demonstrated reliability and low power consumption. All the equipment offered shall be those which adopt the latest and highest grade technique and be stable in operation for a long continuous period of time.

4.2 The IP-DSLAM shall have the capability to provide and support, at least, following services, interfaces and protocols –

- 4.2.1 Plain Old Telephone Services (POTS)
- 4.2.2 ADSL/ADSL2/ADSL2+:ITU-T recommendation G.991.2, G.992.3, G.992.5
- 4.2.3 Fast Ethernet Ports
- 4.2.4 Gigabit Uplink Ports (Dark Fiber -Optical 10Km. / Electrical)

4.3 The ADSL transmission unit line shall simultaneously contain the following:

- A number of downstream frame bearers,
- A number of upstream frame bearers, a baseband POTS/ISDN duplex channel,
- ADSL line overhead for framing, error control, operations and maintenance.

ADSL2+ system shall support net data rates up to 16Mbit/s in downstream direction at a minimum and up to 800 Kbit/s in upstream direction (at a minimum). However actual possible data rate shall be governed by line SNR conditions. Also the data rate may be configurable through EMS. The distance between central office terminal and remote

terminal shall be maximum 1.1 Km. at highest data rate (as stipulated above) under ideal conditions and can reach longer distances at low data rates

**4.4 Equipment Rack Cabinet** - The IP-DSLAM equipment shall be 19" rack mounted type. The 19" steel rack cabinet shall be of adequate height and depth suitable for the equipment and shall be equipped with transparent toughened glass door in front and steel door in the back. It shall have necessary sub racks including that for NMS PC etc. For NMS PC keyboard sliding tray shall be provided. It shall be of reputed make such as Vero President, HP or HCL make.

**4.5 Capacity-** IP-DSLAM equipment shall be provided in following two capacity configurations-

**4.5.1 Configuration I-** The ultimate capacity shall be 640 ports. However the actual equipped capacity shall be as specified by the purchaser. If not specified, it shall mean to be equipped with 528 ports. Each line interface card shall be equipped with 24, 32 or 48 ADSL port cards. The POTS splitter arrangement shall be either integrated with the line interface card or provided in a separate card. At least 10% of the equipped capacity shall be provided as spare.

**4.5.2 Configuration II-** The ultimate capacity shall be 256 ports. However the actual equipped capacity shall be as specified by the purchaser. If not specified, it shall mean to be equipped with 192 ports. Each line interface card shall be equipped with 24, 32 or 48 ADSL port cards. The POTS splitter arrangement shall be either integrated with the line interface card or provided in a separate card. At least 10% of the equipped capacity shall be provided as spare.

**4.6 POTS Splitters:**

The POTS splitter shall be fully compliant to ITU-T G.992.3. Some of the requirements are described below-

- i) The function of POTS splitter is two fold:
  - a. For ADSL signals, it shall provide protection from the high-frequency transients and impedances effects that occur during POTS operation i.e.-ringing, ring-trip and off-hook transients and impedance changes. For POTS voice-band service, the low-pass filter (LPF) provides protection from ADSL signals which may impact remote devices and central office operation, through non-linear or other effects. This filtering shall be performed on the end-to-end voice-band connection (i.e. between POTS and PSTN interfaces).
  - b. The splitter at the central office equipment end shall be an integral part of the IP-DSLAM equipment.
- ii. The POTS splitter shall be implemented as a passive element and shall guarantee the telephone working even during power-failure at the subscriber's premise or when the Remote Terminal modem is switched off.
- iii. The POTS splitter shall be transparent for all signals within the voice-band supporting DC-feed, ringing, DTMF signalling, voice /facsimile, 16 kHz metering (wherever required) and also decade-dialling. Further technical details are given in following clause.



**IP-DSLAM and ADSL modem**

- iv. The voice frequency path shall remain active when the telephone is on-hook for the purpose of Calling Line Identification (CLIP).

**4.7 The IP DSLAM shall be provided with Equipment protection and redundancy features as following**

- 4.7.1 Common control unit (Redundant 1+1)
- 4.7.2 Network interface unit (Hot Swappable)
- 4.7.3 Power supply unit (Redundant 1+1 or Distributed power supply)
- 4.7.4 All the cards of the equipment shall be hot swappable.

**4.8 Hot swappable ADSL2/ ADSL2+ line card features-**

- 4.8.1 Maximum transmission rate up to 16 Mbps/ 800Kbps for ADSL2+ for Video, Data, and Voice triple-play applications
- 4.8.2 One gigabit backplane
- 4.8.3 Support G.992.3 and G.992.5 Spectral Mask
- 4.8.4 Support EOC and Overhead Channel Access defined in G.992.3 and Rec.G.997.1
- 4.8.5 Support the latency path function specified in G.992.3 and G.992.5
- 4.8.6 Support Annex L and Annex M specified in G.992.3 and G.992.5
- 4.8.7 Support loop diagnostic function specified in G.992.3 and G.992.5
- 4.8.8 Support the power management capability specified in G.992.3 and G.992.5
- 4.8.9 Support the capability of the Seamless Rate Adaptation (SRA) on-line configuration specified in G.992.3 and G.992.5
- 4.8.10 Support for ATM QoS (UBR/VBR/CBR) is desirable.
- 4.8.11 Manage with web, CLI, SNMP, and EMS

**4.9 The IP-DSLAM shall have built-in Remote Subscriber Line testing function which is used to test subscriber lines.** This function shall be performed by the Network Management System/ EMS. At least the following parameters shall be tested and reported:

- 4.9.1 Max Down speed
- 4.9.2 Upstream possible on each DSL standard
- 4.9.3 Copper Loop length (m)
- 4.9.4 Loop Attenuation (dB)
- 4.9.5 Mean noise level (dBm/Hz)

**4.10 ALC/Filtering features in the IP-DSLAM**

- 4.10.1 Frame filtering, such as based on source MAC address, port etc.
- 4.10.2 PPPoE filtering
- 4.10.3 Layer 3 filtering based on IP header: source addresses, destination addresses
- 4.10.4 ARP broadcast filtering

**IP-DSLAM and ADSL modem**

4.10.5 ACL filtering feature--NetBIOS should be supported by the DSLAM.

4.10.6 DHCP broadcast filtering

4.10.7 IGMP filtering

4.10.8 MAC OUI Filtering

4.10.9 Advanced upstream ACL

4.10.10 Rate limiting features

- i) Rate limiting per XDSL port
- ii) Rate limiting per XDSL VC Rate limiting per Ethernet port (MSC subtending port.
- iii) Per-PVC upstream rate limiting
- iv) Block user's multicast packets from subscribed user ports

#### **4.11 Power supply**

4.11.1 The IP-DSLAM equipment shall be powered by both AC and DC.

4.11.2 The AC operating voltage shall be 160 – 250VAC or better.

4.11.3 The DC operating voltage shall be -48V nominal with working range -40V to -65V.

#### **4.12 Network/Element Management System (NMS/EMS):**

4.12.1 A fully functional NMS/EMS along with all necessary hardware and software with complete configuration, performance fault and security management functionality shall be provided to manage various components of the network.

Following Network Management methods/ features should be supported by the IP-DSLAM for end to end management.

- Local management through a craft terminal
- Web-based /GUI based Management Interface
- Cluster Management (Up to 8 cluster members) required for managing multiple DSLAM administration with single/master IP address.
- View-based Network Management
- In-band and out-of-band IP interface for management
- SNMPv1/v2c agent/traps
- Standard MIBs report should be viewed for different line card
- Vendor specific MIBs, e.g., Chassis Management MIB (Fan Speed, Voltage, Temperature etc.) or its management through EMS
- Should allow multiple administrative accounts and 3 levels of access privileges (Low: read only; Middle: read / write; High: read / write / user management)

4.12.2 The management system shall be modelled in full compliance of ITU-T Recs. G.992.3 and G.992.5. The ADSL performance primitives & line related performance parameters (line-qualification) and performance data storage shall also be fully compliant to ITU-T Rec. G.992.5. The equipment shall provide an in-built supervisory management system

and shall use the EOC for communicating between the end-terminals. The main function of the supervisory and management system shall be as below:-

#### 4.12.2.1 Configuration Management:

It shall be possible to configure the equipment for any of the interfaces and their associated parameters specified under relevant interface specifications above. At least, the following shall be configured:

- Programming of a multiple interface unit to create, update and retrieve the managed topology data.
- ADSL loop attenuation threshold.
- SNR Margin threshold.

#### 4.12.2.2 Performance Management:

It should be possible to monitor the performance status of the equipment as per ITU-T G.991.2/Table9-18:

- Performance history.
- Performance reporting and monitoring.
- The functionality shall store the performance data of the system.
- Power Management Status.
- DC continuity status.
- ES/SES count.

#### 4.12.2.3 Fault Management:

The system shall be able to report the fault events of the system as well as its interfaces. It shall provide a means to carry out the test functions specified under relevant interface specifications and shall display as:

- Alarm and status display.
- Fault localization.
- Storing and processing of current alarm information.
- Management system shall provide the on-line logging capability for historical alarm events with sufficient information such as managed resource, alarm events type, alarm severity days and time of occurrence.
- Assigning alarm severity, i.e. Critical, Major and Deferred.

#### 4.12.2.4 Security Management :

There should be provision of security management. The stages of security management have to be defined by the manufacturer.

The supervisory and management can be a proprietary design of the manufacturer. The equipment shall provide the following support on the management system:

- Low level protection for read only access for fault and performance information.
- Medium level protection for access to configuration status and feature.
- High level protection for control of access to aforesaid clause and to change the configuration and control parameters.

**5 TECHNICAL REQUIREMENT FOR POTS SPLITTERS:**

The voice terminal shall support the following parameters.

**5.1 Impedance :**

The impedance for voice band terminal shall be 600 ohms.

**5.2 Return loss :**

The return loss of Tele port and line port against 600 ohms shall be as follows :

- 200Hz-1500Hz=11dB
- 1500Hz-2000Hz=10dB
- 2000Hz-3400Hz=9dB

**5.3 Insertion Loss :**

The tele-port to Line port insertion loss shall be <0.3 db at 1 KHz for 600 ohms.

**5.4 Isolation :**

Isolation resistance between tip and ring and between earth  $\geq$  10Mega-ohms.  
Isolation resistance with line port  $\geq$ 10Mega-ohms.

**5.5 Attenuation distortion in voice band :**

The variation of insertion loss with frequency shall be as given table .

Description	Loss *	
	0.2-3.4 kHz	3.4-4.0 kHz
Short loop, CO splitter, ZTc=900, ZTr=600	+1.5 to-1.5	+2.0 to-2.0
Long loop, CO splitter, ZTc=900,ZTr=600	+1.5 to-1.5	+1.0 to -1.5
Short loop, R splitter, ZTc=900,ZTr=600	+1.5 to-1.5	+2.0 to-2.0
Long loop, R splitter, ZTc=900,ZTr=600	+0.5 to-1.5	+1.0 to-1.5
*- Positive value denotes attenuation and negative value gain.		

**5.6 Delay distortion :**

The delay distortion caused by POTS splitter shall be :

- From 0.6-3.2 kHz delay distortion shall be 200 micro –second.
- From 0.2-4.0 kHz delay distortion shall be 250 micro-second.

**5.7 Longitudinal balance of POTS splitter:**

The balance shall be greater than 58 dB for frequency between 200 Hz-1 kHz with a straight line-level decreasing to 53 dB at 3 kHz.

**5.8 Signal Power :**

Maximum peak signal power in 200-4000Hz shall be<3 dbm. Loop current shall be <63mA.

5.9 Ringing:

Ringing frequency shall be 25Hz.

Ringing voltage shall be 75 Vrms(nominal)

5.10 Unbalance about earth :

15Hz-50Hz	>40db terminated with 600 Ohms.
50Hz-600 Hz	>46db terminated with 600 Ohms.
600 Hz-3400 Hz	52db terminated with 600 Ohms.

5.11 Connectors PSTN Line :

The PSTN line is the PIJF cable with 0.5mm. copper pairs.

5.12 The ATU-C shall have suitable termination with connectorised cable to terminate the PSTN lines on the exchange side as well as copper cables terminated on MDF.

5.13 ADSL-band Characteristics :

5.13.1 Longitudinal balance : The longitudinal balance at ATU-C and ATU-R shall be greater than 40 dB over the 5 kHz to 1104 kHz frequency range.

5.13.2 DC characteristics :

The input DC resistance at ATU-C and ATU-R shall be greater than or equal to 5 M ohms.

5.13.3 ADSL-band attenuation :

The insertion loss of low-pass filter shall be greater than 65dB at CO POTS and 70 dB for remote POTS for frequencies ranging from 25 to 300 kHz with an input level of 10dBm.

For frequencies ranging from 300 kHz to 1104 kHz, the attenuation shall be greater than 55dB for CO and Remote POTS splitter at input level of 10dBm.

5.13.4 ADSL-band Return Loss:

The return loss caused by loading the low-pass filter in the band from 25 kHz to 1104 kHz against the reference impedance of 100 ohms shall be greater than 14 dB.

## 6 FUNCTIONAL AND TECHNICAL REQUIREMENTS OF ADSL MODEM:

6.1 ADSL Modem should be a 4-Port Ethernet ADSL2/2+, one USB port with WiFi capability

6.2 It should be fully compliant with ADSL, ADSL2, ADSL 2+ and RE-DSL2 specifications. It should support ADSL downstream and upstream data rates up to 16 Mbps and 800 Kbps.

6.3 It should be Compliant to G.992.1, G.992.2, G.992.3, G.992.5 and READSL2 ADSL standards.

6.4 It should have built-in Quick set up wizard.

- 6.5 It should be fully compliant with Annex A/B/B(U-R2) ADSL2/2+ specifications.
- 6.6 It should support all digital loop ADSL.
- 6.7 It should support IP / Bridge Filtering functionality.
- 6.8 It should support IP QoS features.
- 6.9 It should support RFC 1483 Bridge / Routing over ATM over ADSL.
- 6.10 It should support PPPoE and PPPoA Routing ATM over ADSL.
- 6.11 It should support ATM Layer with Traffic Shaping QoS.
- 6.12 It should support up to 8PVCs.
- 6.13 It should have Hardware Reset button for fast default setting recovery.
- 6.14 It should have HTTP Web-based Management/Configuration.
- 6.15 It should have LED indicator indicating connection status.

## **7 ALARMS FOR ATU-C (IP-DSLAM) AND ATU-R (ADSL MODEM):**

Provision for alarms as mentioned shall be made in the equipment at ATU-C and ATU-R in LED visual form. The same shall also be supported through management system's GUI:

- (a) Derived power supply failure
- (b) Loss of ADSL signal
- (c) Loss of ADSL frame
- (d) Loss of external clock
- (e) Loss of signal at the user interface
- (f) Loss of signal at the application interface
- (g) BER  $10^{-6}$  degradation alarm
- (h) BER  $10^{-3}$  excessive BER alarm
- (i) Line activity
- (j) LAN activity
- (k) Loss of sync word
- (l) Loss of SNR margin
- (m) Loop Attenuation
- (n) Relevant alarms as pertaining to IEEE 802.3 MAC Ethernet clients

## **8 OPERATIONAL CONDITIONS**

Operational Temperature range: 0°C to +50°C minimum  
Storage Temperature range: -10°C to +60°C or better  
Operational and Storage Humidity: up to 95% non-condensing

## **9 SAFETY CERTIFICATE**

**The equipment should be certified to any one of following Safety Certificate-**

- i) EN60950-1
- ii) CSA60950-1
- iii) UL60950-1
- iv) IEC60950-1

## **10 EMC CERTIFICATION**

**The equipment should be certified to any one of following EMC Certification-**

- i) FCC Part 15 Class A

- ii) EN55022 Class A
- iii) EN55024 Class A
- iv) ETSI 300 386

## 11 MANUALS

Installation, operation and maintenance manual in 1 hard copy and 1 soft copy (in CD/DVD) shall be provided for each IP-DSLAM equipment and ADSL modem.

## 12 TRAINING

1 day training at end user premises shall be provided for each IP-DSLAM equipment and ADSL modem.

## 13 WARRANTY

The IP-DSLAM equipment and ADSL modem shall be warranted for a period of 1 year from date of installation and commissioning or 1&1/2 years from date of supply whichever is earlier. However if installation and commissioning is delayed on contractor account, the warranty period shall be 1 year from date of actual installation and commissioning. Railway's decision in this regard shall be final.

## 14 INFORMATION TO BE FURNISHED BY THE PURCHASER-

Following information shall be furnished by the purchaser-

SN	ITEM	QTY.
1	IP-DSLAM equipment-	
	Configuration I- ultimate capacity-640 ports, equipped capacity-____ No. with 10% spare cards	
	Configuration II- ultimate capacity-256 ports, equipped capacity-____ No. with 10% spare cards	
2	Equipment Rack Cabinet	
3	Network/Element Management System (NMS/EMS)	
4	ADSL Modem	

## 15 TYPE TEST

15.1 At least one equipment of each type per lot, randomly selected, shall be type tested. On successful type testing the vendor shall be type approved for supply of such equipments. The initial type approval shall remain valid for a period of two years and subsequent type approvals shall be valid for a period of three years. During validity of type approval the vendor can supply such equipments on the strength of acceptance testing only.

15.2 Supplier shall provide detailed test results for all parameters carried out at OEM premises for the units selected for type testing.

15.3 For type test following Clauses shall be tested-  
Clauses 4, 5, 6, 7, 8

15.4 Supplier shall arrange all necessary test and measuring instruments and other facilities for conducting type test. The type testing shall be done at place/places nominated by the supplier where all test and measuring instruments and other facilities for conducting type test are available. Supplier shall co-ordinate for the type testing.

15.5 For clause 9 (Safety certificate) and clause 10 (EMC Certification) the supplier shall furnish necessary supporting documents, test results and test reports to the satisfaction of purchaser.

15.6 Manuals as per clause 11 for the equipment shall also be furnished by the supplier for approval.

15.7 If the firm do not have their manufacturing base in India and is unable to get the type tests arranged in India, the type approval may be accorded based on the cross approval. The firm has to submit relevant documents required as per guidelines issued by Railway Board for such items. Cross approval shall be issued if the firm meets all the requirement as per Railway Board guidelines.

## **16 ACCEPTANCE TEST**

11.1 All the equipments shall be tested except that equipments which have been type tested.

11.2 Supplier shall provide detailed test results and other supporting documents for all parameters carried out at OEM premises for the units selected for acceptance testing.

11.3 For acceptance test following clauses shall be tested-  
Sub-clauses 4.4, 4.5, 4.7, 4.11, 6.1, 7.

11.4 Supplier shall arrange all necessary test and measuring instruments and other facilities for conducting acceptance test and shall co-ordinate for the acceptance testing.

-----END-----