GOVERNMENT OF INDIA
MINISTRY OF RAILWAYS

TITLE:

DRAFT SPECIFICATION

for

80-Channel DWDM Equipment with channel bit rate up to 10Gbps

Specification No.

RDSO/ SPN/ TC/ 92 /2009

TELECOM DIRECTORATE

RESEARCH DESIGN & STANDARDS ORGANISATION
MANAK NAGAR, LUCKNOW – 226001

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Title of Document **80-Channel DWDM Equipment with channel bit rate up to 10Gbps**		
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Abstract **This document specifies technical specification of 80-Channel DWDM Equipment with channel bit rate up to 10Gbps**		

DOCUMENT CONTROL SHEET

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I. SUMMARY :

This document sets forth general, functional and technical requirements of **80-**Channel DWDM Equipment with channel bit rate up to 10Gbps.
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II. SOURCE :

Draft specification RDSO/ SPN/ TC/ 92 /2009 has been prepared by RDSO, Lucknow as per Railway Board letter No. 2006/Tele/TC/1/Pt. Dated 29.04.2009.
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III. FOREWORD :

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

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

This specification requires the reference to the following specifications:

GR/WDM-06/01.AUG.2009	GR for 80 Channel DWDM Equipment Channel bit rate up to 10Gbps.
ITU-T Rec.G.691	Optical Interfaces for single channel STM-64, STM-258 systems and other SDH systems with optical amplifiers.
ITU-T Rec.G.702	Digital hierarchy bit rates
ITU-T Rec.G.703	Physical/electrical characteristics of hierarchical digital interfaces.
ITU-T Rec.G.707	Network node interface for the synchronous digital hierarchy(SDH).
ITU-T Rec.G.709	Network node interface for the Optical Transport Network hierarchy(OTH).

ITU-T Rec.G.712	Transmission performance characteristics of pulse code modulation channels.
ITU-T Rec.G.773	Protocol suites for Q interfaces for management of transmission systems.
ITU-T Rec.G.774	Synchronous digital hierarchy(SDH)management information model for the network.
ITU-T Rec.G.781	Synchronization layer function.
ITU-T Rec.G.783	Characteristics of SDH equipment functional blocks.
ITU-T Rec.G.784	Synchronous digital hierarchy(SDH) management.
ITU-T Rec.G.803	Architecture of transport networks based on the SDH.
ITU-T Rec.G.811	Timing characteristics of primary reference clocks.
ITU-T Rec.G.812	Timing requirements of slave clocks suitable for use as node clocks in synchronization.
ITU-T Rec.G.813	Timing characteristics of SDH equipment slave clocks(SEC)
ITU-T Rec.G.821	Error performance of an international digital connection operating at a bit rate below he primary rate and forming part of integrated services digital network.
ITU-T Rec.G.823	The control of jitter and wander within digital networks which are based on the 20 8kb/s hierarchy.
ITU-T Rec.G.825	The control of jitter and wander within digital networks which are based on the synchronous digital Hierarchy(SDH).
ITU-T Rec.G.826	Error performance parameters and objectives for international constant bit rate digital paths at or above the primary rate.

ITU-T Rec.G.828	Error performance events for SDH paths.
ITU-T Rec.G.829	Error performance events for SDH multiplex section and regenerator section.
ITU-T Rec.G.841	Types and characteristics of SDH network protection architectures.
ITU-T Rec.G.957	Optical interfaces for equipments and systems relating to the synchronous digital hierarchy.
ITU-T Rec.G.8251	Control of jitter and wander within digital networks which are based on OTN hierarchy.
ITU-T Rec.Q.811	Lower layer protocol profiles for the Q3 and X interfaces.
ITU-T Rec.Q.812	Upper layer protocol profiles for the Q3 and X interfaces
ITU-T Rec.M.2100	Performance limits for bringing into service and international PDH paths, sections and transmission systems.
ITU-T Rec.M.2101	Performance limits for bringing into service and maintenance of international SDH paths and multiplex sections.
ITU-T Rec.M.2120	PDH path, section and system and SDH path and localization procedures.
ITU-T Rec.M.3010	TMN conformance and TMN compliance..
ITU-T Rec.G.7041	Generic Framing Procedure.
ITU-T Rec.G.7712	Architecture and specifications for data communication network for management information.
ITU-T Rec.G.808.1	Generic protection schemes : linear applications.
ITU-T Rec.G.808.2	Generic protection schemes : ring applications.

ITU-T Rec.X.721	Information technology –Open systems interconnection.
IEC Publication 479-1	Guide on the effects of current passing through the human body.
IEC Publication 215	Safety requirements of radio transmitting equipments.
IEC Publication 1000-4-2	Testing and measurement techniques of Electrostatic discharge immunity test.
IEC Publication 1000-4-3	Radiated RF electromagnetic field immunity test.
IEC Publication 1000-4-4	Testing and measurement techniques of electrical fast transients/burst immunity test.
IEC Publication 1000-4-6	Immunity to conducted disturbances.
IS 8437(1993)	Guide on the effects of current passing through the human body.
IS 13252(1993)	Safety of information technology equipment including electrical business equipment.
IEEE 802.3	IEEE Ethernet standards series.
IEEE 802.1d/p/q	IEEE Ethernet Bridging standards series.
IEEE 802.3ah	Ethernet link aggregation standard.
IEEE802.1ah	Provider backbone bridges.
IEEE 802.1ad	Provider bridges standard.

RESEARCH DESIGNS & STANDARDS ORGANISATION

MINISTRY OF RAILWAYS

MANAK NAGAR, LUCKNOW

Draft Specification 80-Channel DWDM Equipment with channel bit rate up to 10Gbps

Draft Specification No. RDSO/SPN/TC/92/2009

1.0 Introduction

1.1 This document lays down the specifications for a 80 channel Dense Wavelength Division Multiplexing (DWDM) Optical Line System (OLS) operating at discrete wavelengths in the C-band centered around 193.1 THz frequency as per ITU-T Rec.G.694.1 grid, at 50GHz channel spacing. The DWDM system shall support transmission comprising of 10Gb/s and 10GE per channel in the C-band based on ROADM technology. The 10GE and 10Gbps shall be supported simultaneously on the same system with no changes to the common equipment at the optical layer.

The DWDM system shall be designed for use in transport networks as a protocol transparent solution for a variety of client/services.

2.0 Functional/ Technical Requirement

2.1.1 The DWDM system shall provide an end to end capacity for 80 channels @10G bit-rate comprising of a combination of SDH and Ethernet interfaces, on day one. *The exact number of actual equipped channels with Transponders/Muxponders of various 'types' shall be as per the requirements of the purchaser.*

2.1.2 Proper termination of the unused channels shall be provided by the manufacturer as part of system design. It shall be possible to utilize the unequipped channels at a later date without affecting the existing traffic.

2.2.1 The following interfaces or combinations thereof shall be supported.

i) STM-1
ii) STM-4
iii) Fiber Channel 1G
iv) Fiber Channel 2G

v) *Fiber channel 8G (Optional)*
vi) *Fiber channel 10g (Optional)*
vii) STM-16
viii) STM-64
ix) 10G Ethernet LAN and WAN PHY as per IEEE 802.3ae
x) OTU-1 and OTU-2 as per G.709
xi) GbE as per IEEE 802.3h for 1000 Base LX-10
xii) GbE as per IEE 802.3 for 1000 Base LX
xiii) *1000 base PX-20 (Optional)*
xiv) *1000 Base ZX (Optional)*
xv) *10 GBASE-LR & ER optical 10G interface as per 802.3ae (Optional)*
xvi) *10 GBASE-LW & EW (Optional)*
xvii) *Interface for 2.5G existing DWDM (Optional)*

The various Muxponders/ Transponders envisaged in this specs to support above client interfaces.

2.2.2 The system should support multiport high-speed (10 Gb/s) flexible interface cards with SDH ADM and packet cards with switching capabilities in point-to-point and ring topologies. These flexible interfaces should be fully integrated with the DWDM platform and should not be provided by an additional network element, such as an external ADM and external Ethernet Switch. Packet functionality includes aggregation and switching of Ethernet Packets between all ports (client and line).

2.2.3 There should be a minimum of 8 pluggable client ports that are configurable for OC-3/12/48, STM-1/4/16, 1 GbE, Fibre Channel (1Gb/s, 2Gb/s), FICON (1Gb/s).

2.2.4 It should have SAN support for full GFP encapsulation with VCAT .

2.2.5 It should have VC-4 time slot interchange between all ports and DWDM line-side interfaces (“non-blocking”)

2.3.1 Muxponder shall multiplex various combinations of above channels. Certain cases are given below.

i) Multiplexing upto 4 no. STM-16 to a 10G channel
ii) Muliplexing upto 4 no. OTU1 to a 10G channel
iii) Multiplexing upto 8 no. of GbE interfaces to a 10G channel
iv) Multiplexing combinations of STM-16, FC & GbE channels

The above cases are optional and exact requirement shall be given by the purchaser.

2.3.2 The system shall support Reconfigurable Optical Add Drop Multiplexer (ROADM) in a specific manner as per the requirements of the purchaser.

2.3.3 The following Network topologies shall be supported.

i) Point to point
ii) Linear add/drop
iii) Mesh Network system with auto recovery feature
iv) Closed ring (without 3R generation)

The network protection shall be available both at SDH client level as well as at DWDM optical layer, at various granularities and configurations.

2.3.4 The protection at DWDM layer shall be soft-configurable on per-channel (OCh), for all network topologies from the EMS of the equipment, in accordance with ITU-T Recs.G.808.1 .

2.4.1 The system shall work in unidirectional mode on a pair of fibre for all network topologies using dedicated fibre for Tx and Rx direction .

2.4.2 The system shall work in long haul span and/or very long haul span (as per purchaser's requirement) configuration with or without ILA as per network requirement. However this does not exclude other application codes.

Since the no. of spans (with out the use of 3R regenerator) may vary depending on the type of equipments used, the purchaser may ask vendor to carry out the network planning on the basis of network information provided by the purchaser.

2.5 Booster amplifier and pre amplifier shall be integral part of DWDM terminals, ILAs and OADMs/ ROADMs.

2.6 The system will permit wavelength reuse after dropping a particular channel without any restriction on number of reuse of each wavelength. The system should support the capability to pass-through or add/drop 100% of the total system channels via Software control , and be able to scale in increment of one wavelength at a time (from one to full channels) without the need of manual power balancing of individual wavelength and without the restriction of any banded channel architecture.

2.7.1 The system shall comply with ITU-T recommendation G709 & G 959.1 for OTN specification.

2.7.2 All client services shall be supervised by processing ODU/OTU overhead bytes in accordance with ITU-T Rec. G.709. At least path monitoring and section monitoring shall be supported.

2.8.1 The system shall support out of band FEC as per ITU-T Rec. G.709.

2.8.2 Super FEC as per ITU-T G.975.1 shall also be supported.

2.8.3 The system shall be provided with the FEC enable/ disable facility through LCT/EMS.

2.8.4 There shall be access point in the system to facilitate BER testing by enabling/ disabling FEC as well.

2.9 The optical fiber shall be ITU-T.G.652 single mode optical fiber

2.10 The equipment shall support Dispersion Compensation Modules (DCM) at the line side equipped for the capacity at the interface rate of 10G. The manufacturer shall provide comprehensive details of such DCMs. *If required by the purchaser, link engineering support/ link engineering exercise support shall be provided by the manufacturer using link planning/ design tools or any other method.*

2.11 The system shall have entire common hardware including Mux/Demux, DCMs and embedded control & management software etc. for 80 channels @ 10G DWDM system on day one, to be upgraded in field to 80 channels @ 10G through insertion of Transponders/ Muxponder cards only, to reach its full capacity.

2.12 Optical monitoring as per ITU-T Rec.G.697 should be supported at all nodes through EMS.

2.13 It shall be possible to remove or insert any transponders/MUXponders and or multiplexer/D-multiplexer card without affecting the working of other channels.

2.15 To accurately simulate the performance of the offered equipment under end of life conditions (i.e. equipment with aged components operating at maximum channels over aged fibre) and ensure successful transmission at 10Gbps per channel over high loss optical fibre, a comprehensive network planning tool shall be supported. The tool may be standalone or may be integrated in to EMS. The tool shall, among others, perform the following analysis and recommend the most suitable hardware components as well as settings (i.e. optical power, gain) to mitigate the limiting effects:

i) Attenuation (including optical fibre loss, system component loss and margins),

ii) Chromatic dispersion (including required residual dispersion and dispersion compensation),

iii) Polarization mode dispersion (including contribution from both optical fiber and system components),

iv) Optical signal to noise ratio (OSNR) and

v) Non-linear effects (inc. XPM, SPM, FWM and SRS)

2.16 The equipment shall support (without using transponders at either of the end points) direct internetworking with narrow wavelength colored interface (as per ITU-T Rec. G.694.1 DWDM grid) from SDH or MSPP equipment for interfacing STM-64 optical signals. In such cases purchaser opting for coloured SDH wavelengths from 3rd party SDH system to Mux input directly may not be able to avail the benefits of certain quality parameters like FEC.

2.17 The terminations for the unused channels shall be provided by the manufacturer as a part of the system. It shall be possible to equip the unused channel at a later date without affecting the existing traffic.

2.18 The system shall support one Optical Supervisory Channel (OSC) as specified by ITU-T Rec.G.692 for the monitoring and configuration of OTM, ILA, OADM and ROADM on the route and shall be manageable from one location for the entire route via the EMS or LCT of the equipment. The OSC transmitter and receiver behaviour at the Inline Amplifier/Booster/Pre-Amp shall be monitored through EMS via suitable alarms.

2.19 The system shall provide software controlled Variable Optical Attenuators (VOA). The optical power per channel must be adjusted automatically, without using external measurement equipment. The adjustment arising out of adding/removing channels has to be done without manual adjustment and shall be possible without affecting other channels; it shall either be triggered by a software command or automated.

2.21 The optical amplifiers must implement the following mechanisms to maintain error free system operation under dynamic conditions:

a) Fast gain control loop: to protect against short term transient conditions such as sudden loss of channels.

b) Slow output power control loop: to protect against long term conditions such fibre aging.

2.22 The equipment shall have the provision for monitoring the performance of individual channel through B1 byte of SDH. Also, in the case Ethernet support, there shall be the provision of analysis of Ethernet frames at GigE Transponders.

2.23 There shall be the provisioning of power and wavelength monitoring points for external monitoring of power and wavelengths at the input/output points of the Booster Amplifier, ILA and Pre-amplifier. These points shall be suitably connectorised and connecting the measurement devices shall not affect the transmission of the main path. Power splitter modules with a ratio of 95%/5% shall be available to use them where needed.

2.24 The optical window of operation of the DWDM shall be C-Band.

2.25 Channel spacing**:** The nominal central wavelength spacing shall be 50GHz. *Any consecutive 80 wavelengths may be chosen by purchaser from DWDM-grid as specified in ITU-T Rec. G.694.1.*

2.26.1 Specifications of SDH Interfaces to be supported.

a) STM-16 AND OTU-1 Interfaces as per ITU-T G.957, G.825 & G.709

b) STM-64 AND OTU-2 interfaces as per ITU-T G.959.1, G.691, G.709, G.825, G.783 AND G.8251

2,26.2 Specifications of Ethernet Interfaces to be supported

a) Optical Gigabit Ethernet @ 1.25 Gbps : As per IEEE 802.3, IEEE 802.3ah as applicable for various types of desired and optional interfaces.

b) Optical10 Gigabit Ethernet: As per IEEE 802.3, IEEE 802.3ae as applicable for various types of desired and optional interfaces.

2.27 For the optical connectors used on the equipment side the 'Optical Return Loss' of these connectors shall better than 50 dB.

2.28 Transponder/Muxponder shall be provided with tuneable laser for the DWDM line interface covering the complete C-band for 80 discrete wavelengths at 50 GHz spacing for fast provisioning of transparent end-to-end services and spare part reduction.

2.29 The equipment shall be housed in the standard 19" width sub-racks or ETSI standard racks.

2.30 The equipment shall have the provision of Automatic Laser Shut-Down (ALSD) in the case of fibre-plant breakdown and automatic re-start on restoration of fault in accordance with ITU-T Recs. G.664 . The system shall restore within 0 – 10 sec (programmable) after restoration of fibre-plant breakdown or a faulty amplifier.

2.31 The equipment shall adopt standard mapping techniques for GFP mapping, Forward Error Correction coding and multiplexing techniques as per ITU-T Rec. G.7041, G.975.1 and G.692 standards respectively. The output of Muxponder/Transponder shall be in a standard ITU-T format.

2.32 The system shall comply to laser hazard class 1M or better.

2.33 The network based on the DWDM System should easily evolve from a point-to-point unprotected system to a DWDM ring or mesh network. Migration and expansion shall not cause any interruption or change of service, nor modify the operational concept or network management.

2.34 It shall be possible to equip the system progressively, in accordance to the number of channels transmitted, in order to allow real "pay as you grow" configurations.

2.35 The system shall be transparent to the protocols of services transmitted through it.

A. The system shall not violate data integrity due to the high sensitivity of SAN protocols to latency.

B. The system shall not add any overhead to the services transmitted through it.

C. The system shall allow disabling Digital Performance Monitoring.

2.36 The equipment should be interoperable with leading Storage Equipment like IBM, SUN, HP, EMC etc.

2.37 The system should support Integrated Ethernet switching functionality, including:
- E-Line and E-LAN services
- Ethernet specs – 802.1D, 802.1Q and 802.1ad
- MEF style traffic management, including CIR, CBS, EIR and EBS
- 802.3ad link aggregation across ports for protection and multi-link bonding
- MPLS protection on the line side

3.0 Network configurations

3.1 The various network topologies supported are
(i) Point to Point
(ii) Linear add drop topology
(iii) Two fibre DWDM ring with true optical ring closure without need for rgeneration via OEO.
(iv) Mesh Network System with Embedded Intelligence supporting auto discovery feature to provide automatic protection required for provision of protected "Lambda services and auto restoration across multiple rings.

3.2 The system shall fulfill the technical requirements of parametric values, span-budget, dispersion etc as per ITU-T.692, G.957, G.959.1 and other relevant ITU-T recs.

4.0 The system to support

4.1 Longhaul application with per span attenuation 22 dB with no. of span without 3R regenerator upto 10 or more using DCM and FEC.

4.2 (Optional) Very Longhaul application with per span attenuation 33 dB with no. of span without 3R regenerator upto 6 or more using DCM and FEC.

4.3 The parametric specifications shall be as per as per ITU-T.692, G.957, G.959.1 and other relevant ITU-T recs.

4.4 Enroute nodes can be OA/OADM/ROADM

4.5.1 Network Protection : OCh-SNCP protection at wavelength level with protection switching getting completed within 50ms (Excluding fault detection and fault propagation time etc.)

4.5.2 The system shall support service/line signal protection with redundant line interface on a single transponder/muxponder unit for at least the following services: STM-16, *OC-3 (Optional), OC-12 (Optional), OC-48 (Optional), FE, GbE, FC (Optional), 2G-FC (Optional) and 10G-FC (Optional). FICON (optional), FICON express (Optional) and ESCON (Optional).*

4.5.3 The system shall support service protection in ring topologies. A mixture of protected and unprotected services shall be possible.

4.5.4 The system shall support protection switching based on Loss of Signal and Loss of Clock.

4.5.5 The system shall also support protection switching based on signal degrade criteria such as:

i) OTH/G.709 criteria such as uncorrected FEC errors, section Monitoring, Path Monitoring.

ii) SDH/SONET B1/B2 errors

4.5.6 The system shall support line protection with bi-directional switching.

i. The system shall support line protection switching based on fiber break (LOS)

ii. The system shall support line protection switching based on fiber degradation.

iii. The protection switching shall be only performed in case that the protection path is available and with a power level higher than a user-defined value.

iv. The system shall support low priority traffic on the protection path.

v. The system shall support line protection in single fiber working scenarios.

vi. Protection switching shall be performed in a sub-50ms time frame.

vii. Protection switching at optical layer shall be envisaged as 1+ N switching where N= 0,1,2,3.The Optical Switching solution must handle automatic Service recovery through protection switching to multiple alternative paths via protection or Forced switching as may be required for Maintenance purposes. The switching should be service independent, non-affected by link distances, 3R[O-E-O] Regeneration and service Transparency shall not be affected.

viii. TRAFFIC FREE BACKPLANE: In order to achieve the highest possible system availability and to avoid a single point of failure the system must have a traffic free backplane. The systems should not carry any payload over the backplane. The system shall perform functions as all wavelengths conversion on single transponders / muxponders which avoid the necessity to carry payload / customer traffic over the backplane.

4.6 **Equipment Protection**:

a) System should have automatically switched equipment protection for:

· Power Supply protection

· Optical Line Card protection

· Channel Card protection

b) The failure of controller card should either be non traffic affecting or automatically switched and protected.

c) Total time taken for Fault detection and Switching from active to standby module should be less than 50 ms. There shall be absolutely no interruption to traffic

5.0 DWDM Equipment Building Blocks

5.1a **Muxponder (To be used both at Transmit and Receive end):**

5.1a.1 At transmit end to multiplex multiple STM-16 bit rates SDH payloads/ OTU-1 or multiple GigE interfaces or their combination to form a 10Gb/s coloured wavelength and to demultiplex at receive end. It shall involve 3R functionality.

5.1a.2 Muxponders shall be provided with tuneable lasers for the DWDM line interface covering the complete C Band i.e., 80 discrete wavelengths at 50 GHz spacing for fast provisioning of transparent end-to-end services and spare parts reduction.

5.1a.3 It will support the management aspect of optical network as specified in ITU-T Rec. G.874.

5.1a.4 It shall support the generation of all the relevant alarms and monitoring and supervision of performance parameters specified in ITU-T G.707, G.709, G.798 and also in ITU-T Rec. G.872

5.1a.5 Thew will support Super FEC as per ITU-T G.975.1.

5.1a.6 The mapping/ Demapping of SDH/ Ethernet data on OTUk shall be as per ITU-T G.709 and ITU-T G.806.

5.1b **Transponder (To be used both at Transmit and Receive end):**

5.1b.1 At transmit end to map STM-64 and 10 GbE client to DWDM coloured wavelength after regeneration and mapping necessary overheads for ODU and FEC as per ITU-T G.694.1, G709, G. 806, G975.1. It shall involve 3R functionality.

5.1b.2 For fast provisioning of transparent end-to-end services and spare part reduction, Transponders/Muxponders shall be provided with tuneable lasers for the DWDM line interfaces each covering the complete C-Band i.e., 80 discrete wavelengths at 50 GHz spacing.

5.1b.3 It will support the management aspect of optical network as specified in ITU-T Rec. G.874.

5.1b.4 It shall support the generation of all the relevant alarms and monitoring and supervision of performance parameters specified in ITU-T G.707, G.709, G.798 and also in ITU-T Rec. G.872

5.1b.5 The technical requirements of parametric values, as per ITU-T.692, G.957, G.959.1 and other relevant ITU-T recs.

5.2 Mux-Demux characteristics : As per clause 6.3 of GR No. GR/WDM-06/01.AUG.2008. In addition they should also meet various functional requirements given in this specification.

5.3 **Optical amplifier (Booster amplifier/ Pre- amplifier/ ILA) characteristic.**

5.3.1 They shall be EDFA amplifier.

5.3.2 The technical requirements of parametric values, as per ITU-T.692, G.957, G.959.1 and other relevant ITU-T recs.

5.3.3 The Optical Amplifiers shall be of 'Mid-Access' type with due implementation for gain-flatness, feed-back gain-control & channel-power balancing etc. The Optical amplifiers have to work on 80 channels from day one.

5.3.4 The Dispersion Compensation Module (DCM) are required to reasonably and accurately compensate the dispersion occurred in the link.

5.3.5 At least two types of Line Amplifiers shall be supported viz. Longhaul Amplifier and Very Longhaul Amplifiers based on the amplification capabilities *for specific application code as per purchaser's requirement.*

5.3.6 Sudden addition/removal of channels at intermediate site must not affect whole transmission of DWDM signals.The optical amplifiers shall respond automatically to changes in the number of channels without the need for manual intervention or realignment.

5.3.7 They shall have Integrated VOA to allow the amplifier units to automatically compensate for variations in span-attenuation due to ageing and splicing etc.

5.3.8 They will support in built optical spectrum monitoring device, which will not apply the correction to channels to keep the spectrum flat, but also shall be used for the monitoring of optical monitoring as per ITU-T G.697. This functionality can also be handled in all ROADM nodes.

5.3.9 The system shall restore autonomously on the restoration of link after fibre plant breakdown or a faulty amplifier.The optical amplifiers must implement the following mechanisms to maintain error free systemoperation under dynamic conditions:

a) Fast gain control loop: to protect against short term transient conditions such sudden loss of channels.

b) Slow output power control loop: to protect against long term conditions such as fibre aging.

Note: The above requirement shall hold for the optical amplifiers that are part of OADM, Mux & Demux also.

5.4 **Optical Add/Drop Multiplex equipment characteristics:**

5.4.1 To support "East-West separation (EWS) i.e. the add/drop channel traversing the east direction shall not share common cards with add/drop channels in west direction.

5.4.2 OADM node shall provide an integrated two-stage EDFA/Raman optical amplifier to offset various losses i.e., insertion loss for channel add/drop and fibre-attenuation etc. Upgrades to additional add/drop channels upto limits proposed, shall be hitless and shall be supported in field.

5.4.3 They shall be dual fibre.

5.4.4 There shall be option for both the long haul and *very long haul application code as per purchaser's requirement.*

5.4.5 The technical requirements of parametric values, as per ITU-T.692, G.957, G.959.1 and other relevant ITU-T recs.

5.4.6 Two variants of Optical Add/Drop Multiplexers shall be supported –OADM (static) and Reconfigurable OADM (ROADM).

i) OADM (Static):

Such an Optical Add/Drop Multiplexer shall support a minimum of 4 nos. of bidirectional optical wavelengths for add/drop traffic with the remaining optical wavelengths passed through to outgoing path without OEO regeneration. *Purchaser may indicate the exact number of add/drop channels.*

ii) Reconfigurable OADM (Dynamic):

A reconfigurable optical add-drop multiplexer (ROADM) is a form of optical add-drop multiplexer that adds the ability to remotely configure wavelength in OADM system. This allows individual wavelengths carrying traffic channels to be added and dropped from a transport fibre without the need to convert the signals on all of the WDM channels to electronic signals and back to optical signals. ROADM shall support the following functionalities:

a) The planning of entire bandwidth assignment need not be carried during initial deployment of a system. The configuration can be done as and when required.
b) ROADM shall allow for remote configuration and reconfiguration.
c) In ROADM, as it is not clear beforehand where a signal can be potentially routed, there is a necessity of power balancing of these signals. ROADMs shall allow automatic power balancing.
d) The ROADM shall be compact in size and shall be of low power consumption and low insertion loss type.
e) It shall provide Express channel equalization.
f) ROADM shall provide add/drop scalability from 0 to 80 channels.
g) It shall be highly reliable.

h) The ROADM system should support multi-degree configurations from 1 to 8 degrees with full mesh capabilities between degree. *Purchaser shall indicate the actual no. of directions to be supplied.*

i) Each side of an ROADM node is to be split logically and physically, ensuring that there are no single points of failure that would cause both east and west add/drop traffic to be lost.

j) The WSS based MD ROADM must support "drop and continue" Power leveling of add wavelengths without the need for additional equipment required and ROADM solutions must provide the capability to add/drop all wavelengths running per degree if configured accordingly

Such an Optical Add/Drop Multiplexer shall support the add/drop of any channel in resolution of single channel of bi-directional optical wavelengths up to the maximum of 80 nos of bidirectional optical wavelengths, with the remaining optical wavelengths passed through to any other location without 3R regeneration. There shall be no restrictions on wavelength assignment to the add/drop channels, allowing any or all unique optical wavelengths to be added/dropped at any location. Both symmetric add/drop (whereby no. of dropped channels is equal to no. of inserted channels) and asymmetric add/drop (whereby no. of dropped channels is not equal to no. of inserted channels) shall be supported.

The system design shall be such that it implements wavelength reuse at Optical Add/Drop Multiplexers, allowing any particular wavelength that has been dropped from a previous optical multiplex section to be reinserted into any subsequent optical multiplex section to carry new traffic. Any insertion losses incurred in the add/drop process shall be compensated within the system. The system shall support the physical ports for all the add/drop channels. The add/drop capability cited above shall be supported by the system at day one, irrespective of the no. of equipped channels. No additional hardware except, Muxponders/ transponders shall be required for the future upgradation of the equipment.

6.0 Optical monitoring:

6.1 As per ITU-T Rec.G.697

6.2 Monitoring BER before FEC by analyzing the number of corrected bits by FEC as per ITU-T Rec. G.798

7.0 Other requirements

7.1 Optical safety:

The optical safety shall be as defined in ITU-T Rec. G.664 & IEC 60825-1 (latest edition). The optical access ports shall be designed to protect themselves against the entry of dust when they are not occupied by an external fibre-optic connection. The optical access port shall be easy to clean by the user.

7.2 Jitter & wander:

The output jitter and input jitter tolerance specifications (considering the worst-case channel) for transponders, at all DWDM channels, shall be as per relevant ITU-T Recs. G.825 and G.783 for SDH and as per IEEE 802.3 standards for Ethernet client signals. The jitter and wander for the ODU (OTN) shall be as per ITU-T Rec. G.8251.

7.3 Optical supervisory channel (OSC):

The system shall support one Optical supervisory channel (OSC) as specified by ITU-T Rec.G.692 for the monitoring and configuration of Optical Terminal Multiplexer, Optical Line Amplifier and Optical Add/Drop Multiplexer on the route and shall be manageable from one location for the entire route via the EMS platform or LCT of the equipment. The OSC channel shall be provided preferably at 1510nm wavelength. The OSC transmitter and receiver behavior at the Inline Amplifier /Booster/Pre-Amp shall be monitored through EMS via suitable alarms. The OSC shall be accessible at all the ILAs and OADM sites.

Another function of the OSC is the recovery of the transmission from a failed line. In case of a fibre-cut on a section of the line, or subsequent Automatic Shutdown of the related amplifiers, the OSC is used to advise recovery of the line. The OSC shall continue to operate even after the Automatic Shutdown of the related amplifiers and when correctly received at the corresponding OSC unit of the recovered section, the amplifiers are restarted. It shall be required that OSC channel shall provide access to underlying DCC at Ethernet interface making possible to transport management information to other nodes through extended DCN. OSC is also used to transmit alarm information and consequently locating failures. If a card in a node fails, the alarm is written on the DCC of the OSC with the corresponding address of the “Smallest Replaceable Unit” failed. The information is propagated through the network carried by the DCC until it reaches the gateway to the EMS.

The OSC channel shall not consume any of the 80 traffic wavelengths. The OSC shall use a separate card and shall not be mixed with other node functionalities such as amplifiers, i. e. amplifiers and OSC are not allowed to be on the same card in order to ensure highest DCN reachability

7.4 Supervisory parameters:

The supervisory system of the equipment shall be capable of local & remote monitoring the following of the Local and Remote equipment:

1. Input power of the Booster Amplifier
2. Output power of the Booster Amplifier
3. Laser temperature of the Booster Amplifier
4. Input power of the pre-amplifier
5. Output power of the pre-amplifier
6. Laser temperature of pre-amplifier
7. Input power of the Optical Line Amplifier
8. Output power of the Optical Line Amplifier
9. Laser temperature of the Optical Line Amplifier
10. Input power of the Insert Channel
11. Output power of the Dropped Channel
12. Input power of the Transponder
13. Output power of the Transponder
14. Laser temperature of the Transponder
15. Input power of the individual optical channel
16. Input power of the Optical Supervisory Channel (optional)
17. Output power of the Optical Supervisory Channel (optional)
18. Laser temperature or Laser-Bias current of the Optical Supervisory Channel
19. B-1 Errors of individual Transponders/Mux-ponder.
20. Total power at the input of Booster amplifier
21. Total power at the output of Booster amplifier.
22. Total power at the input of Line amplifier
23. Total power at the output of Line amplifier
24. Total power at the input of Pre- amplifier
25. Total power at the output of Pre- amplifier
26. Bit error ratio (BER) before FEC at OTU-2 line interface of the Transponders/Muxponders
28. Fan failure at OADM/ILA/OTM.
29. ODU/OPU alarms as per G.709.
30. Core header errors for GbE /10GE for Ethernet data
31. Extension Header errors for GbE /10GE for Ethernet data.

The supervisory parameters shall be monitored and on crossing the specified limits an alarm shall be activated against each parameter listed as above. On the basis of nature of alarm, it shall be possible to mark it as Critical, Non-urgent and Deferred.

The measurement accuracy of input/output power of the Booster/In-Line Amplifier/ Pre- Amplifier/ Transponders from the EMS of the system shall

be within ± 0.5dB from the actual measured value on a wide-band Optical Power Meter.

The supervisory system shall provide necessary audio/visual alarm on equipment for indicating the alarms. Also from the EMS of the system it shall be possible to locate the faulty-section in the case the fibre is cut. To maintain transparency and supervision capability of client services in accordance with ITU-T Rec. G.709, all client services shall be supervised by processing the ODU/OTU overhead bytes.

At least path monitoring (PM) and section monitoring (SM) shall be supported.

7.4.1 Monitoring points:

There shall be the provisioning of monitoring points for monitoring of channel power, OSNR and wavelengths at the output points of Booster Amplifier, In Line Amplifier and Pre-amplifier using external OSA/DWDM analyzer etc. These points shall be suitably connectorised and on connection of a measurement device, the main transmission path shall not be affected at all.

7.5 Engineering order-wire:

There shall a provision for minimum one engineering order-wire (EOW). The EOW could be either 'omnibus' or 'selective'. The order wire shall be on 2W/4W basis utilizing a 64 Kb/s PCM channel. The performance of the order-wire channel shall be as per ITU-T Rec. G.712. The EOW shall extend the ring back tone to the caller. Also that, it shall be possible to extend the EOW to other DWDM links.

VoIP based implementation for EOW shall also be permitted subject to-

1. Speech quality is as per ITU-T Rec. G.712.
2. End to end packetized voice characteristics are with in ITU-T Rec. G.114 prescribed limits.
3. Manufacturer arranges the test methodology and test procedure of the implementation.

8.0 Performance requirements:

The equipment shall support the following performance parameters relating to the ODU-k as specified in ITU-T Recs.G.8201 and G.7710.

1. Optical Channel Transport Unit Background Block Error (OTU_ BBE).
2. Optical Channel Transport Unit Errored Second (OTU_ ES).
3. Optical Channel Transport Unit Severely Errored Second (OTU_ SES).
4. Optical Channel Transport Unit Unavailable Second (OTU_ UAS).
5. Optical Channel Transport Unit Far End Error Background Block Error (ODU_FEBBE).

6. Optical Channel Transport Unit Far End Errored Second (OTU_FEES).
7. Optical Channel Transport Unit Far End Severely Errored Second (OTU_FESES)
8. Optical Channel Transport Unit Far End Unavailable Second(OTU_ FEUAS).
9. Optical Channel Transport Unit Incoming Alignment Errored Second (OTU_IAES).
10. Optical Channel Transport Unit Backward Incoming Alignment Errored Second (OTU_BIAES).
11. Optical Channel Data Unit Incoming Alignment Errored Second (ODU_IAES).
12. Optical Channel Data Unit Backward Incoming Alignment Errored Second (ODU_BIAES).
13. Optical Channel Data Unit Path Monitoring Background Block Error (ODU_PM_BBE).
14. Optical Channel Data Unit Path Monitoring Errored Second (ODU_PM_ES)
15. Optical Channel Data Unit Path Monitoring Severely Errored Second (ODU_PM_SES).
16. Optical Channel Data Unit Path Monitoring Unavailable Second (ODU_PM_UAS).
17. Optical Channel Data Unit Path Monitoring Far End Error Background Block Error (ODU_PM_FEBBE).
18. Optical Channel Data Unit Path Monitoring Far End Errored Second (ODU_PM_FEES).
19. Optical Channel Data Unit Path Monitoring Far End Severely Errored Second (ODU_PM_FESES)
20. Optical Channel Data Unit Path Monitoring Far End Unavailable Second (ODU_PM_FEUAS)

8.1 Performance requirement In laboratory:

BER performance shall be better than 10-12 (with FEC disable) over a simulated section for a period of 48 Hrs. . For Ethernet clients, end to end IETF RFC 2544 compliance and ITU-T G.7041 – GFP mapping compliance shall be ensured.

8.2 Performance requirement In field:

BER performance for 48 hours shall conform to ITU-T Rec. G.828 for SDH payloads. For Ethernet clients, end to end IETF RFC 2544 compliance and ITU-T G.7041 – GFP mapping compliance.

9.0 Alarms:

9.1 The following DWDM related alarm conditions shall be reported by the EMS:

1. Input power failure of the Transponder/Mux-ponder interface (including Ethernet interfaces).
2. Input power failure of the Amplifiers
3. Output power failure of the Amplifiers
4. Fan/s failure
5. Output power out of range for OA, OADMs
6. Input power out of range for OA, OADMs
7. Derived power supply failure alarm
8. Loss of input at Optical Add/Drop Multiplex equipment
9. Input channel failure at Optical Add/Drop Multiplex equipment
10. Hardware mismatch alarm
11. Low input power at Transponder
12. Low input power at OA, Optical Add/Drop multiplex equipment
13. Degraded input at OA, Optical Add/Drop multiplex equipment
14. Degraded output of OA, Optical Add/Drop multiplex equipment
15. Degraded output of the dropped channel.
16. GFP related alarm for GE clients.

These alarms shall be categorized as Urgent, Non-urgent and Deferred alarms, with threshold programming by software, wherever applicable.

9.2 The following ODU-k related alarms listed in ITU-T G.798 shall be reported by the equipment through the EMS:

1. OTU-k Loss of Frame alarm (OTU -LOF).
2. OTU-k Loss of Multiframe alarm (OTU -LOM).
3. Loss of Payload alarm (LOS-P).
4. Open Connection Indication alarm (OCI).
5. OTU-k Degrade Defect alarm.
6. OTU-k Trace Identifier Mismatch alarm (OTU-k TIM).
7. OTU-k-AIS alarm
8. OTU-k Backward Defect Indication alarm (OTU-BDI).
9. OTU-k Payload Mismatch alarm.
10. ODU-k AIS alarm at path layers
11. ODU-k Backward Defect Indication alarm (ODU-kp BDI) at path.
12. ODU-k Locked Defect alarm at path layers.
13. ODU-k signal degrade alarm (ODU-kp DEG)
14. ODU-k loss of frame and multi frame. ODU-LOFLOM)
15. ODU-k Trace Identifier Mismatch alarm (ODU-k TIM) at path level.
16. ODU-k Payload mismatch alarm at path level (ODU-kp PLM)

10.0 Quality requirement

10.1 The equipment shall be manufactured in accordance with international quality management system ISO-9001:2000 for which the manufacturer shall be duly accredited. A quality plan describing the quality assurance system followed by the manufacturer, shall be required to be submitted.

10.2 The equipment shall also meet the latest quality manual of BSNL on

a) Quality and reliability in product design (QM- 118)

b) Guidelines for standard of workmanship for printed boards and assemblies (QM-205)

c) Guidelines for standard of workmanship for surface mounted devices QM (QM-210)

The supplier shall furnish a certificate from the manufacturer to this effect.

11.0 Environmental Requirement:

The equipment shall conform to the requirement for the latest quality manual QM-333 for B2 class of BSNL for specification for environmental testing of electronic equipments for transmission and switching use for operation, transportation and storage, including vibration test.

12.0 Power Supply:

a) Nominal power supply is -48 V DC. The equipment shall work in the range -40 V Dc to -60 V DC**.**

b) The equipment shall be protected in case of voltage variation beyond the range specified in sub clause (a) above and also against reverse input polarity.

c) The derived DC voltages in the equipment shall have protection against over- voltage, short circuit and overload.

d) The equipment shall have the option of operating from two independent sources of input power supply.

13.0 Documentation:

Technical literature in English with complete layout, detailed block schematic and circuit diagram of various assemblies with test voltages/waveforms at different test-points of the units shall be provided. All aspects of installation, operation, maintenance and repair shall be covered in the manuals. The soft copy as well as hard copy of the manuals shall also be provided. The manuals shall include the following:

i) Installation, Operation and Maintenance Manual

a) Safety measures to be observed in handling the equipment;

b) Precautions for installation, operation and maintenance;

c) Test jigs and fixtures required and procedures for routine maintenance, preventive maintenance, trouble-shooting and sub-assembly replacement;

d) Illustration of internal and external mechanical parts.

e) The detailed description about the operation of the software used in the equipment including its installation, loading and debugging etc.

ii) Repair Manual (Optional to be supplied when ordered)-

a) List of replaceable parts used including their sources and the approving authority;

b) Detailed ordering information for all the replaceable parts shall be listed in the manual to facilitate reordering of spares as and when required;

c) Procedure with flow chart for troubleshooting and sub-assembly replacement shall be provided. Test fixtures and accessories required for repair shall also be indicated. Systematic troubleshooting charts (fault-tree) shall be given for the probable faults with their remedial actions.

14.0 Protection requirements:

14.1 The equipment shall have a terminal for grounding the rack.

14.2 Protection against short circuit/ open circuit in the accessible points shall be provided.

14.3 All switches/controls on front panel shall have suitable safeguards against accidental operation.

14.4 The equipment shall be adequately covered to safe-guarded against entry of even dust, insects etc.

15.0 Safety requirements:

15.1 The operating personnel should be protected against shock hazards as per IS 8437 {1993}-"Guide on the effects of current passing through the human body" [equivalent to IEC publication 60479].

15.2 The equipment shall conform to the relevant clauses of the document No. IEC 61010-1(2001) with corrigendum-1(2002) and corrigendum-2 (2003) - “Safety Requirements for Electrical Equipment for Measurement, Control and laboratory use".

15.3 If the fiber is broken or an optical connector is opened, the laser shall be automatically shut down or the optical power to be decreased to a value less than -10 dBm. Optical connectors, if used in the system, shall be self protective against entry of dust when not occupied by external patch cord.

16.0 General Electromagnetic Compatibility (EMC) Requirements:

A) The equipment shall conform to the EMC requirements as per the clause 12.0 of TEC GR No.:GR/WDM-06/01. AUG.2008. A test certificate and test report shall be furnished from a test agency.

B) ELECTROMAGNETIC INTERFERRENCE

Any Telecommunication circuits in the vicinity of AC Traction running parallel to 25 KVAC lines are liable to be affected by AC induced voltage. Therefore, design considerations and precautions should be taken to eliminate the possibility of induced voltage affecting equipment and human. A large number of sections where DWDM is to be deployed are already electrified with 25 KVAV traction. Special protective measures (viz. provision of G.D tubes, uses and earthing etc) are required to be taken for telecommunication lines entering 25 KV sub station /switching posts. For the human safety considerations, the safe working voltages should be 60 V under normal conditions and 150 V with special precautions and 430 V under fault conditions.

Instructions for protection of railway staff/working personnel on signaling and telecommunications installations on 25 kV AC traction shall be strictly adhered to. Precautions are required to be taken on account of following :

i) Proximity of live conductor.

ii) Pressure of return current in Rails.

iii) Induction in all metallic bodies situated closed to over head equipment.

17.0 Management system requirements:

The EMS and FCAPS template for DWDM transmission systems shall met the requirements as specified in Appendix I of TEC GR No.:GR/WDM-06/01.AUG.2008. *However the purchaser can specify his own scalability aspects, EMS Server specifications, application server specifications, Database Server specifications and specification for LCT.*

18.0 TEST REQUIREMENTS:

18.1 Conditions of Tests:

18.1.1 Unless otherwise specified all tests shall be carried out at ambient atmospheric conditions.

18.1.2 Inspection and testing shall be carried out to the effect that all requirements of this specification are complied with.

18.2 Type Tests:

18.2.1 Type test can be applied for any of the network topology and application code (Long haul/ Very long haul). The same shall be outlined on Type Approval .

Only one complete system shall be tested for this purpose. The system shall successfully pass all the type tests for proving conformity with this specification. If any one of the equipment fails in any of the type tests, the purchaser or his nominee at his discretion, may call for another equipment/card(s) of the same type and subject it to all tests or the test(s) in which failure occurred. No failure shall be permitted in the repeat test(s).

a) Visual inspection
b) Functional requirement test (Clause 2.0, 3.1, 4.0, 7.4, 7.5 excluding parameters which are covered under various clauses of performance tests)
c) Endurance test (Clause 8.2)
d) Performance tests (Clauses 3.2, 5.0, 6.0, 7.2, 8.0). The various parametric values shall be as per relevant ITU-T Rec and as defined in table 1& 2 of GR No. GR/WDM-06/01.AUG.2008
e) Functioning of EMS/ NMS (Clause 17.0, 9.0)
f) Functioning of OSC (Clause 7.3)
g) Quality requirement (Clause 10.0)
h) Environmental requirement (Clause 11.0)
i) Power supply requirement (Clause 12.0)
j) Documentation (Clause 13.0)
k) Protection requirement (Clause 14.0)
l) Safety Requirement (Clause 15.0)
m) General Electromagnetic Compatibility (EMC) Requirements (Clause 16.0)

18.2.2 Any other tests shall be carried out as considered necessary by the inspecting authority.

18.2.3 Following systems should be submitted to RDSO after approval.

a) Muxponder
b) Transponder
c) Mux/ Demux
d) OADM
e) ROADM
f) ILA

18.3 Acceptance Tests:

18.3.1 The following shall constitute the acceptance tests which shall be carried out by the inspecting authority for the purpose of acceptance on 20% of the lots (minimum 2 each type of system) offered for inspection by the supplier:

a) Visual inspection of complete system

b) Performance Test to check the compliance of various parametric values of various building blocks of the DWDM system as per the specification. The various parametric values shall be as per relevant ITU-T Rec and as defined in table 1& 2 of GR No. GR/WDM-06/01.AUG.2008

c) Endurance test (Clause 8.2)

18.3.2 Any other tests shall be carried out as considered necessary by the inspecting authority.

19.0 TEST PROCEDURE:

The test procedure shall be based on the system design. The methodologies to be adopted for various tests for Type tests and acceptance tests both shall be proposed by the manufacturer and will be approved by R.D.S.O.

19.1 Visual Inspection:

Each equipment of the system shall be visually inspected to ensure dimensional requirements, markings, workmanship, finish etc.

19.2 Performance Test:

19.2.1 Factory Acceptance Test (FAT) results shall be submitted by the Original Equipment Manufacturer (OEM), if these items are being manufactured abroad, otherwise tests will be conducted in manufacturing premises of the firm.

19.2.2 The FAT shall be able to prove compliance to the specifications through test or test certificates.

19.2.3 All compliances to various standards as given in specifications shall be submitted with documentary proof. These shall include certificates for EMI/EMC/Safety/ Environment protection.

20 MAINTENANCE AND SUPPORT

A) GENERAL DESCRIPTION

20.1 The supplier shall provide a short description of the technical support services available for the operation and maintenance of the supplier's system, including

20.1.1 Repair and Return services,

20.1.2 Call Center and Technical assistance center,

20.1.3 Software support and update services,

20.1.4 Web based support services and product notification,

20.1.5 Call tracking, reporting, escalation and review meetings.

20.2 The supplier shall describe and flexibly provide various levels of support coverage.

20.2.1 For the complete installed base, or

20.2.2 For part of the installed base.

20.3 The supplier shall provide a detailed support service agreement upon request.

20.4 The supplier shall provide pricing for all support service levels available, as an annual percentage of the supported systems.

B) REPAIR AND RETURN

20.5 The supplier shall provide MTBF values for all field replaceable components of the system.

20.6 The supplier shall state which of the following means are available to reduce the quantity of spare modules for field replacement:

20.6.1 Provision of a spare channel or spare wavelength in the system.

20.6.2 User pluggable interface modules.

20.6.3 Universal channel modules, which can transmit a wide range of different services and capacities.

20.6.4 Advanced replacement service.

20.7 The supplier shall ensure continuous hardware and software compatibility and up-gradability between spare stock and installed base.

C) SOFTWARE SERVICES

20.8 The supplier shall provide maintenance and feature releases for all software components of the system at no cost outside the normal supply and support agreements, such as firmware, operation SW, communication SW and application SW, including.

20.8.1 Installation and update instructions,

20.8.2 Documentation of changes,

20.8.3 Compatibility with all other hardware and software.

20.9 The supplier shall provide maintenance and bug-fix releases for all management software components of the system at no cost outside the normal supply and support agreements, including

20.9.1 Installation and update instructions,

20.9.2 Documentation of changes,

20.9.3 Compatibility with all other hardware and software.

20.10 The supplier shall support the current major software release of all software modules, including all it’s minor releases, and at least one previous major release of the software.

E) WEB BASED SUPPORT AND NOTIFICATION

20.11 The supplier shall provide around-the-clock web access to following information, which must be updated on a bi-weekly basis:

20.11.1 Product overview, product descriptions, data sheets and specifications

20.11.2 Product, system and network management user manuals

20.11.3 Compatibility matrices and release notes
20.11.4 Equipment hardware and software installation / upgrade instructions
20.11.5 All equipment software patches and maintenance releases
20.11.6 Equipment software files, MIB files, integration scripts
20.11.7 Technical Tips, Application Notes, Protocol and Attenuation Guides.
20.12 The supplier shall automatically notify the buyer within 10 days about:
20.12.1 Release of a new software version – release notes, reason for new SW (feature enhancement / customer request / bug-fix), new features, upgrade procedure, inter-working information
20.12.2 Release of new hardware variant – see above
20.12.3 Discovery of a common technical issue – software bug with workaround, issues concerning specific network scenarios (for example inter-working with manufacturer X).
20.12.4 New or updated material (configuration instructions, training, service portfolio)
20.12.5 Start of Beta-testing phase.

21.0 Engineering Requirements

a. The equipment shall be fully solid-state and adopt state-of-the-art technology. There shall be common shelf for all possible configurations e.g., Terminal, OADM and ILA.

c. All connectors shall be reliable and of standard type to ensure failure-free operation over long periods under specified environmental conditions

d. All connectors and cables used shall be of low-loss type and suitably shielded. The type of connectors used at the application interfaces & the user- interfaces shall be of wire-wrapping type or as per any other international industry standard. No soldering shall be allowed for the connectors.

e. The equipment shall be housed in standard 19" or ETSI standard rack and shall provide front access.

f. The equipment shall provide natural cooling arrangement which shall not involve any forced cooling by using fans etc., either inside or outside the equipment. In case, the natural cooling arrangement is not sufficient, the manufacturer may use fans for cooling purposes provided:

• The fan failure is reported through LCT/EMS.
• Multiple fans are there in one tray with hot-standby redundancy.
• Fans are located at convenient place in the equipment not disturbing the internal equipment layout.
• Fans are DC operated.
• MTBF is better than 1,00,000 hours.

• Inclusion of fans for cooling purposes does not deteriorate the MTBF values of the equipment.
• There shall be fan failure alarm for each of the installed fan.
• The power consumption of all the fans provided with equipment shall not exceed the 20% of the total power consumption of that particular sub-rack under the fully equipped conditions.

h. The plug-in units shall be hot-swappable to allow easy removal/ insertion while the equipment is in energized condition.

i. The mechanical design and construction of each card/ unit shall be inherently robust and rigid under all conditions of operation, adjustment, replacement, storage & transport and shallconform to the BSNL quality manual.

j. Each sub-assembly shall be clearly marked with schematic references to show its function, so as to be easily identifiable from the layout diagram in the handbook.

k. Each terminal block and individual tag shall be numbered suitably with clear identifying code and shall correspond to the associated wiring drawings.

l. All controls, switches & indicators etc., shall be clearly marked to show their circuit designation and functions.

m. Important Do's and Don'ts about the operation of the equipment shall be clearly indicated at a convenient place on the equipment.

22.0 MARKING

22.1 The following information shall be clearly marked at a suitable place on each equipment:

a) Name and Address of the manufacturer.
b) Year of the manufacturer.
c) Serial number of Equipment
d) Specification number
e) Schematic diagram of the equipment on the side of the cover.

23.0 Information to be given by the purchaser regarding optional items and purchaser requirement.

With respect to following clauses , the purchaser to specify his options/ requirements.

Clause nos. 2.1.1, 2.2.1, 2.3.1, 2.4.2, 2.10, 2.25, 4.2, 4.5.2, 5.3.5, 5.4.4, 5.4.6(i), 5.4.6 (ii) h and 17.

ABBREVIATIONS

ALS : Automatic Laser Shutdown
BER : Bit Error Ratio
BIP : Bit Interleaved Parity
CD : Chromatic Dispersion
CISPR : Special International Committee on Radio Interference
CORBA : Common Object Request Broker Architecture
DC : Direct Current
DCM : Dispersion Compensation Module
DCN : Data Communication Network
DHCP : Dynamic Host Control Protocol
DUCS : Dispersion Under Compensation Scheme
DVB-ASI: Digital Video Broadcasting- Asynchronous Serial Interface
DWDM : Dense Wavelength Division Multiplexing
EDFA : Erbium Doped Fibre Amplifier
EMC : Electro Magnetic Compatibility
EMS : Element Management System
EOW : Engineering Order Wire
ESCON: Enterprise System Connection
ETSI : European Telecommunications Standards Institute
EWS : East West Separation
FDF : Fibre Distribution Frame
FEC : Forward Error Correction
FICON: Fiber connectivity
FTP : File Transfer Protocol
FWM : Four Wave Mixing
GbE : Gigabit Ethernet
GDMO : Generic Guidelines for Definition of Model Objects
GFP : General Framing Procedure
GNE : Gateway Network Element
GR : Generic Requirements
GUI : Graphical User Interface
IaDI : Intra Domain Interface
IEC : International Engineering Consortium
IEC : International Electro-technical Commission
IEEE : Institute of Electrical and Electronics Engineers
IETF : Internet Engineering Task Force
ILA : In Line Amplifier
IP : Internet Protocol
IPSec : Internet Protocol Security
IrDI : Inter Domain Interface
ISC: Internet System connection
ISO : International Standard Organization

ITU : International Telecommunication Union
LAN : Local Area Network
LCT : Local Craft Terminal
LOF : Loss of Frame
LOM : Loss of Multiframe
LOS : Loss of Signal
MEMS : Micro Electromechanical System
MIB : Management Information Board
MPI : Multiple Path Interference
MPI-R : Main Path Interface at the receiver
MPI-S : Main Path Interface at the transmitter
MPLS : Multi Protocol Label Switching
MSPP : Multi-service Provisioning Platform
MTBF : Mean Time Between Failures
MTNM : Multi-Technology EMS/NMS
NDA : Non-Disclosure Agreement
NE : Network Element
NML : Network Management Layer
NMS : Network Management System
NOC : Network Operation Centre
NZDSF : Non-Zero Dispersion Shifted Fibre
OA : Optical Amplifier
OADM : Optical Add Drop Mux
OCI : Open Connection Indication
OD : Optical Demultiplexer
ODF : Optical Distribution Frame
ODU : Optical Data Unit
OLS : Optical Laser Source
OM : Optical Multiplexer
OPU : Optical Payload Unit
OS : Operating System
OSC : Optical Supervisory Channel
OSI : Open Systems Interconnection
OSNR : Optical Signal to Noise Ratio
OTM : Optical Terminal Mux
OTN : Optical Transport Network
OTU : Optical Transport Unit
PCB : Printed Circuit Board
PICS : Protocol Information Compliance Statement
PKI : Public-Key Infrastructure
PLM : Payload Mismatch
PMD : Polarization Mode Dispersion
QA : Quality Assurance

QM : Quality Manual
RAID : Redundant Array of Independent Disks
RDBMS : Relational Database Management System
RFC : Request For Comments
RISC : Reduced Instructions Set Computing
ROADM : Reconfigurable Optical Add Drop Mux
ROM : Read Only Memory
RX : Receiver
SDH : Synchronous Digital Hierarchy
SFEC : Super Forward Error Correction
SFP : Small Form Factor Pluggable Transceiver
SLM : Single-Longitudinal Mode
SMF : Single Mode Fibre
SML : Service Layer Management
SNMP : Simple Network Management Protocol
SNR : Signal to Noise Ratio
SPM : Self Phase Modulation
SRS : Stimulated Raman Scattering
STM-16 : Synchronous Transport Module at 2.5Gbps
STM-64 : Synchronous Transport Module at 10Gbps
TCP : Transmission Control Protocol
TIM : Trace Identifier Mismatch
TM : Terminal Multiplexer
TMF : Tele Management Forum
TRE : Terminal Receiving Equipment
TX : Transmitter
UDP : User Datagram Protocol
UNIX : Uniplexed Information and Computing System
VLAN : Virtual LAN
VOA : Variable Optical Attenuator
VPN : Virtual Private Network
WAN : Wide Area network
WSS : Wavelength Selective Switch
XFP : 10 Gigabit Small Form Factor Pluggable
XPM : Cross Phase Modulation